Government of Canada | Gouvernement du Canada

Canadian General Standards Board | Office des normes générales du Canada

Series 171

Série des 171

WITHDRAWAL

October 2011

Selected standards in the series Geomatics

These National Standards of Canada are hereby withdrawn. Their content is covered in CAN/CGSB-171.100-2009, North American Profile of ISO 19115:2003 — Geographic Information — Metadata (NAP — Metadata).

The Standards Council of Canada requires that accredited Standards Development Organizations, such as the CGSB, regularly review a consensus Standard to determine whether to re-approve, revise or withdraw. The review cycle is normally five years from the publication date of the latest edition of the Standard.

The information contained in these Standards was originally developed pursuant to a voluntary standards development initiative of the CGSB. The information contained therein may no longer represent the most current, reliable, and/or available information on these subjects. CGSB hereby disclaims any and all claims, representation or warranty of scientific validity, or technical accuracy implied or expressed respecting the information therein contained. The CGSB shall not take responsibility nor be held liable for any errors, omissions, inaccuracies or any other liabilities that may arise from the provision or subsequent use of such information. These Standards are to be referred to for archival purposes only

RETRAIT

Octobre 2011

Sélection de normes de la série Géomatique

Ces Normes nationales du Canada sont retirées par le présent avis. Leur contenu fait l'objet de CAN/CGSB-171.100-2009, Profil nord-américain de la norme ISO 19115:2003 — Information géographique — Métadonnées (PNA — Métadonnées).

Le Conseil canadien des normes exige que les organismes accrédités d'élaboration de normes, tel que l'ONGC, effectue régulièrement un examen des normes consensuelles afin de déterminer s'il y a lieu d'en renouveler l'approbation, de les réviser ou de les retirer. Le cycle d'examen d'une norme est généralement de cinq ans à partir de la date de publication de la dernière édition de celle-ci.

L'information contenue dans ces normes a été élaborée initialement en vertu d'une initiative volontaire d'élaboration de normes de l'ONGC. Elle peut ne plus représenter l'information disponible et/ou l'information la plus actuelle ou la plus fiable à ce sujet. L'ONGC décline par la présente toute responsabilité à l'égard de toute affirmation, déclaration ou garantie de validité scientifique ou d'exactitude technique implicite ou explicite relative à l'information contenue dans ces normes. L'ONGC n'assumera aucune responsabilité et ne sera pas tenu responsable quant à toute erreur, omission, inexactitude ou autre conséquence pouvant découler de la fourniture ou de l'utilisation subséquente de cette information. Ces normes doivent être

as the content has been repealed as of the date on this withdrawal notice.

Archived copies of withdrawn standards for historic or archival purposes are still available from the CGSB Sales Centre by telephone at 819-956-0425 or 1-800-665-2472, by fax at 819-956-5740, by Internet at www.tpsgc-pwgsc.gc.ca/ongc-cgsb/, by e-mail at ncr.CGSB-ONGC@tpsgc-pwgsc.gc.ca or by mail at Sales Centre, Canadian General Standards Board, 11 Laurier Street, Gatineau, Canada K1A 1G6.

CAN/CGSB-171.1-95

CGIS-SAIF — Canadian Geomatics Interchange Standard — Spatial Archive and Interchange Format: Formal Definition (Release 3.2) (ICS 07.060)

CAN/CGSB-171.4-94

Canadian Geomatics Interchange Standard — Digital Geographic Information Exchange Standard (CGIS-DIGEST) (ICS 07.060)

consultées à des fins archivistiques seulement puisque leur contenu a été révoqué à la date du présent avis de retrait.

Des copies archivées des normes (spécifications) retirées peuvent être obtenues à des fins historiques ou archivistiques auprès du Centre des ventes de l'ONGC. Il suffit d'en faire la demande par téléphone au 819-956-0425 ou 1-800-665-2472, par télécopieur au 819-956-5740, par Internet à : www.tpsgc-pwgsc.gc.ca/ongc-cgsb/, par courriel à ncr.CGSB-ONGC@tpsgc-pwgsc.gc.ca, ou par courrier adressé au Centre des ventes, Office des normes générales du Canada, 11, rue Laurier, Gatineau, Canada K1A 1G6.

CAN/CGSB-171.1-95

Cette norme est disponible en anglais seulement.

CAN/CGSB-171.4-94

Cette norme est disponible en anglais seulement.

The

DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD

(DIGEST)

Parts 1, 2 and 3

Withdrawn/Retirée

Produced and issued under the direction of the Directorate of Geographic Operations,
Department of National Defence, Canada on behalf of the
Digital Geographic Information Working Group.

Edition 1.2 January 1994

The
DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD
(DIGEST)

Part 1

GENERAL DESCRIPTION

Withdrawn/Retirée

Produced and issued under the direction of the Directorate of Geographic Operations,
Department of National Defence, Canada on behalf of the
Digital Geographic Information Working Group.

Edition 1.2 January 1994

DIGEST Part 1

General Description

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NOTICE TO USERS

1. This international exchange standard has been designed to enable the transfer of Digital Geographic Information (DGI) between geographic information systems. This documentation now forms a baseline from which both system developers and national survey organizations can plan their development and production activities.

2. Research into all aspects of DGI is continuing within the Digital Geographic Information Working Group (DGIWG) forum and any subsequent potential changes will be subject to formal change control procedures.

3. DGIWG has decided to hold DIGEST Parts 1, 2 and 3 stable until at least June 1996 in order to allow system developers the opportunity to develop compatible software. Any clarifications or corrections to the standard approved by the committee will be recorded in separate clarification and corrections documents which will be available from the committee through the national representatives. These documents will be incorporated into the next edition of DIGEST along with any upward compatible extensions approved at that time.

RECORD OF AMENDMENTS

NUMBER	DATE	ENTERED BY	REMARKS

Withdrawn/Retiree

FOREWORD

Authority. The **DI**gital **G**eographic Information **E**xchange **ST**andard (DIGEST) was prepared by and issued under the authority of the Digital Geographic Information Working Group (DGIWG).

Security Classification. All parts of DIGEST are unclassified but may be subject to the limitation of use that the copying of the documents is prohibited without the authority of the national representative (see Part 1 — 5.2).

Changes from the Last Edition. DIGEST Edition 1.2 cancels and replaces DIGEST Edition 1.1 (October 1992). The major changes have been technical improvements to the theoretical data model, reworking of the encapsulations, and updating of the coding scheme. The significant changes are:

- The separate data structures used to describe Spaghetti, Chain-Node, and Topological data have been combined into a common data model which supports four different levels of implementation corresponding to Level 0 — Spaghetti, Level 1 — Chain-Node, Level 2 — Planar Graph, and Level 3 — Full Topology (including faces on a 2-D manifold). This harmonized a major aspect of the standard with other international standards such as the IHO data interchange standard and with several national standards.

- DIGEST has been revised in order to make the standard consistent across all of its various parts. Additional fields have been added to the various encapsulations so that the same information content can be carried in any of the encapsulations.

- The description of which data fields are optional and which fields are dependent on the existence of other fields has been clarified by introducing a mechanism of identifying the depth of nesting of conditional and repeating fields and sub-fields.

- DIGEST has been revised to align it with the most recent versions of the ISO character set and coding standards. Text, expressed in any recognized alphabet in the world, may be supported in attributes or in specific data sub-fields. Four levels of text are supported ranging from ASCII (ISO 646), through Latin Alphabet 1 for western European Languages (ISO 8859), a comprehensive Latin Alphabet (ISO 6937) and the Universal Character Set standard including all world alphabets (ISO 10646).

- Additional informative descriptive diagrams have been added to the document in the form of annexes in order to assist in the implementation of the standard. These informative annexes consist of data model diagrams and logic flow diagrams.

- The lists of codes for projections, grids, ellipsoids and datums have been extended significantly.

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- FACC has been greatly extended, incorporating many new features and attributes derived from other catalogues. This makes FACC a much more comprehensive catalogue.

Document Structure. DIGEST is published as four parts:

- Part 1: General Description
- Part 2: Theoretical Model, Exchange Structure, and Encapsulation Specifications
- Part 3: Codes, Parameters and Tags
- Part 4: Feature and Attribute Coding Catalogue

This part provides a general description of DIGEST, including a brief summary of the exchange standard. It is structured as follows.

- The first four clauses provide the scope, purpose and field of application; conformance; references; and terminology (the first three apply to DIGEST as a whole).
- The maintenance of DIGEST (all parts) is covered in Clause 5, including custodianship, national representatives, procedures for effecting changes to the standard, and distribution of the documents.
- Clause 6 gives the background and general concept of DIGEST.
- Clause 7 provides a summary description of the theoretical model, exchange structure and encapsulation specifications of DIGEST.

Document Maintenance. The maintenance of DIGEST is covered in Clause 5 to this Part, including custodianship, national representatives, procedures for effecting changes to the standard, and distribution of the documents.

Acknowledgements. It is truly remarkable when a group of individuals from 11 different countries spanning two continents can work together on a project as extensive and complex as designing an exchange standard for digital geographic information. The editor would like to acknowledge the efforts and contributions of all DGIWG members—past and present—in the creation and evolution of this standard.

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1 SCOPE, PURPOSE AND FIELD OF APPLICATION

1.1 SCOPE

Digital geographic information (DGI) has evolved into an essential element in the planning and conduct of civil and military operations. The required data volume, demands and data complexity dictates that multi-national agreements for digital data standards be established to assure compatibility. In support of this aim these standards define those aspects necessary to the exchange of DGI. They are as follows:

- the data structures to be supported;
- format;
- feature and attribute coding scheme;
- exchange media; and
- administrative procedures.

The type of data to be exchanged using these standards includes the digital representation of the following:

- elevation and depth information;
- geographic feature geometry and feature attribute information;
- information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum, e.g. radar, infra-red; and
- other geographic information.

The data will all be available on a common worldwide reference datum of World Geodetic System 1984 (WGS 84).

1.2 PURPOSE

These standards will enable interoperability and compatibility among national and multi-national systems and users. They will also support the increasing use of joint development programs. In fact it is essential that geographic staffs involved in the development of national Geographic Information Systems are advised of the advantages of making their data structures and feature and attribute coding schemes compatible with these standards.

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1.3 FIELD OF APPLICATION

The application of the agreed standards being dealt with hereafter has several aspects, including organizational; geo-scientific; and regional and thematic.

1.3.1 ORGANIZATIONAL APPLICABILITY

This document applies to the topographic, hydrographic and aeronautical institutions of the participating nations. The standards have been built to support exchange of DGI between the central agencies operating in this geo-scientific field. This does not preclude the use by other institutions; on the contrary, all users are requested to widen the field of applications even to their contractors on the commercial side by making these standards part of relevant contracts. This will help to avoid redundant developments and cut costs by using common approaches.

1.3.2 GEO-SCIENTIFIC APPLICABILITY

These standards apply to geodetic, geographic, geological and geophysical data of interest. Since the present, and even more importantly the future area of interest for research, development, planning, and execution of operations is hard to define, the term has to be interpreted in a wide sense. Positioning, navigation, simulation, targeting, map and chart automated production, display and manipulation of data are some applications. All the data in this document are covered by the terms "geo data" and DGI. Geo data will be turned into applications-specific user-oriented "product data" out of the original "non-product oriented data".

1.3.3 REGIONAL AND THEMATIC APPLICABILITY

The contents of databases are mainly a national responsibility, but authorities may wish to state points of interest referring to the regional extension and the thematic subjects held in these databases. An integrated multi-national database is not foreseen. Should it come into existence, the standards of this document can easily be applied, since international agreements (ISO standards and NATO STANAGs) have been considered as far as published and known to DGIWG. For bi- or multi-national system developments this document should apply.

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2 CONFORMANCE

This standard is applicable to all member nations of DGIWG. Information processing systems which have the capability of exchanging DGI shall have the capability of reading and writing data in conformance with this standard. This standard shall be used for the exchange of DGI unless the interchanging parties have agreed on an alternative exchange format.

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3 REFERENCES

Following are the normative references which are used in the application of DIGEST. References which are informative or which merely assisted in the preparation of the standard are included in the bibliography (Annex G to Part 2).

International/Multinational

1. ISO 646 — *Information Processing — ISO 7-bit coded character set for information interchange*, Ed. 2, 1983.

2 ISO 1000 — *SI units and recommendations for the use of their multiples and of certain other units,* Third Edition 1992-11-01

3. ISO 1001 — *Information Processing — File Structure and Labelling of Magnetic Tapes for Information Interchange*, Ed. 2, 1986. Common with references 16 and 24.

4. ISO 2022 — *Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques*, Ed. 3, 1986.

5. ISO 2375 — *Data Processing — Procedure for registration of escape sequences*, Ed. 3, 1985.

6. ISO 3788 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information Interchange recorded at 63 cpmm (1600 cpi), Phase Encoded.* Ed. 1, 1976. Common with references 17 and 22.

7. ISO 5652 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information interchange formats and recording, using group coding 246 cpmm (6,250 cpi).* Common with references 19 and 23.

8. ISO 6937 — *Information Processing — Coded character sets for text communication*, Ed. 1, 1983.

9. ISO 8211 — *Information Processing — Specification for a data descriptive file for information interchange*, 1985.

10. ISO 8601 — *Data Elements and Interchange Format; Information Interchange Representation of Dates and Time*, 1988. (Replaces ISO 4031)

11. ISO 8824 — *Information processing systems — Open Systems Interconnection — Specifications of Abstract Syntax Notation One (ASN.1)*, 1987. (CCITT X.208)

12. ISO 8825 — *Information processing systems — Open Systems Interconnection — Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*, Ed. 1, 1987.

13. ISO 9660 — *Information Processing — Volume and File Structure of CD-ROM for Information Interchange*, Ed. 1, 1988.

14. ISO 8859 -1— *Information processing — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1,* First Edition 1987-02-15

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15. ISO/IEC/10646 -1 — *Information technology - Universal Multiple-Octet Coded Character Set (UCS), Part 1: Architecture and Basic Multilingual Plane,* First edition 1993-05-01

16. CCITT Recommendation, 1992, Geneva:
T50 — *International Reference Alphabet* (IA5),
T51 — *Latin Alphabet Coded Character Sets for Telematic Services,*
T52 — *Non Latin Alphabet Coded Character Sets for Telematic Services.*

17. DLMS Accuracy Working Group. (*Accuracy Determination Method.*)

18. European Computer Manufacturer's Associates (ECMA), *Standard for Data Interchange on Read Only 120 mm Optical Data Disks (CD-ROM).* ECMA/TTC31/87/47, September 1987. (DRAFT).

National

19. ANSI X3.27—1978, *Magnetic Tape Labels and File Structure for Information Interchange (ASCII)*, 1978. Common with references 2 and 24.

20. ANSI X3.39—1973, *Recorded Magnetic Tape for Information Interchange (1,600 cpi, PE)*, 1973. Common with references 5 and 22.

21. ANSI X3.4—1977, *Code for Information Interchange*, 1977.

22. ANSI X3.54—1976, *Recorded Magnetic Tape for Information Interchange (6,250 CPI, Group-Coded Recording)*, 1976. Common with references 7 and 23.

23. ANSI/IEEE - 754—1986, *IEEE Standard for Binary Floating Point Arithmetic.*

24. FIPS PUB 1-1 — *Code for Information Interchange*, 24 Dec 1980.

25. FIPS PUB 10-3 — *Countries, Dependencies, Areas of Special Sovereignty, and their Principal Administrative Divisions*, 9 Feb 1984.

26. FIPS PUB 25 — *Recorded Magnetic Tape for Information Interchange (1,600 CPI, Phase Encoded)*, 30 Jun 1973. Common with references 5 and 17.

27. FIPS PUB 50 — *Recorded Magnetic Tape for Information Interchange, 6,250 cpi (246 cpmm), Group-Coded Recording*, 1 Feb 1978. Common with references 7 and 19.

28. FIPS PUB 79 — *Magnetic Tape Labels and File Structure for Information Interchange*, 17 Oct 1980. Common with references 2 and 16.

29. DoD (US Department of Defense) *Standard Printing Color Catalog.*

30. DoD (US Department of Defense) *Operators Manual for the MC&G Standard Printing Color Identification System.*

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4 TERMINOLOGY

4.1 TERMS AND DEFINITIONS

A list of terms and their definitions as used in DIGEST can be found in Part 2 — 4.1.

4.2 ACRONYMS AND ABBREVIATIONS

Although most acronyms and abbreviations are defined the first time they are used, the following list is provided as a quick reference for all the acronyms and abbreviations appearing in this part of DIGEST.

ANSI	**A**merican **N**ational **S**tandards **I**nstitute
ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
ASN	**A**bstract **S**yntax **N**otation
CCITT	**C**omité **C**onsultatif **I**nternational **T**élégraphique et **T**éléphonique
CD-ROM	**C**ompact **D**isk — **R**ead **O**nly **M**emory
cpi	**c**haracters **p**er **i**nch
cpmm	**c**haracters **p**er **mm** (millimetre)
DCC	**D**ocument **C**hange **C**ontrol
Dept	**Dep**artment
DIA	(US) **D**efense **I**ntelligence **A**gency
DG	**D**irector **G**eneral
DGI	**D**igital **G**eographic **I**nformation
DGIWG	**D**igital **G**eographic **I**nformation **W**orking **G**roup
DIGEST	**D**igital **G**eographic **I**nformation **E**xchange **S**tandard
DLMS	**D**igital **L**andmass **S**ystem
DoD	U.S. **D**epartment **o**f **D**efense
ECMA	**E**uropean **C**omputer **M**anufacturer's **A**ssociates
FACC	**F**eature and **A**ttribute **C**oding **C**atalogue
FIPS PUB	(U.S.) **F**ederal **I**nformation **P**rocessing **S**tandards **Pub**lication
GDS	**G**eo **D**ata **S**ubset
Geo	**Geo**graphic
HDS	**H**eader **D**ata **S**ubset
HQ	**H**ead**q**uarters
IA5	**I**nternational Reference **A**lphabet-5
ID	**I**dentification
IEEE	**I**nstitute of **E**lectrical and **E**lectronic **E**ngineers
IGMI	**I**stituto **G**eografico **M**ilitare **I**taliano
IGN	**I**nstitut **G**éographique **N**ational
in	**in**ch
ISO	International Organization for Standardization ("iso" = Greek for "same")
MC&G	**M**apping, **C**harting and **G**eodesy
mm	**mm** (millimetre)
NATO	**N**orth **A**tlantic **T**reaty **O**rganization

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OSI	**O**pen **S**ystems **I**nterconnection
PE	**P**hase **E**ncoded
RGB	**r**ed, **g**reen, **b**lue
STANAG	**Stan**dardization **Ag**reement
THF	**T**ransmittal **H**eader **F**ile
VA	**V**irginia
VRF	**V**ector **R**elational **F**ormat
WGS	**W**orld **G**eodetic **S**ystem

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5 MAINTENANCE OF DIGEST

5.1 CUSTODIAN

The Directorate of Geographic Operations, National Defence Headquarters, Canada is the custodian of DIGEST Parts 1, 2 and 3. Address and telephone/fax numbers are:

Director of Geographic Operations
National Defence Headquarters
MGen G. Pearkes Building
Ottawa, Canada K1A 0K2
Telephone: 1-613-996-2240
Fax: 1-613-996-3328

The United States Defense Mapping Agency is the custodian of DIGEST Part 4 (Feature and Attribute Coding Catalogue). Address and telephone/fax numbers are:

HQ Defense Mapping Agency
Attn: TIJ (A-10)
8613 Lee Highway
Fairfax, VA 22031-2137
USA
Telephone: 1-703-285-9238
Fax: 1-703-285-9397

5.2 NATIONAL REPRESENTATIVES

Any queries with regard to the content or application of DIGEST should be addressed to the national representative (point of contact). The DGIWG national representatives are:

- Belgium:
  Institut Géographique National
  Abbaye de la Cambre 13
  B 1050 Brussels
  Belgium

- Canada:
  Director of Geographic Operations
  National Defence Headquarters
  MGen G. Pearkes Building
  Ottawa, Canada
  K1A 0K2

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- Denmark:
  Chief of Defence Denmark
  Log Plans Branch
  PO Box 202
  DK-2950 Vedvæk
  Denmark

- France:
  Centre Géographique Interarmées
  F-00450 Armées
  France

- Germany:
  Amt für Militärisches
  Frauenberger Str 250
  Mercator Kaserne
  53879 Euskirchen
  Germany

- Italy:
  IGMI — Via C. Battisti 10
  50100 Firenze
  Italy

- The Netherlands:
  Directie Operatiën Koninklijke Landmacht
  Sectie Militaire Geografie
  Postbus 90701
  2509 LS Den Haag
  The Netherlands

- Norway:
  Norwegian Military Geographic Service (FMGT)
  Oslo Mil/Akershus
  N-0015 Oslo
  Norway

- Spain:
  Servicio Geografico del Ejercito
  Dario Gazapo Num 8
  28024 Madrid
  Spain

- UK:
  Requirements Division
  Geo Commitments Group
  DG Military Survey
  Feltham Middlesex TW13 7AH
  UK

- US:
  HQ Defense Mapping Agency
  Attn: TIJ (A-10)
  8613 Lee Highway
  Fairfax, VA 22031-2137
  USA

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5.3 PROPOSED CHANGES AND AMENDMENTS

Any proposed changes or comments should be keyed to the specific page, paragraph and line of text. Reasons should be provided for each comment to ensure understanding and complete evaluation. Comments should be addressed to the national representative who will then forward the details to the custodian nation. DGIWG will ensure that all such comments are processed through formal document change control (DCC) procedures.

Amendments to this specification will be the responsibility of the custodian on behalf of and in agreement with DGIWG, and will be issued as necessary through the national representatives.

5.4 DISTRIBUTION

International distribution of DIGEST will be the responsibility of DGIWG, through the national representatives within each DGIWG country. The national representative can distribute freely outside DGIWG nations.

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6 GENERAL CONCEPT OF DIGEST

6.1 NATIONAL DIGITAL GEOGRAPHIC INFORMATION SYSTEM

As a prerequisite to creating a multi-national system for the exchange of DGI, each nation wishing to participate will need to establish a national system having the following major elements:

- a database of positionally related digital information including:
  - elevation and depth information;
  - geographic feature geometry and feature attribute information;
  - information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum; and
  - other geographic information together with other associated data.
- procedures for the:
  - acquisition of data to populate the database;
  - maintenance of the database;
  - transmission of data to and from the database;
  - management of data to ensure its integrity and quality; and
  - provision of information about the data, including availability, accuracy, security classification, and release restrictions. This includes the capability to allow for the exchange of indexing or catalogue information.

Nations may differ in their concepts for digital production. In one case a range of products may be produced by largely separate production processes. For each product, data is extracted from source material and that data is then formatted for the specific product in the input to a product database, from which the needs of users are constrained to use a limited range of standard products. The product data may be further transformed, by the user, to obtain data in the precise form needed.

In another production approach a nation with a wide range of products will extract data on a multi-product basis from source material to form a multi-product database from which a range of products may be generated. In some cases this product generation may be simply the extraction of certain features from the database; other cases may involve a considerable amount of further processing.

The important data exchange issue is the creation of compatibly structured database(s) for neutral data and products so the exchange of data under the multi-national system is practical.

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6.2 OPERATIONAL CONCEPT

International exchange standards for DGI is the principal concern of DGIWG. The development of a multi-national digital geographic information system is needed to facilitate the exchange. The system will consist of standards and procedures needed to permit data to be exchanged among nations. The following paragraphs describe the principles that will govern this exchange and therefore form the basis of the operational concept for DGIWG.

Data exchange will be governed by a series of agreements among nations. There will be no single master database; each nation will be responsible for providing data to meet its international commitments and for holding data, both nationally produced and received from other nations.

Nations may agree to arrange for the procurement of common hardware and software. However, standards have been produced with the assumption that, in general, nations will be using different hardware and software.

Standards for data exchange have been agreed to on a multi-national basis. The standards must allow for the exchange of both digital geographic products and basic geographic data. This geographic data may consist of multi-product database information or other forms of intermediate digital data used in the production of maps, charts or digital products.

There are a number of types of exchange relationships (Figure 6-1).

- **Internal Exchange** — the exchange within national agencies. This is not of direct concern to other nations.
- **Inter-agency Exchange** — the exchange of basic data and products between map production agencies. This is the principal concern of DGIWG.
- **Provision of Products** — the supply of products by production agencies to their users. This is a national responsibility however DGIWG is interested in product standards.
- **User Exchange** — the exchange of products and information between user systems. Such an exchange may take place if a system is developed as an international project; then there will be commonality of equipment between nations. Exchanges of this type are primarily the responsibility of those responsible for the system and are not the concern of DGIWG.

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The exchange of DGI will be carried out initially by means of internationally standard, removable storage media. Emphasis will be placed initially on magnetic tape and optical disks. Interchange by means of communication links may be a further alternative.

The work of DGIWG is directed towards establishing a multi-national system to enable the exchange of DGI and products, and information about them between national systems. This will require the development of standards for data and the definition for the exchange media and the procedures for exchange. Exchange of data will be by a series of agreements among nations.

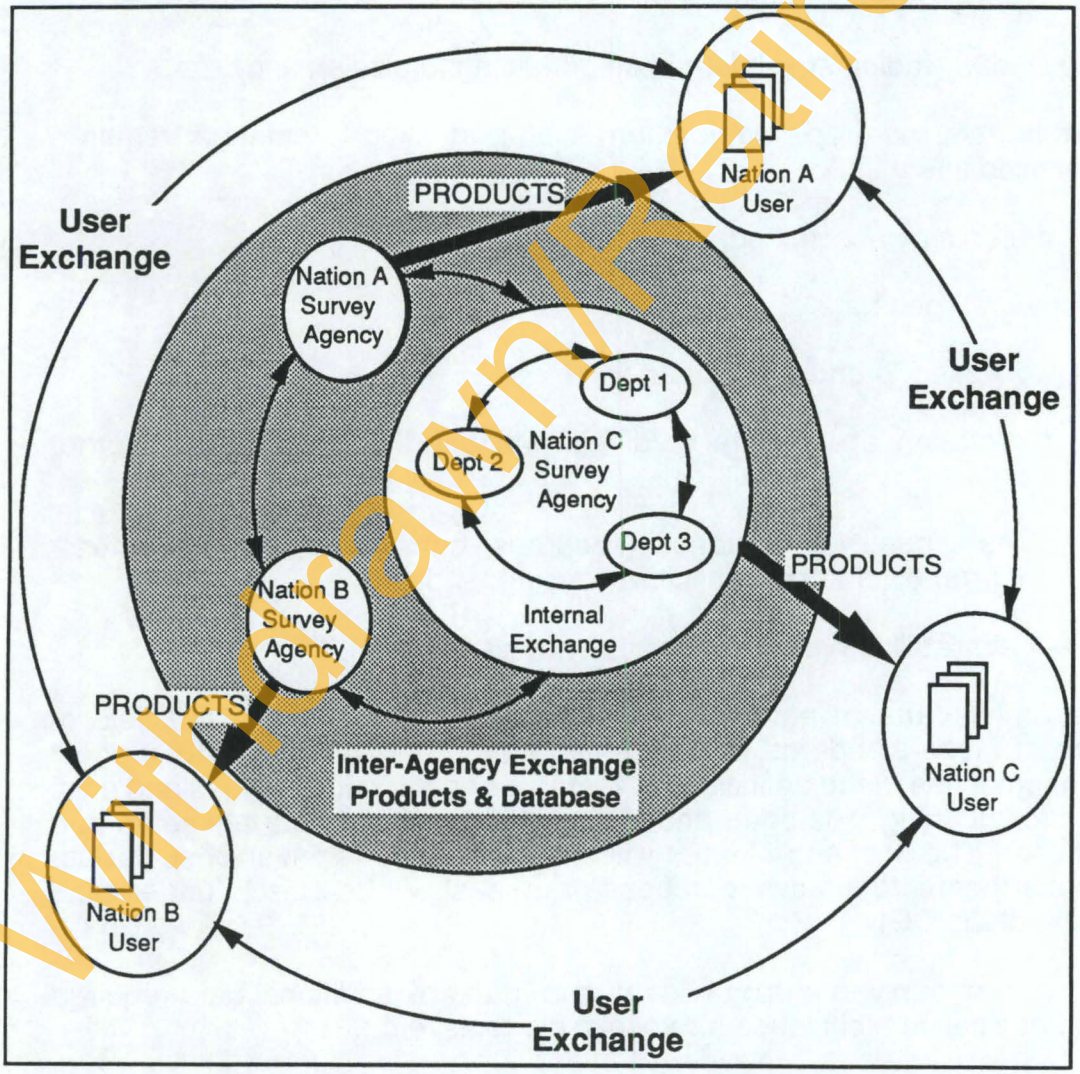


Figure 6-1 DGIWG Digital Data Exchange

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6.3 DATA STRUCTURES

DIGEST applies to:

- spaghetti vector data (Level 0 Topology);
- chain-node vector data (Level 1 Topology);
- planar graph vector data (Level 2 Topology);
- full topological vector data (Level 3 Topology);
- raster data (radiometric information pertaining to pixels); and
- matrix data (non-radiometric information pertaining to points at regularly identified intervals).

These structures may accommodate:

- neutral "geo data";
- processed "product data"; and
- information about data holdings, which will include (among other things):
  - — data quality information (accuracy, consistency, completeness, currency, and security classification); and
  - — availability (production status and releasability).

Since the architecture of national databases is not contained in the field of application of these standards, it is the main goal of this document to suggest common approaches to the definitions of features and attributes, values and units as well as to a coding catalogue and a logical structure of data elements and their relations. The exchange format will ensure that the receiver of such data can integrate them into his own database or at least will be able to understand the meaning of the DGI.

DIGEST does not apply to analog (video) data or to any additional data required by telecommunication techniques (protocols, modems, etc.).

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6.4 GUIDING PHILOSOPHY

DIGEST is designed to establish a uniform method for the exchange of DGI. This uniformity is based on a common logical organization of any geo dataset exchanged, whatever the data exchange structure used, on the fundamental principles agreed to within DGIWG as expressed throughout DIGEST; and on methods of representation of the data taken from the International Organization for Standardization (ISO).

For any exchange of DGI between national agencies to be carried out in a practical manner it is necessary that the following aspects be supported:

- a clear definition of the **data model** to be used for each type of data (see Part 2 — 5);
- a commonly understood means of identifying **features** and their descriptive **attributes** (see Part 2 — 6 and Part 4);
- a clear statement on the **quality and accuracy of the data** (see Part 2 — 7);
- a clear definition of the **logical organization and structure of the data** (see Part 2 — Section Two), including:
  - — a clear definition of **information for interpreting the overall content of a DGI transmittal** (see Part 2 — 9), and
  - — a clear definition of **information for supporting each specific dataset** (see Part 2 — 10 and 11);
- a clear definition of the **organization and representation of the data** (i.e. format) **on the exchange media** (see Part 2 — 13); and
- a clear statement of the **recording standards used for the exchange media** (see Part 2 — 14).

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7 SUMMARY DESCRIPTION OF DIGEST

7.1 THEORETICAL MODEL

The theoretical model includes the data models, feature and attribute coding structure, and data quality.

7.1.1 DATA MODEL

There are three types of spatial data supported by DIGEST. These are illustrated in Figure 7-1 and are listed below:

- vector data (at various levels of topology);
- raster data; and
- matrix data.

Each of these types of data is a different method of representing a map or chart. They are complementary in that they provide different methods of representing data about the same geographical area.

Vector data represents geographic data in terms of the boundaries and attributes of individual features. Features are real items that can be identified on the earth, such as a river or a tower, or they are abstract items such as political boundaries. Attributes may be ascribed to features which describe what type of item they are and also provide information with respect to the particular instance of the item. For example a feature code might describe that a particular item is "bridge" and an attribute code may describe that the bridge is capable of supporting a specified load. Features may be either of Point, Line or Area type or be of Complex type composed of more than one Point, Line and/or Area features. The spatial extent of features is described in terms of Node, Edge and Face elements. These primitive elements carry positional attributes. The relationship between these primitive spatial elements is optionally described in terms of topology. For example, whether a particular point feature is contained in a particular area feature is described in terms of the containment of the corresponding entity point (node) element within a face element. DIGEST permits topological relationships to be described in a vector data set to four different levels of sophistication. The most basic vector data set (Level 0 topology) does not carry any topological relationship information. This is known as "Spaghetti" data. The next level of data is "Chain-Node" (Level 1 topology) where all edges terminate at nodes. This describes the connectivity of the data set, but edges are permitted to cross. The next level of vector data is "Planar Graph" data (Level 2 topology) where a node must exist at the intersection of all edges. Adjacency information is carried at this level of topology. The highest level of topology supported by DIGEST vector data is termed "Full Topology" (Level 3 topology) where the data set forms a mathematical 2-D manifold, complete with faces. Containment information is carried at this level of topology.

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DIGEST provides a single vector data model which can carry any of the four identified levels of topology.

Raster data represents geographic data in terms of an array of picture elements, corresponding to the individual colours for each small segment of the map. A raster map is defined as a set of rows and columns of identical picture elements (pixels). Each pixel may take on a given colour. Colour may be described either as a set of Red, Green, or Blue values for the individual pixel or as a reference to a colour lookup table which indirectly describes the Red, Green, or Blue colour values. A significant amount of support data is carried along with the set of pixels to put the raster map in context. If the raster data set was created by scanning a paper map or chart, the projection, map grid, reference points and other information about the scanned source paper map are carried. If the data is from some other source, information about the source is carried.

Matrix data represents geographic data as a set of values measured on a grid. For example a Digital Terrain Elevation Model consists of a set of elevations measured on a regular grid.

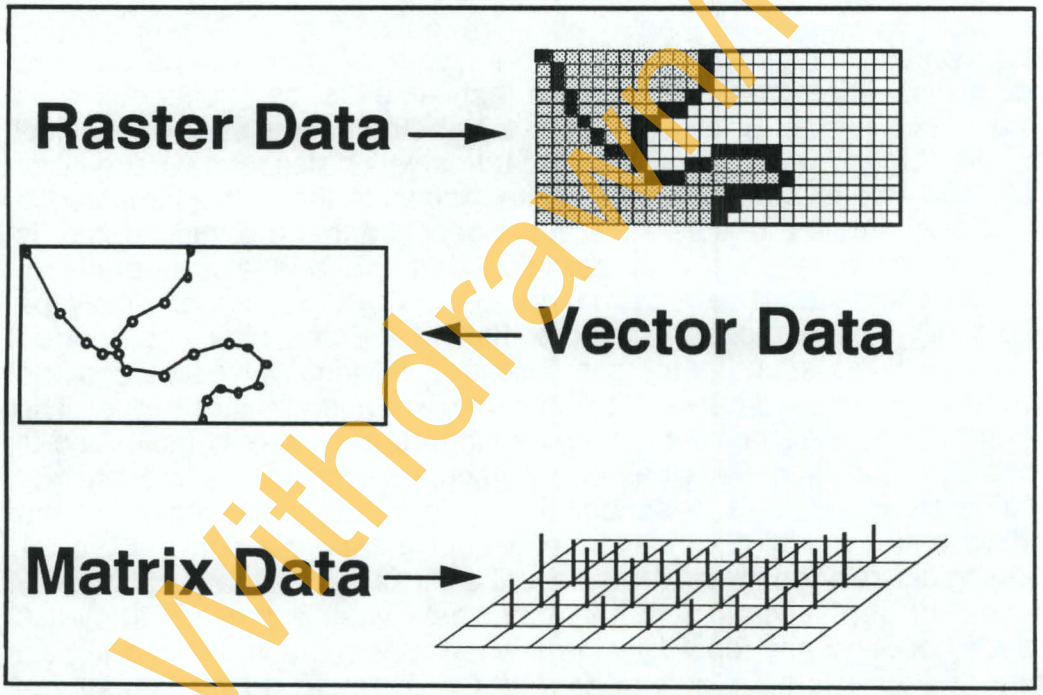


Figure 7-1 Spatial Data Types

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7.1.1.1 VECTOR DATA

Conceptually, the three possible topological data entities — node, edge and face — form the building blocks of a complete and consistent topological representation of the two-dimensional space covered by a given dataset. Well-defined topological relationships exist between the different topological entities. As well, a succinct set of rules is defined to which each entity must conform. The geographic features — point, line, area and complex — in the dataset are then represented by one or more topological entities with a many-to-many mapping between features and entities.

In DIGEST, topological entities and features are linked by a mandatory one-way relation, and, optionally, some reverse relations (see Figure 7-2). The use of only the one-way relation reduces the data volume while preserving the structure of the full conceptual scheme. The use of the reverse relationship, available in Vector Relational Format (VRF) form, improves computational efficiency.

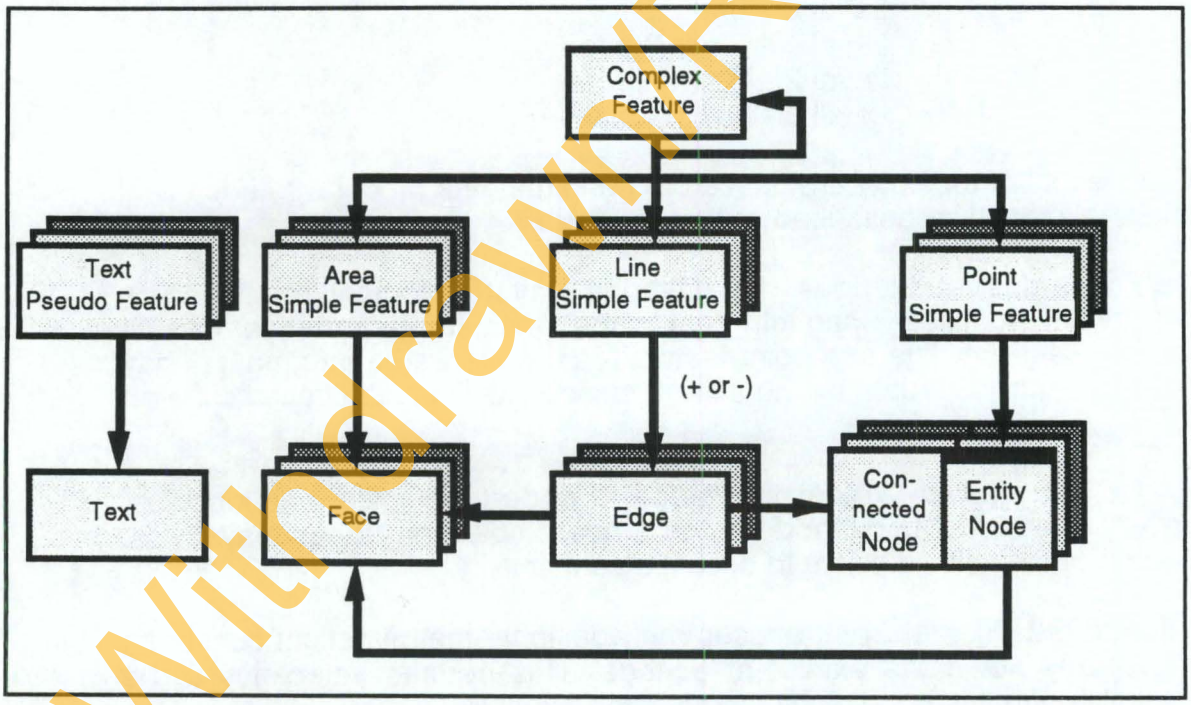


Figure 7-2 Mandatory Topology

Note: The arrow indicates, for example, that edge refers to its nodes, but nodes do not refer to its edge. Some reverse arrows are optional, for example, Edge-to-Line, Simple Feature-to-Complex Feature. The relationship between nodes, edges and faces are described at different levels of topology.

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There are eight logical **entity types** in the DIGEST vector data model:

- feature entities — simple point
  — simple line
  — simple area
  — complex
- topological entities — node
  — edge
  — face
- topological construct — ring

The text pseudo feature exists to provide an annotation capability which can have complex attributes similar to the topological features.

Four levels of topology are provided in DIGEST for vector data. These are:

Level 0 - Spaghetti
Level 1 - Chain Node
Level 2 - Planar Graph
Level 3 - Full Topology

These four levels of topology are based on the same data model with additional topological relationships described at higher levels.

Spaghetti data (Level 0) does not describe any topological relationships between primitive entities. Spaghetti data in the strictest interpretation, can be used to represent only line and point features. However, area information may be captured in spaghetti data by the use of "closed lines" which circumscribe an area.

Chain Node data (Level 1) describes edge to node topological relationships, where every edge must begin and end on a node; however, edges may cross. This level of topology is sufficient to describe connectivity.

Planar Graph data (Level 2) introduces the additional mathematical constraint that edges may not cross except at a node. This permits adjacency to be calculated although it is not directly stored in the structure.

Full Topology data (Level 3) introduces the concept of a face and describes face to edge as well as node to face topological relationships. This carries adjacency, left face / right face topological relationships as well as node in face containment.

The topology represented in the exchange dataset is logically consistent and all related entities and features are exchanged, including those edges that define

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the boundary of the dataset. It represents a topology consistent with the coordinate plane.

For Level 0 and Level 1 data simple spatial records may be used instead of separate node and edge entities.

7.1.1.2 RASTER DATA

Raster graphics consist of:

- scanned graphic data in pixel form;
- a support file that contains geographic coordinates with which to register the digital data to the original graphic's projection;
- a map information file that contains textual information about the graphic; and
- optional supplementary text that contains textual descriptions of selected items depicted on the original graphic.

Raster graphics are a collection of red, green and blue (RGB), or colour-coded digital images stored in (optionally compressed) unsigned binary integer format. The total extent of a graphic product may be scanned including margin, border and legend areas. Each image, which normally consists of one graphic product, is provided with geographic control on the original datum or projection so that transformation and seaming of the data can be performed at user discretion. A raster image is usually either an RGB digital image consisting of the three image bands or a colour-coded image consisting of at least one image band.

7.1.1.3 MATRIX DATA

Matrix data are arrays of non-radiometric information pertaining to points at regularly identified intervals (e.g. grid, Cartesian, latitude/longitude) and characteristics which are present at that particular location. Such characteristics could be soil type or elevation. Each array of matrix information will consist of a uniform number of locations, the basic structure of which is identical to the raster structure.

7.1.2 FEATURE AND ATTRIBUTE CODING

The aim of the feature and attribute coding specification is to provide a standard scheme for documenting features and attributes necessary to distinguish those

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features commonly found in a Digital Geographic Information System and for the orderly exchange of such data.

The specification, which is Part 4 of DIGEST, provides a common menu of features and attributes along with a standardized coding system. They are known collectively as the Feature and Attribute Coding Catalogue (FACC). Where particular applications require the definition of a few specialized features and attributes not yet contained in FACC, a Data Dictionary may be used. Otherwise, features and attributes shall be encoded using FACC.

FACC can be modified and updated to keep pace with the dynamic technology improvements and changing requirements, as it is not tied to any specific database or product line. In this way, it is intended that FACC should be extended so as ultimately to meet the requirements of every application.

Within FACC, each feature is identified by a unique five-character code. The first character corresponds to the feature category and can have an alphabetic value from A through Z. Currently there are ten major feature categories:

- Culture;
- Hydrography;
- Hypsography;
- Physiography;
- Vegetation;
- Demarcation;
- Aeronautical Information;
- Cadastral Information;
- Dataset-specific features; and
- General.

Each major category is further divided into subcategories identified by the second character of the five-digit code which is an alphabetic value from A through Z. Finally, the third, fourth, and fifth characters of the five-character feature code are a numeric value from 000 through 999, which provides unique feature identification within categories (a block of numeric values has been set aside for special (non-FACC) use). Thus, all features must be identified by all five alphanumeric characters.

DIGEST provides an extensive list of explicit attributes which further define a feature, e.g. vegetation characteristic or surface material. Each attribute is identified by a unique three-character alphanumeric identifier. DIGEST also allows implicit attribution (see Part 2 — 12.2.3).

Appended to each attribute is either an integer code between 0 and 999 to represent the value of the attribute (a block of numeric values has been set aside for special (non-FACC) use) or an indefinitely long alphanumeric, integer or floating point value representing the actual magnitude of the attribute.

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DIGEST supports multi-level (hierarchical) attribution (see Part 2 — 12.2.2). For example, a buoy may have a top mark with the attribute of two cones pointing up, which has an additional attribute of the colour black. In theory this could be further attributed as "glossy" (or "flat").

7.1.3 DATA QUALITY

Data descriptors are necessary in order to evaluate the quality of exchanged geographical data referring to features/attributes and geometry and to integrate them into a receiving database without ambiguity. Therefore quality statements are required for a single datum as well as for certain data levels or categories. Special statements are required for:

- source;
- accuracy (positional and attribute);
- up-to-dateness/currency;
- logical consistency;
- completeness (feature and attribute);
- clipping indicator;
- security classification; and
- releasability.

Note: The last three descriptors, although not relating to data quality, are included here because of their logical similarity to data quality descriptors.

Data is organized in structures that comprise several categories, e.g.:

- volume;
- dataset;
- topological/spatial records (face, edge, node);
- feature; and
- attribute.

Quality descriptors may be assigned to each of the above categories.

7.2 THE EXCHANGE STRUCTURE

DIGEST allows the definition of sets of geographic information (e.g. maps or charts) to be exchanged. The interchange unit is called a "transmittal" interchange entity.

The guiding philosophy has been to organize the required information for the transmittal of any DGI into an exchange structure (see Figure 7-3) which includes the following elements:

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- **Transmittal Header File**, which contains details of the contents of the transmittal (which may comprise one or several datasets encoded on one or several media volumes).

- **Header Data Subset**, which contains the supporting information specific to each transmitted geo data subset.

- **Geo Data Subset**, which contains the actual DGI data of each transmitted dataset.

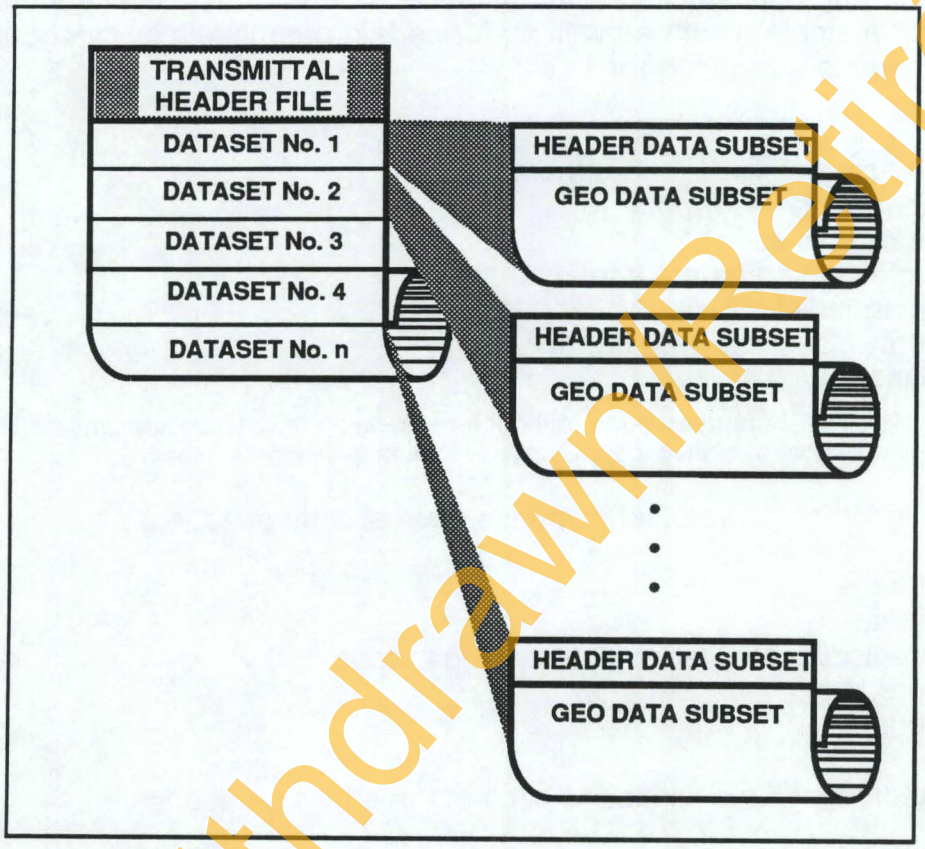


Figure 7-3 Structure of DGI Transmittal

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7.2.1 TRANSMITTAL HEADER FILE

The Transmittal Header File (THF) defines the contents of the transmittal. The THF consists of a Transmittal Description Record and a Security and Update Record as shown in Figure 7-4.

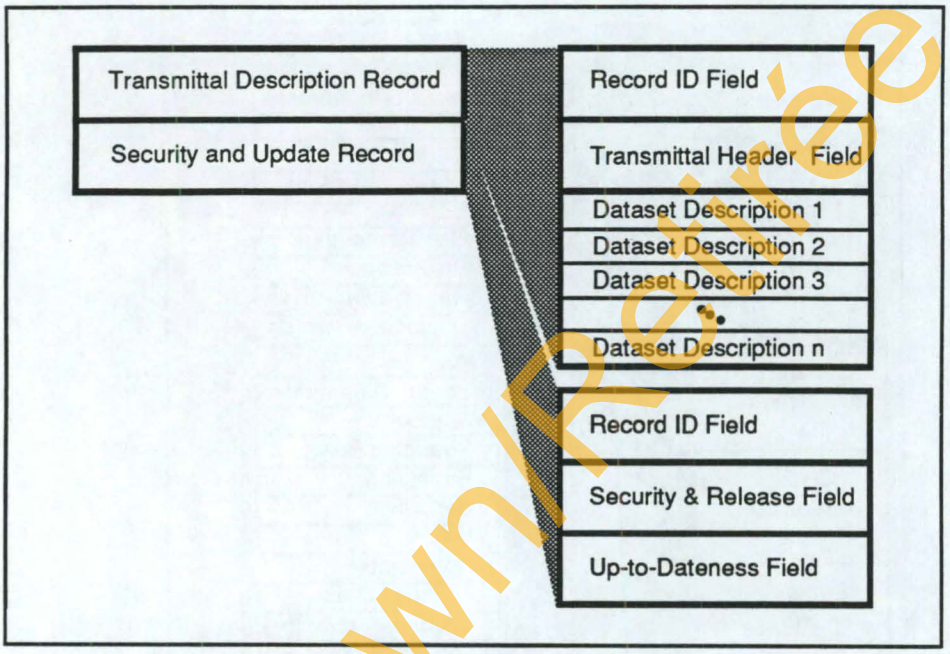


Figure 7-4 Transmittal Header File

The THF occurs once for each transmittal and a transmittal is composed of one or more datasets. Each dataset consists of two subsets of data: a Header Data Subset and a Geo Data Subset.

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7.2.2 HEADER DATA SUBSET

Figure 7-5 represents the Header Data Subset (HDS) as a logical entity grouping all supporting information required for exchanging one dataset of geo data.

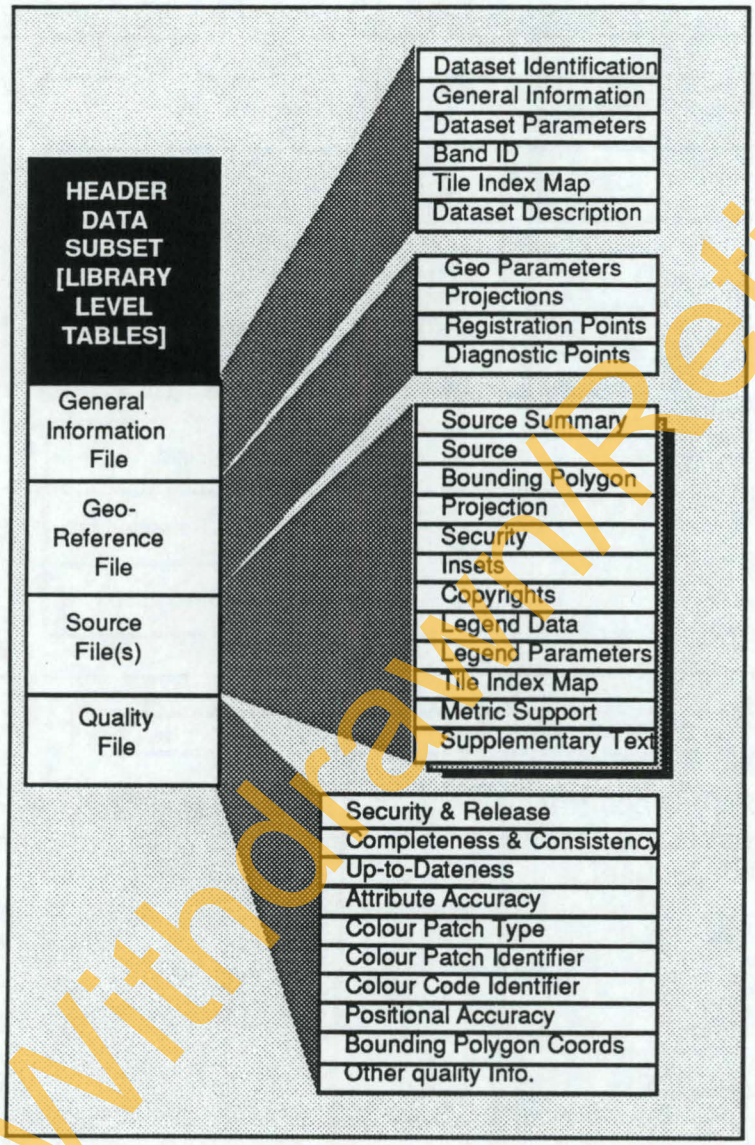


Figure 7-5 Header Data Subset

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7.2.3 GEO DATA SUBSET

The Geo Data Subset (GDS) contains the actual collection of digital information representing physical and cultural characteristics of the Earth's surface. Thus, the geographic information describing a map, chart etc. will be contained in the GDS. The collection of information shall be geographically contiguous except for raster insets which may not be contiguous to the primary source. These data however must be represented in the same data structure, and utilize the same geographic reference system and projection. The GDS can support several data structures; however, data structures may not be mixed within a dataset. Also, within a single dataset only one geographic reference system and projection is allowed. Figure 7-6 illustrates the contents of the GDS.

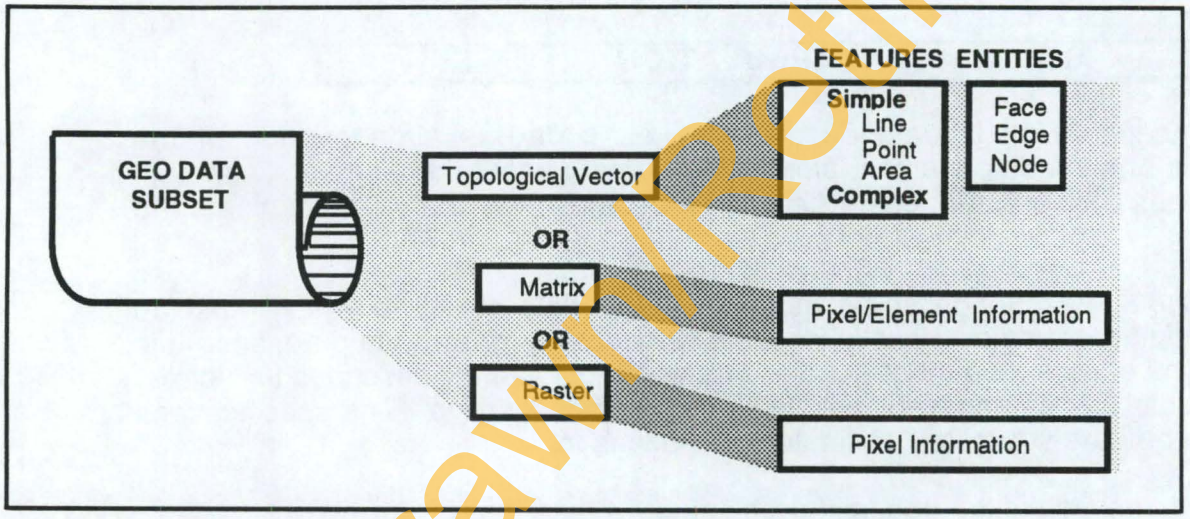


Figure 7-6 Geo Data Subset

Although the GDS is a single logical entity, it may be represented as a number of separate files for convenience in processing or transfer. For example, it may be beneficial to group all of the Edge, Node and Face Records into their own separate files.

The vector data may be implemented by either a feature-oriented data structure or a relational data structure. In both approaches the topological relationships are accomplished by means of pointers, or keys, to the relevant features or entities. In the case of the feature-oriented approach the link is defined by pointers to the record ID; for the relational approach it is by keys to the row ID of a table.

All record structures necessary to capture the topological, spatial, descriptive feature/attribute and data quality information are contained in the GDS. A GDS consists of one or more files.

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7.3 ENCAPSULATION SPECIFICATIONS

DIGEST provides a small number of ways to encode geographic data. This makes the task of decoding the data simpler for the recipient (as opposed to more generalized exchange structures which require the recipient to interpret the source structure). The three encapsulation specifications provided are:

- ISO 8211 — generally for bulk transfer and for archival purposes;
- ISO 8824 (ASN.1) — for telecommunication; and
- Vector Relational Format (VRF) — generally for database user applications.

7.3.1 ISO 8211 ENCAPSULATION

This encapsulation is data descriptive, i.e., it carries a description of the meaning of each data element along with the data about the element. Although this is less efficient, it is easier to handle on a diverse array of machines and systems.

An ISO 8211 exchange set is usually a large data structure which must be specified in great detail, usually for bulk transfer and for archival purposes. It is typified by a large amount of header data which completely describes the format and structure of its encapsulation. It is thus self-descriptive. The specifications include the data structures and data descriptions for:

- the files of the transmittal file set;
- the records and fields of each file; and
- the subfields of each field.

The first two items are specified as ordered, rooted fields with an explicit statement of the required or permitted subtrees. The third item is specified as the field descriptions of the component files. The details of this specification format are given in Annex A to Part 2.

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7.3.2 ISO 8824 (ASN.1) ENCAPSULATION

An ISO 8824 (ASN.1) encapsulation is in alignment with the OSI standards for telecommunication systems, and it is normally used for telecommunications and thus consists of a sequential stream of information. The structure of this stream of information is defined by the identifier together with the length of the data elements embedded in the stream. The basic information elements are equivalent to the fields used in the ISO 8211 formulation of the same data format. The details of this specification format are given in Annex B to Part 2.

7.3.3 VECTOR RELATIONAL FORMAT ENCAPSULATION

Vector Relational Format (VRF) is a direct use data format for representing large spatially referenced databases. VRF is a standard format, structure, and organization for large geographic databases that are based on a geo-relational data model and are intended for direct use. VRF allows application software to read data directly from computer-readable media without prior conversion to an intermediate form. VRF uses tables and indexes which are sufficient to implement the entire VRF data model. VRF permits direct access by spatial location and thematic content and is designed to be used for any DGI in vector format that can be represented using nodes, edges, and faces. VRF defines the format of the data objects, and the geo-relational data model provides a data organization within which software can manipulate the VRF data objects.

In VRF a field is an individual data element. VRF supports 17 different types of fields (fixed, variable, coordinate pairs, etc.). Text strings, for example, can be fixed or variable length and are not viewed as collections of smaller fields, but rather they are viewed as single atomic data elements, which permits VRF tables to be viewed as a form of relation.

Features are defined from tables of primitives; attributes are defined by relational modeling. A feature is represented by a set of one or more primitives, a single primary row of attribute data, and zero or more other rows of attribute data. A simple feature with only one primitive and one primary row might consist of a single face and a single row of attribute data. Features can be operated on as sets, which are grouped into feature classes. Feature classes may be identified by their feature tables, since every feature class has one and only one such table. There are three types of feature classes in VRF: simple, complex, and pseudo.

The VRF structural scheme (Figure 7-7) differs from that shown for mandatory topology (Figure 7-2) in that some reverse pointers are possible, and relationships between features and entities are accomplished by means of intermediate "join tables". They allow one-to-many, many-to-one, and many-to-many relationships.

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The details of this specification format are given in Annex C to Part 2.

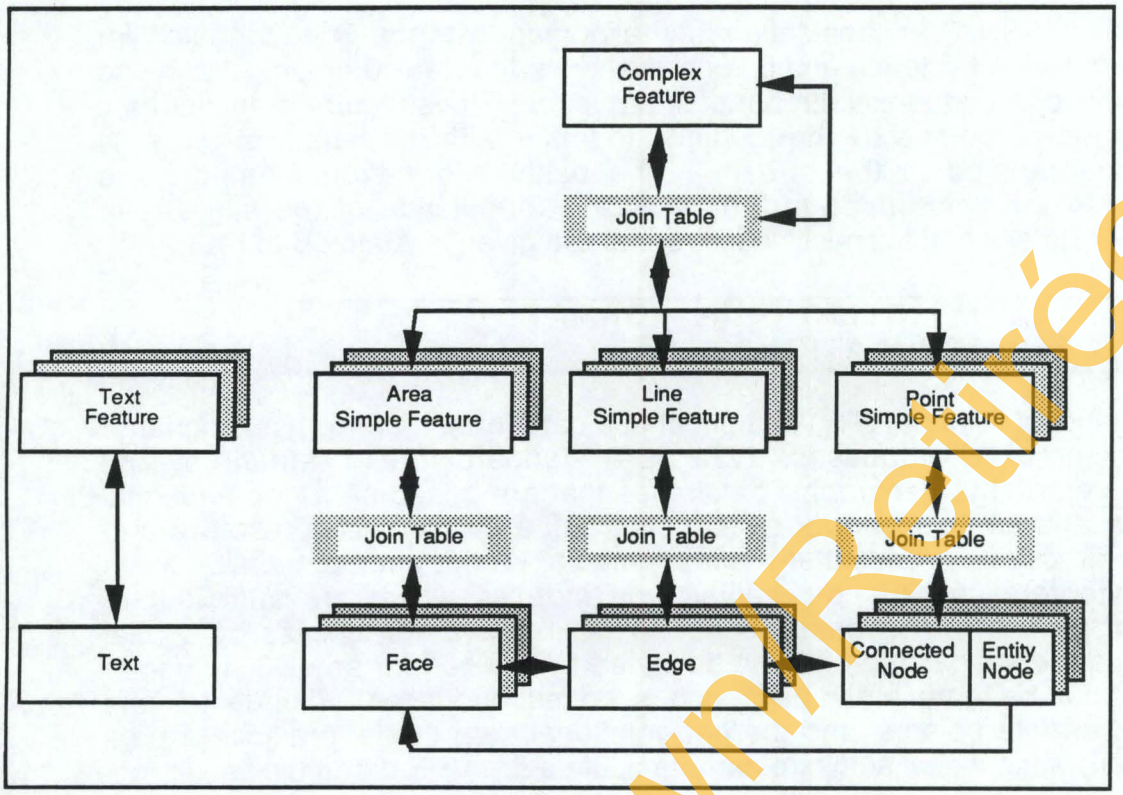


Figure 7-7 VRF Structural Scheme

7.4 MEDIA STANDARDS

DIGEST defines media and labeling standards for magnetic tape, CD-ROM, and many other exchange media. The data format is largely independent of the underlying exchange media over which it is carried. As well, file naming conventions and character representation are specified.

7.5 CODES, PARAMETERS AND TAGS

Various technical codes, parameters and tags which are to be used with DIGEST are provided in Part 3.

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The

DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD

(DIGEST)

Part 2

THEORETICAL MODEL, EXCHANGE STRUCTURE AND ENCAPSULATION SPECIFICATIONS

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DIGEST Part 2

THEORETICAL MODEL, EXCHANGE STRUCTURE AND ENCAPSULATION SPECIFICATIONS

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NOTICE TO USERS

1. This international exchange standard has been designed to enable the transfer of Digital Geographic Information (DGI) between geographic information systems. This documentation now forms a baseline from which both system developers and national survey organizations can plan their development and production activities.

2. Research into all aspects of DGI is continuing within the Digital Geographic Information Working Group (DGIWG) forum and any subsequent potential changes will be subject to formal change control procedures.

3. DGIWG has decided to hold DIGEST Parts 1, 2 and 3 stable until at least June 1996 in order to allow system developers the opportunity to develop compatible software. Any clarifications or corrections to the standard approved by the committee will be recorded in separate clarification and corrections documents which will be available from the committee through the national representatives. These documents will be incorporated into the next edition of DIGEST along with any upward compatible extensions approved at that time.

RECORD OF AMENDMENTS

NUMBER	DATE	ENTERED BY	REMARKS

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FOREWORD

Authority. The **DI**gital **G**eographic Information **E**xchange **ST**andard (DIGEST) was prepared by and issued under the authority of the Digital Geographic Information Working Group (DGIWG).

Security Classification. All parts of DIGEST are unclassified but may be subject to the limitation of use that the copying of the documents is prohibited without the authority of the national representative (see Part 1 — 5.2).

Changes from the Last Edition. DIGEST Edition 1.2 cancels and replaces DIGEST Edition 1.1 (October 1992). The major changes have been technical improvements to the theoretical data model, reworking of the encapsulations, and updating of the coding scheme. The significant changes are:

- The separate data structures used to describe Spaghetti, Chain-Node, and Topological data have been combined into a common data model which supports four different levels of implementation corresponding to Level 0 — Spaghetti, Level 1 — Chain-Node, Level 2 — Planar Graph, and Level 3 — Full Topology (including faces on a 2-D manifold). This harmonized a major aspect of the standard with other international standards such as the IHO data interchange standard and with several national standards.

- DIGEST has been revised in order to make the standard consistent across all of its various parts. Additional fields have been added to the various encapsulations so that the same information content can be carried in any of the encapsulations.

- The description of which data fields are optional and which fields are dependent on the existence of other fields has been clarified by introducing a mechanism of identifying the depth of nesting of conditional and repeating fields and sub-fields.

- DIGEST has been revised to align it with the most recent versions of the ISO character set and coding standards. Text, expressed in any recognized alphabet in the world, may be supported in attributes or in specific data sub-fields. Four levels of text are supported ranging from ASCII (ISO 646), through Latin Alphabet 1 for western European Languages (ISO 8859), a comprehensive Latin Alphabet (ISO 6937) and the Universal Character Set standard including all world alphabets (ISO 10646).

- Additional informative descriptive diagrams have been added to the document in the form of annexes in order to assist in the implementation of the standard. These informative annexes consist of data model diagrams and logic flow diagrams.

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- The lists of codes for projections, grids, ellipsoids and datums have been extended significantly.

- FACC has been greatly extended, incorporating many new features and attributes derived from other catalogues. This makes FACC a much more comprehensive catalogue.

Document Structure. DIGEST is published as four parts:

- Part 1: General Description
- Part 2: Theoretical Model, Exchange Structure, and Encapsulation Specifications
- Part 3: Codes, Parameters and Tags
- Part 4: Feature and Attribute Coding Catalogue

This part, the main body of DIGEST, is structured as follows.

- The first four clauses provide the scope, purpose and field of application; conformance; references; and terminology (the first three apply to DIGEST as a whole).

- The main body of the document is divided into three sections:

  — **theoretical model**, which covers data models, feature and attribute coding, data quality, and cartographic text.

  — **exchange structure**, which explains the Transmittal Header File, Header Data Subset, Geo Data Subset, and the various coding and usage rules.

  — **encapsulation/encoding and media standards**, which covers the various aspects of encapsulation/encoding, and details standards for magnetic tape and optical disk.

- Annexes A, B and C provide encapsulation specifications for ISO 8211, ISO 8824 (ASN.1) and Vector Relation Format respectively; and Annex D is the Volume Transmittal Form. All of these annexes are normative.

- Annexes E and F provide descriptive diagrams for the Vector Data Model and the Logic Flow of DIGEST respectively. Both annexes are purely informative.

- Annex E, the Bibliography for DIGEST as a whole, is also informative.

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Document Maintenance. The maintenance of DIGEST is covered in Part 1 — 5, including custodianship, national representatives, procedures for effecting changes to the standard, and distribution of the documents.

Acknowledgements. It is truly remarkable when a group of individuals from 11 different countries spanning two continents can work together on a project as extensive and complex as designing an exchange standard for digital geographic information. The editor would like to acknowledge the efforts and contributions of all DGIWG members—past and present—in the creation and evolution of this standard.

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1 SCOPE, PURPOSE AND FIELD OF APPLICATION

1.1 SCOPE

Digital geographic information (DGI) has evolved into an essential element in the planning and conduct of civil and military operations. The required data volume, demands and data complexity dictates that multi-national agreements for digital data standards be established to assure compatibility. In support of this aim these standards define those aspects necessary to the exchange of DGI. They are as follows:

- the data structures to be supported;
- format;
- feature and attribute coding scheme;
- exchange media; and
- administrative procedures.

The type of data to be exchanged using these standards includes the digital representation of the following:

- elevation and depth information;
- geographic feature geometry and feature attribute information;
- information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum, e.g. radar, infra-red; and
- other geographic information.

The data will all be available on a common worldwide reference datum of World Geodetic System 1984 (WGS 84).

1.2 PURPOSE

These standards will enable interoperability and compatibility among national and multi-national systems and users. They will also support the increasing use of joint development programs. In fact it is essential that geographic staffs involved in the development of national Geographic Information Systems are advised of the advantages of making their data structures and feature and attribute coding schemes compatible with these standards.

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1.3 FIELD OF APPLICATION

The application of the agreed standards being dealt with hereafter has several aspects, including organizational; geo-scientific; and regional and thematic.

1.3.1 ORGANIZATIONAL APPLICABILITY

This document applies to the topographic, hydrographic and aeronautical institutions of the participating nations. The standards have been built to support exchange of DGI between the central agencies operating in this geo-scientific field. This does not preclude the use by other institutions; on the contrary, all users are requested to widen the field of applications even to their contractors on the commercial side by making these standards part of relevant contracts. This will help to avoid redundant developments and cut costs by using common approaches.

1.3.2 GEO-SCIENTIFIC APPLICABILITY

These standards apply to geodetic, geographic, geological and geophysical data of interest. Since the present, and even more importantly the future area of interest for research, development, planning, and execution of operations is hard to define, the term has to be interpreted in a wide sense. Positioning, navigation, simulation, targeting, map and chart automated production, display and manipulation of data are some applications. All the data in this document are covered by the terms "geo data" and DGI. Geo data will be turned into applications-specific user-oriented "product data" out of the original "non-product oriented data".

1.3.3 REGIONAL AND THEMATIC APPLICABILITY

The contents of databases are mainly a national responsibility, but authorities may wish to state points of interest referring to the regional extension and the thematic subjects held in these databases. An integrated multi-national database is not foreseen. Should it come into existence, the standards of this document can easily be applied, since international agreements (ISO standards and NATO STANAGs) have been considered as far as published and known to DGIWG. For bi- or multi-national system developments this document should apply.

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2 CONFORMANCE

This standard is applicable to all member nations of DGIWG. Information processing systems which have the capability of exchanging DGI shall have the capability of reading and writing data in conformance with this standard. This standard shall be used for the exchange of DGI unless the interchanging parties have agreed on an alternative exchange format.

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3 REFERENCES

Following are the normative references which are used in the application of DIGEST. References which are informative or which merely assisted in the preparation of the standard are included in the bibliography (Annex G to Part 2).

International/Multinational

1. ISO 646 — *Information Processing — ISO 7-bit coded character set for information interchange*, Ed. 2, 1983.

2 ISO 1000 — *SI units and recommendations for the use of their multiples and of certain other units,* Third Edition 1992-11-01

3. ISO 1001 — *Information Processing — File Structure and Labelling of Magnetic Tapes for Information Interchange*, Ed. 2, 1986. Common with references 16 and 24.

4. ISO 2022 — *Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques*, Ed. 3, 1986.

5. ISO 2375 — *Data Processing — Procedure for registration of escape sequences*, Ed. 3, 1985.

6. ISO 3788 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information Interchange recorded at 63 cpmm (1600 cpi), Phase Encoded.* Ed. 1, 1976. Common with references 17 and 22.

7. ISO 5652 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information interchange formats and recording, using group coding 246 cpmm (6,250 cpi).* Common with references 19 and 23.

8. ISO 6937 — *Information Processing — Coded character sets for text communication*, Ed. 1, 1983.

9. ISO 8211 — *Information Processing — Specification for a data descriptive file for information interchange*, 1985.

10. ISO 8601 — *Data Elements and Interchange Format; Information Interchange Representation of Dates and Time*, 1988. (Replaces ISO 4031)

11. ISO 8824 — *Information processing systems — Open Systems Interconnection — Specifications of Abstract Syntax Notation One (ASN.1)*, 1987. (CCITT X.208)

12. ISO 8825 — *Information processing systems — Open Systems Interconnection — Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*, Ed. 1, 1987.

13. ISO 9660 — *Information Processing — Volume and File Structure of CD-ROM for Information Interchange*, Ed. 1, 1988.

14. ISO 8859 -1— *Information processing — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1,* First Edition 1987-02-15

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15. ISO/IEC/10646 -1 — *Information technology - Universal Multiple-Octet Coded Character Set (UCS), Part 1: Architecture and Basic Multilingual Plane,* First edition 1993-05-01

16. CCITT Recommendation, 1992, Geneva:
T50 — *International Reference Alphabet* (IA5),
T51 — *Latin Alphabet Coded Character Sets for Telematic Services,*
T52 — *Non Latin Alphabet Coded Character Sets for Telematic Services.*

17. DLMS Accuracy Working Group. (*Accuracy Determination Method.*)

18. European Computer Manufacturer's Associates (ECMA), *Standard for Data Interchange on Read Only 120 mm Optical Data Disks (CD-ROM).* ECMA/TTC31/87/47, September 1987. (DRAFT).

National

19. ANSI X3.27—1978, *Magnetic Tape Labels and File Structure for Information Interchange (ASCII),* 1978. Common with references 2 and 24.

20. ANSI X3.39—1973, *Recorded Magnetic Tape for Information Interchange (1,600 cpi, PE),* 1973. Common with references 5 and 22.

21. ANSI X3.4—1977, *Code for Information Interchange,* 1977.

22. ANSI X3.54—1976, *Recorded Magnetic Tape for Information Interchange (6,250 CPI, Group-Coded Recording),* 1976. Common with references 7 and 23.

23. ANSI/IEEE - 754—1986, *IEEE Standard for Binary Floating Point Arithmetic.*

24. FIPS PUB 1-1 — *Code for Information Interchange,* 24 Dec 1980.

25. FIPS PUB 10-3 — *Countries, Dependencies, Areas of Special Sovereignty, and their Principal Administrative Divisions,* 9 Feb 1984.

26. FIPS PUB 25 — *Recorded Magnetic Tape for Information Interchange (1,600 CPI, Phase Encoded),* 30 Jun 1973. Common with references 5 and 17.

27. FIPS PUB 50 — *Recorded Magnetic Tape for Information Interchange, 6,250 cpi (246 cpmm), Group-Coded Recording,* 1 Feb 1978. Common with references 7 and 19.

28. FIPS PUB 79 — *Magnetic Tape Labels and File Structure for Information Interchange,* 17 Oct 1980. Common with references 2 and 16.

29. DoD (US Department of Defense) *Standard Printing Color Catalog.*

30. DoD (US Department of Defense) *Operators Manual for the MC&G Standard Printing Color Identification System.*

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4 TERMINOLOGY

4.1 TERMS AND DEFINITIONS

The following are definitions of various terms as used in DIGEST. For an explanation of what various acronyms and abbreviations merely stand for, see 4.2 below.

Accuracy — the degree of conformity with a standard, or the degree of perfection attained in a measurement. Accuracy relates to the quality of a result and is distinguished from precision which relates to the quality of the operation by which the result is obtained. See also *precision.*

ARC Standard Raster Graphics (ASRG) — raster graphic data transformed to the Equal **A**rc-second **R**aster **C**hart/Map (ARC) Projection System.

Attribute:

— **Explicit Attribute**: that which is normally a characteristic of a Feature. It is described by an Attribute identifier, name, definition, and applicable values (see Part 4, FACC Attributes). Explicit Attributes are either qualitative or quantitative.

— **Implicit Attribute**: that which is a characteristic of a Feature and/or of a topological entity. An implicit attribute is a constant component of a given record type. Consequently, a specific field may be dedicated for the encoding of this attribute. An implicit attribute is not defined by either identifier or name; these are "implicit".

Attribute Identifier — a three alphanumeric character designator of an attribute.

Attribute Index — a pointer to row data based on the value of non-coordinate columns

Attribute Table — a collection of attribute rows with the same field definitions

Attribute Value — a specific quality or quantity assigned to an attribute.

Automated Cartography — an approach to producing map/chart products using computer-assisted techniques.

Cartographic Primitive — a type of primitive that does not participate in topology. Text is the only cartographic primitive.

Chain-node — data structure characterized by data in which one or more chains are related to one or more features. (See also *Level 1 Topology.*)

Colour Bar — the bar normally printed on the side of each map copy, prior to trimming, that may be used to determine the individual colours used on the map. (For displaying colour used in printing.)

Colour Coding — a nominal code assigned to a defined range of red, green, and blue intensities.

Colour Patch — a standard colour reference of defined intensity and hue that is attached to each multi-colour graphic to be scanned. (Used for calibration.)

Column — the set of all instances of a particular field within a table; equivalent to an attribute type; not to be confused with Raster or Matrix data.

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Completeness — the relationship between the features represented and those defined by a capture specification. Spatial completeness requires that the coverage of the plane be exhaustive. Attribute completeness requires that all attribute values use known meanings.

Complex Feature — See *Feature*.

Complex Feature Class — A single feature that relates directly to other features rather than to a primitive. The other features may be simple or complex and may have primitives of any type.

Compound Feature-a simple feature that is composed of more than one primitive of the same type and may exist in more than one tile (see **Simple Feature).**

Component Coverage — a term used to distinguish the parts of a tiled coverage from an untiled coverage. Component coverages are complete except that they contain no feature attribute tables and no schema table.

Connected Node — a node at the end of an edge. A connected node is topologically linked to edges (VRF). See *Node*.

Containing Face — the face in which an entity (isolated) node lies.

Coverage — a set of feature classes whose primitives interconnect as described by the coverage's topology (i.e. within which the topology is complete). A coverage is analogous to a single map sheet or separation in conventional cartography.

Coverage Attribute — the property of a coverage

Cross Tile Topology — the particular encoding of topological relationships such that those relations are maintained within a dataset that has been subdivided into multiple tiles.

Data —a representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or by automated means *(ISO)*. Geographic data can be in either neutral or product form. See also *information*.

Data Bank — a collection of data relating to a specific subject, such as digital data pertaining to bridges, roads, or vegetation.

Database

1. A collection of interrelated data stored to serve one or more applications. The data are stored so that they are independent of programs which use the data. A common and controlled approach is used in adding new data and in modifying and retrieving existing data within a data base.
2. A collection of related libraries (VRF).

Database Attribute — a property of a database, generally contained in the Database Header Table.

Database Management System (DBMS) — an organized collection of software required to use a database. There are three common ways of organizing the data within a specific DBMS:

(1) **Hierarchical or Tree** — all data element groups except the root are related to one and only one group on a higher level.

(2) **Network or Plex** — a relationship between records in which a child record can have a more than one parent record.

(3) **Relational** — a capability to recombine the data elements in a database to form new relations.

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Data Dictionary — a table or set of records whose values define the allowable content and meaning of attributes.

Data Format — a specification that defines the order in which data is stored, or a description of the way data is held in a file or record.

Dataset — A DIGEST dataset is a collection of data arranged in a DIGEST compliant format. It is normally used for the bulk exchange of data between producers.

— A standardized DIGEST dataset is a collection of data which has a specification which pre-defines the content and the DIGEST encapsulation.

Data Structure — in the context of geographic databases, the formal organization of data elements, their attributes and spatial position. For definitions of different types of data structures see *Spaghetti*, *Chain-node*, and *Topological*.

Data Structure — the physical structure used to represent the data model.

Data Syntax — description of the bit-level representation of data.

Density — the amount of detail within a given area. Density normally varies with scale and the nature of the area being compiled.

Diagnostic Point — a point within a dataset with known and accurate geographic location which is used to verify the adequacy or inadequacy of transformation result to the dataset (the diagnostic point is not part of the transformation solution).

Digital Geographic Information (DGI) — includes the digital representation of the following :

(1) Elevation and sounding information.
(2) Geographic feature geometry and feature attribute information.
(3) Information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum; e.g., radar, infrared, etc.
(4) Military Geographic Information together with other ancillary information.
(5) Other digital information.

Digital Geographic Information System (DGIS) — consists of agreed standards and specifications (structure, format and content) for digital geographic data (both neutral and product) and the process and procedures by which such data may be exchanged between member nations.

Digitized Vector Graphics — digital representation of a map or chart which is captured by manual digitization, digitization by automated line following systems, or vectorizing of graphics, stored on digital media. This data may be accompanied by descriptive information (attributes of the individual map/chart features).

Direct Access — retrieval of data by reference to its location on a storage medium rather than relative to the previously retrieved data. The access mechanism goes directly to the data in question, as is normally required for the on-line use of data.

Directory — a list and address of files or other directories.

Domain — the set of all permissible values for an attribute.

Edge — a curve joining two (possibly the same) nodes, representing all or part of the extent of a Feature and/or the boundary of a Feature. Alternatively, it is a line used to represent the location of a line feature and the borders of faces. Edges may be topologically linked to Nodes, Edges and Faces.

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Electronic Map — consists of the information of a map or chart, which is captured, stored, and displayed by electronic means.

Encapsulation — the identification of fields and the grouping of fields, and data syntax rules used.

End Node — the second node of an edge (an edge is traversed from the start node to the end node)

Entity Node — See *Isolated Node.*

Entity Set — an attribute table.

Face — a maximal, connected area in the complement of the edge-node graph, representing all or part of the extent of a Feature or of the unattributed area. A Face is an undivided area defined by its bounding edges and nodes.

Feature - A Feature is a geographic entity which occurs relative to the Earth's surface. It may be either a Simple Feature, a Compound Feature, or a Complex Feature. A Simple or Compound Feature has a specific set of Attribute values. A Complex Feature consists of a number of Features (Simple, Compound and/or Complex).

Feature Attribute — See *Attribute.*

Feature Class — a set of features sharing a consistent set of attribute types. A feature class is implemented by using a set of tables that includes at least one primitive table and at least one attribute table. A feature class has the same columns (attribute types) of attribute information for each feature and only one feature table . Classes of features are created in order to allow the relational model to operate on them as sets. Every feature class has one and only one feature table (VRF). The two basic type of feature classes are simple and complex (Compound features are simple features that exist across tiles). The subtypes of simple features are point feature class, line feature class, area feature class, and text feature class.

Feature Class Attribute Table-a table that contains properties for all feature classes in a coverage. The Feature Class Attribute Table is required to support the Feature Index Tables.

Feature Class Schema Table — a table that stores the rules for the construction of feature classes. This table describes how each table in a feature class relates to each other table in the feature class (VRF).

Feature Code — a feature code is a unique identifier assigned to a feature. The code is composed of five characters. The first is a letter indicating the category, the second is a letter indicating the sub-category and the last three characters (numeric) indicate a serial number in the sub-category.

Feature Index Table-a table constructed specifically to provide for rapid retrieval of feature information when given a selected primitive. It provides a join index from primitive to feature.

Feature Join Table — a table that identifies which primitives belong to which features. Simple features may be composed of more than one primitive, and complex features may be composed of more than one simple feature. A primitive may be a component of more than one simple feature (VRF).

Feature Table — a table made up of the primary-keyed rows of the features in a feature class. These rows collectively form the feature table for that feature class (VRF).

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Feature-Oriented — a term used to describe the approach for encoding geographic entities in which a series of interrelated geographic/cartographic objects are organized into a network-like structure of data and predefined relationships.

Field — an individual data element. In an attribute table, a field is a single attribute value of a single entity.

File — a collection of information consisting of records pertaining to a single subject (e.g., a geographic information file) (*ANSI*).

File Set — a collection of one or more related files (e.g., geographic information files or geographic header (sub) files) recorded consecutively on a volume or volume set (*ANSI*).

First Edge — arbitrarily chosen first edge of a connected node.

Fixed (Length) Field — a field having a predefined number of bytes. Fixed fields are generally used for numeric data, or when blank entries are significant.

Foreign Key — a column in one table that can be used as a primary key in another table (VRF).

Georelational Model — a generic conceptual model in which geographic information is represented using vector geometry and relational modeling (VRF).

Geographic Data Model — a formalized method for representing geographically referenced information.

Geographic (Geo) Data Subset — one of two logical components of a dataset. This logical component consists of the actual, digital geographic information being transferred. These data are characterized by common properties such as geodetic datum and projection.

Geographic Entity — a real-world feature that is of interest; something about which data is stored.

Geographic Information System (GIS) — an organized collection of computer hardware/software and geographic data, designed to efficiently capture, store, update, manipulate, analyze, and display geographically referenced information.

Geographic Non-Linearity — the error introduced by digitization and subsequent processing to the total error of both absolute and relative positioning of any feature on the graphic.

Geographic Primitive — See *Geometric Primitive*.

Geographic Reference Table — a table which contains the information from the GEO_REFERENCE_FILE (VRF).

Geographic Reference Point (GRP) — a point (X, Y, Z) within the Feature that allows an easy geographic locating method.

Geometric Primitive — one of the three basic geometric units of representation: node, edge, and face; equivalent to *geographic primitive* and *topological entity*.

Geometric Non-Linearity — any distortion introduced by digitizing and subsequent processing of a mathematically correct reference system or grid, other than simple rotation, translation or scale change.

Graphic Product — may be a paper copy of a map or chart, or the reproduction material (repromat) used to produce the map or chart. Repromat

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may be in layers (bands) , each representing a single colour on the map, or all colours on the map may be reproduced using 3 to 4 layers (process printing repromat).

Header Data Subset - One of two logical components of a dataset. This logical component consists of descriptive information about the digital geographic information contained in the second logical component; the geo data subset.

Hierarchical DBMS — See *Database Management System.*

Image — a raster representation of a graphic product or remotely sensed surface that consists of one or more image bands.

Image Band — a scan of an image recording intensities of a single colour, or sensor consisting of one or more sub-blocks.

Index -a mechanism used to quickly identify a particular record or group of records based on a table's primary key.

Index File-an index stored in a file. There are variable-length indexes, spatial indexes, and thematic indexes.

Information — Sometimes the following distinction is made between "information" and "data": Information results from the processing of data; i.e., information is derived from the assembly, analysis, or summarizing of data into a meaningful form *(CHANDOR).* See also *data.*

Integrated Data — a geographic dataset where multiple coverages have been spatially joined.

Isolated Node — a zero-dimensional primitive used only to represent a feature. An isolated node is never used as a start or end node. An isolated node is topologically linked to its containing face when faces are present and cannot occur on an edge. This is also known as an "Entity Node".

Key — a column that can identify or select a row (VRF).

Layer —A layer consists of a consistent set of data of the same type (e.g. Raster, Vector, Matrix, Imagery, Text). For Vector data, a layer is a pre-defined collection of geographical features, grouped by theme, contained within a single specified level of topology (following the rules of that level of topology, e.g. if it is planar graph there are no crossing lines). Layers will be composed of one or more area, line, or point features as defined by a specification. A layer can also be referred to as a coverage.

Layered Data — thematically separated data (VRF). See *coverage.*

Left Edge- the first neighbor of the current edge as one moves counterclockwise around the start node of the current edge (VRF).

Left Face — the face to the left of an edge in a traverse from start node to end node.

Level 0 Topology — a surface which contains a set of entity points and edges. Edges contain only coordinate and attribute information; no topological information is present for the entity nodes or edges (VRF). See also *spaghetti .*

Level 1 Topology — a non-planar surface which consists of a set of entity points and edges that may not meet at nodes. Edges contain start node, end node, right forward edge, and left forward edge information (VRF). See also *Chain-node.*

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Level 2 Topology — a planar surface which consists of a set of edges and entity points, where the edges meet only at connected nodes. Edges contain start node, end node, right forward edge, and left forward edge information (VRF).

Level 3 Topology — a planar surface which is partitioned by a set of mutually exclusive and collectively exhaustive faces. Edges contain left face and right face, start and end node, and right forward and left forward edge information. Edges meet only at connected nodes (VRF).

Library — a collection of coverages contained within a specified spatial extent, all of which share a single coordinate system and scale and have a common thematic definition (VRF).

Library Attribute — properties of a library. These properties are contained in the Library Header Table, the Library Attribute table, and in other tables related to them (VRF).

Logical Consistency — the correctness of the relationships encoded in the data structure of the dataset.

Logical Model (Level) — a description of the overall database structure as perceived by the users (VRF).

Management Information System (MIS) — a system which may perform routine processing functions but which is designed so that such processing will also produce information for presentation to management to assist in decision making.

Matrix Data — data in an array with associated information about regularly spaced points.

Minimum Bounds (MB) — two triplets (X, Y, Z) of coordinates that define the minimum and maximum extent of the spatial coordinates defining a Feature.

Minimum Bounding Rectangle (MBR) — the two-dimensional representation of the minimum bounds.

Multi-National Database — a standardized database operated and maintained under the control of two or more participating member nations.

Names Placement Coverage-a coverage that contains (at a minimum) a point feature table with columns indicating a place name and its known coordinate. It is used to help a user locate places by name.

National Database — a database designed, operated, and maintained by one nation for purposes specific to that nation.

Network DBMS — See *Database Management System.*

Neutral Data — data which is not intended to support a specific application unless combined with other information.

Neutral Format — a characteristic of a data model that does not contain product specification-dependent information.

Next Right Edge — the first edge connected to the End Node, counterclockwise around the End Node from the current edge.

Node — a zero-dimensional primitive. See *Isolated Node*, *Entity Node*, *Connected Node*, *Start Node*, and *End Node.*

Non-key — a description of a column that is neither a primary key nor a foreign key (VRF).

Withdrawn/Retired

Operational System — a system that has been developed, verified, and put into operation. In a military context, an "operational system" is one that is in development for, or is in use by, military operational staff (i.e., as distinct from training or administrative systems).

Pathname — a name that uniquely identifies the location of a file within a series of one or more directories.

Physical Implementation — the specifications for physically encoding the data at the file/record/field level.

Pixel — (originated from "picture element") a single element of a raster image usually characterized by row, column and spectral value.

Pixel Run — a set of consecutive pixels with the same value.

Plex DBMS — See *Database Management System.*

Pointer — the address of a record or other data groupings contained in another record.

Polygon — thematically common areas composed of contiguous faces (VRF).

Precision — a quality associated with the refinement of instruments and measurements, indicated by the degree of uniformity or identicalness of repeated measurements. See also *accuracy.*

Previous Left Edge — the first edge, connected to the Start Node, counterclockwise around the Start node, from the current edge.

Primary Key — a key that uniquely identifies a row (VRF).

Primary Row — a single row of attribute data associated with a simple feature (VRF).

Product — A DIGEST product is a standardized DIGEST dataset with a defined media and packaging, stated in a product specification. A product is usually delivered to an end user.

Product Data — data which is either collected in a specific product form or data which is derived from neutral data for a specific application.

Pseudo-Feature Class — consists of a text primitive table and an optional text attribute table (VRF).

Raster Data — data arranged in a regular array with information pertaining to each element (pixel) or group of elements.

Radiometric Linearity — gray levels in linear proportion to the light intensities (in each colour band).

Radiometric Non-linearity — the analogue-to-digital conversion system which provides signal-to-noise (S/N) ratios of the sensors, where the S/N is calculated by the difference of the sensor's average response to a white reference and the sensor's average dark signal value divided by the Root Mean Square dark noise value. Intermediate intensities will be linear representations from average white reference to the average dark reference. Intermediate intensities will be represented using a linear tonal transfer curve for each colour channel. Error introduced during the digitization process which causes the gray scale values for a colour component (RGB) to NOT be in linear proportion to the source intensities for that component.

Registration Point Mensuration Accuracy — Registration point identification will be accurate to ± 1/2 pixel interval. The absolute and relative accuracies of the registration points falling on Latitude/Longitude line intersections is the same as the accuracies given for the source graphic.

Withdrawn/Retirée

Relation — a logical link between two elements (topological entities and/or features), such as "is on the left of"; "is on the right of"; "is composed of "; "is contained in"; etc.

Relational Join — a logical operation that combines two tables which both contain a column or a set of columns possessing domains common to both tables. Rows from each table are combined with all rows in the other table that possess identical values in their join columns.

Relational DBMS — See *Database Management System.*

Resolution — the measure of the ability to distinguish detail or separation of objects under certain specific conditions. Alternatively, it is the minimum distance between two adjacent objects, or the minimum size of an object which can be distinguished under certain specific conditions.

RGB — the scanned response for any colour represented by red, green, and blue intensities.

Right Edge- the first neighbor of the current edge as one moves counterclockwise around the end node of the current edge.

Right Face — the face to the right of an edge in a traverse from start node to end node.

Ring- a connected set of edges that composes the face border. Any single ring is only referenced to and by a single face. If the same set of edges is shared by two different faces (e.g. a doughnut), two rings, that correspond to the two faces, are composed of the same edge set.

Row — an ordered collection of fields pertaining to the entity (VRF). Not to be confused with Raster or Matrix data.

Row ID — an integer that uniquely identifies each row in a table (VRF).

Row ID Index — a pointer to the beginning of the row data in a file containing a table's content (VRF).

Schema — a map of the overall logical structure of the database (VRF).

Seamless Database - Logically continuous topological and feature relationships across physical partitions (Tiles) of the data. This is also referred to as "Sheetless database" (VRF).

Simple Feature Class — consists of a single type of primitive (face, edge, node, or text) and a single simple feature table. There are four types of simple feature classes; point, line, area, and text (VRF).

Spaghetti — a digital storage format in which all lines and points are unrelated to each other.

Spatial Index — a data structure that allows for the rapid identification of features using their spatial location (VRF).

Spatial Segment — a non-topological edge (a curve joining two, possibly the same, coordinate points).

Standardized Raster Graphics (SRG) — a digital representation of a map or chart which is captured by automatic digitization (scanning), stored on digital storage media, and displayed on raster screens or raster plotters; obtained by a regular scan of a paper map or chart or repromat. It consists of a raster dataset of RGB intensities or colour codes.

Start Node — the first node of an edge.(an edge is traversed from start node to end node).

Subblock -See *Tile.*

Withdrawn/Retired

Table — a matrix of rows and columns; a collection of rows with the same field definitions (VRF).

Text — character strings placed in specific locations in geographic space. Text is a cartographic object, not a geographic object. It does not participate in topology.

Thematic Primitive — an attribute row (VRF). See *Attribute Table*.

Tile —

1. A regular rectangular subdivision of the dataset/coverage ("sub-block" and "tile" have the same meaning).
2. A partitioning of the Earth's surface into a regular, usually rectangular, area for administrative purposes.

Note: Definition 2 is not the definition used within this document.

Tiled Coverage — a coverage that has been physically partitioned into smaller coverages. One or more of these smaller coverages share the same set of feature classes with the same definitions. Each tile defines an independent topology (VRF).

Tiling Scheme — the scheme used to define the tile shape and size, and unique tile identification number.

Topographic Data — data about the features of the surface of the Earth. It will include its relief features, water and drainage features and man-made features.

Topological Entities — a collection of objects (i.e., nodes, edges and faces) used to define the spatial relationships among the features of the earth's surface. See Geometric Primitives.

Topology — a branch of mathematics that investigates the properties of a geometric configuration that are unaltered if the configuration is subjected to any one-to-one transformation continuous in both directions.

Transfer Standard — a set of procedures used to export data information from one system to another system .

Transmittal — a term used to reference the entire contents of a data transfer, including all geo data subsets, header data subsets, and the Transmittal Header File.

Transmittal Header File — the Transmittal header file occurs once per transmittal, and contains a general description of the contents of the transmittal.

Tree DBMS — See *Database Management System*.

Variable Length Field — a field whose length is determined by the amount of storage needed to store its contents. Useful for character strings and coordinate strings, both of which are highly variable in length.

Vector Data — spatial information whose data model is based on graph theory.

Vector Relational Format (VRF) — a geo-relational implementation of vector data in this standard.

Volume — an exchangeable physical unit of storage media (e.g., a reel of magnetic tape). A volume may contain part of a file (e.g. a geographic header (sub) file, a complete file (e.g., geographic information file) or more than one file (ANSI)).

Withdrawn/Retired

Volume Set — a collection of one or more volumes on which one and only one file set is recorded (ANSI).

2-Dimensional Manifold — a planar graph and its complementary areas. Each edge bounds two, and only two, not necessarily distinct, faces. The faces are mutually exclusive and collectively exhaustive (VRF).

4.2 ACRONYMS AND ABBREVIATIONS

Although most acronyms and abbreviations are defined the first time they are used, the following list is provided as a quick reference for all the acronyms and abbreviations appearing in this part of DIGEST.

AAH	Source Graphic's Horizontal Accuracy Value
AAV	Source Graphic's Vertical Accuracy Value
ANSI	American National Standards Institute
ARC	Equal Arc-second Raster Chart/Map
ASCII	American Standard Code for Information Interchange
ASN	Abstract Syntax Notation
ASRP	ARC Standard Raster Products
ASRG	ARC Standard Raster Graphics
BP	Byte Position
CCITT	Comité Consultatif International Télégraphique et Téléphonique
CD-ROM	Compact Disk — Read Only Memory
CIE	Commission Internationale de l'Eclairage (International Commission on Illumination)
col	column
cpi	characters per inch
cpmm	characters per millimetre
DBMS	Database Management System
DCC	Document Change Control
dept	department
DG	Director General
DGI	Digital Geographic Information
DGIS	Digital Geographic Information System
DGIWG	Digital Geographic Information Working Group
DIGEST	Digital Geographic Information Exchange Standard
DLMS	Digital Landmass System
DTED	Digital Terrain Elevation Data
ECMA	European Computer Manufacturer's Associates
E/W	East/West
FACC	Feature and Attribute Coding Catalogue
FIPS PUB	(US) Federal Information Processing Standards Publication
GCR	Group Coded Recording
GDS	Geo Dataset
geo	geographic
GIS	Geographic Information System
GRP	Geographic Reference Point

Withdrawn/Retired

HAV	Raster **H**orizontal **A**ccuracy **V**alue
HDS	**H**eader **D**ataset
HQ	**H**ead**q**uarters
ID	**I**dentification
IEEE	**I**nstitute of **E**lectrical and **E**lectronic **E**ngineers
IGMI	**I**stituto **G**eografico **M**ilitare **I**talia
IGN	**I**nstitut **G**éographique **N**ational
ISO	International Organization for Standardization ("iso" = Greek for "same")
LORAN	**Lo**ng **Ra**nge **N**avigation
MIS	**M**anagement **I**nformation **S**ystem
MB	**M**inimum **B**ounds
MBR	**M**inimum **B**ounding **R**ectangle
MRE	**M**ultiple **R**egression **E**quation
MSD	**M**etric **S**upport **D**ata
NATO	**N**orth **A**tlantic **T**reaty **O**rganization
NE	**N**orth-**e**ast
N/S	**N**orth/**S**outh
NW	**N**orth-**w**est
PCB	Size of **P**ixel/Element **C**ount element in **B**its
PE	**P**hase **E**ncoded
PVB	Size of **P**ixel/Element **V**alue element in **B**its
RG	**R**aster **G**raphic
RGB	**r**ed, **g**reen, **b**lue
RID	**R**ecord **ID**
RTY	**R**ecord **T**ype
SE	**S**outh-**e**ast
SF	**S**imple **F**eature
SRG	**S**tandard **R**aster **G**raphics
S/N	**S**ignal to **N**oise ratio
STANAG	Standardization **Ag**reement
SW	**S**outh-**w**est
TA	**T**otal **A**rea
TAD	**T**errain **A**nalysis **D**ataset
TBR	**T**o **B**e **R**esolved
THF	**T**ransmittal **H**eader **F**ile
UPS	**U**niversal **P**olar **S**tereographic
US	**U**nited **S**tates
USRP	**U**TM/UPS **S**tandard **R**aster **P**roducts
UTM	**U**niversal **T**ransverse **M**ercator
UVL	**U**ser **V**olume **L**abel
VA	**V**oid **A**rea
VA	**V**irgini**a**
VDT	**V**alue **D**escription **T**able
VRF	**V**ector **R**elational **F**ormat
WGS 84	**W**orld **G**eodetic **S**ystem 19**84**

Withdrawn/Retirée

4.3 CODES AND LABELS

Although most are defined the first time they appear, the following list is provided as a quick reference for all the codes, labels, etc. found in this part of DIGEST (excluding the annexes).

A	**A**lphanumeric (attribute value format)
A	**M**atrix datasets (use code)
AAH	Horizontal Accuracy (quality and control attribution code)
AAV	Vertical Accuracy (quality and control attribution code)
ALT	**Alt**ernative Representation (explicit relation code)
BFC	**B**uilding **F**unction **C**ategory (attribute code)
C	**C**oincident (spaghetti/chain-node code)
C	**C**ommon to all datasets (use code)
C	**C**onfidential (security classification code)
CCC	**C**olour **C**ode **C**ategory (attribute code)
CLI	**Cli**pping Indicator (quality and control attribution code)
COD	Column Sequence (Scan direction parameter)
CMO	**C**omposed **O**f (explicit relation code)
CPO	**C**omponent **O**f (explicit relation code)
D	**D**epending (requirement code)
D	**D**isjoint Forward (spaghetti/chain-node code)
DA	ATTRIBUTE/VALUE_ASSOCIATION_RECORD (Record Type)
DAT	**Dat**e (date code)
DD	Day (Up-to-dateness descriptor)
DD	FEATURE/ATTRIBUTE_ENTRY_RECORD (Record Type)
DF	FEATURE/ATTRIBUTE_ASSOCIATION_RECORD (Record Type)
DIG	Table (**dig**itized) data (geo parameter)
E	Disjoint Reverse (spaghetti/chain-node code)
ED	EDGE_RECORD (Record Type)
EXC	Number of Coordinate Sets (counter)
EXE	Number of Edges, Faces, or Nodes (counter)
EXR	Number of Explicit Relations (counter)
EXT	Number of Explicit Attributes (counter)
F	**F**orward (spaghetti/chain-node code)
FA	AREA_FEATURE_RECORD (Record Type)
FC	COMPLEX_FEATURE_RECORD (Record Type)
FE	FACE_RECORD (Record Type)
FL	LINE_FEATURE_RECORD (Record Type)
FP	POINT_FEATURE_RECORD (Record Type)
GEN	**Gen**eral Information File (file name extension)
GER	**G**eographic **R**eference File (file name extension)
GMA	**G**rid North - **M**agnetic North **A**ngle (source code)
HH	Hour (Up-to-dateness descriptor)
I	**I**nside Forward (spaghetti/chain-node code)
I	**I**nteger (attribute value format)
IMG	Main Raster **Img**e (file name extension)
J	Inside Reverse (spaghetti/chain-node code)

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L	**L**eft (Chain-node orientation parameter)
M	**M**andatory (requirement code)
MAP	**Map** data (geo parameter)
MM	Month (Up-to-dateness descriptor)
N	**N**o (flag)
NFC	Number of Subblocks West/East or Left/Right (counter)
NFL	Number of Subblocks North/South or Top/Bottom (counter)
NLF	Number of Features (counter)
NO	NODE_RECORD (Record Type)
O	**O**ptional (requirement code)
ORC	**O**perating **R**ange **C**ategory (attribute code)
PAT	Buoy **Pat**tern Category (attribute code)
PNC	Number of pixels per subblock E/W (counter)
PNL	Number of pixels per subblock N/S (counter)
POR	Pixel Order (Scan direction parameter)
PRODSPEC	**Prod**uct-**spec**ific Directory (VRF)
QAL	**Qual**ity File (file name extension)
QID	**Q**uality/Source Record **Id**entifiers (quality and control attribution code)
QLE	Releasability (quality and control attribution code)
QUL	Reliability of **Qual**itative Attribute (quality and control attribution code)
QUT	Standard Deviation of **Q**uantitative Attribute (quality and control attribution code)
R	**R**aster datasets (use code)
R	**R**estricted/For Adminisrative Use Only (security classification code)
R	**R**everse (spaghetti/chain-node code)
R	**R**ight (Chain-node orientation parameter)
ROD	Row Sequence (Scan direction parameter)
S	**S**ecret (security classification code)
SOU	**Sou**rce File (file name extension)
SP	**S**PATIAL_DATA_RECORD (Record Type)
SPL	number of spatial data records (counter)
STK	**S**tacked On
STU	**S**tacked **U**nder
T	**T**op Secret (security classification code)
THF	**T**ransmittal **H**eader **F**ile (file name extension)
TMC	**T**op **M**ark **C**haracteristic (attribute code)
TP	TEXT_PLACEMENT_RECORD (Record Type)
U	**U**nclassified (security classification code)
UNI	**Uni**ts (attribute code)
V	**V**ector datasets (use code)
VEC	Edges, Nodes, Faces, Features (file name extension)
WID	**Wid**th (attribute code)
Y	**Y**es (flag)
YYYY	Year (up-to-dateness descriptor)

Withdrawn/Retirée

SECTION ONE THEORETICAL MODEL

For any exchange of DGI to be carried out in a practical manner it is necessary that the following semantic aspects be supported:

- a clear definition of the data model to be used for each type of data;
- a commonly understood means of identifying features and their descriptive attributes; and
- a clear statement on the quality and accuracy of the data.

These three issues are described in greater detail in 5, 6 and 7 respectively below.

5 DATA MODELS

The three types of geographic data supported by DIGEST are:

- **Vector data** which may be organized according to four different topological levels (see 5.1):
  - — **spaghetti** vector data (Level 0 Topology),
  - — **chain-node** vector data (Level 1 Topology),
  - — **planar graph** vector data (Level 2 Topology), and
  - — **full topological** vector data (Level 3 Topology);
- **Raster data** (radiometric information pertaining to pixels) (see 5.2); and
- **Matrix data** (non-radiometric information pertaining to points at regularly identified intervals) (see 5.3).

5.1 VECTOR DATA

This data structure represents a logical view of the interface format for the transfer of vector DGI by participating nations.

The topology represented in the exchange dataset is defined according to the coordinate system in which the topological entities are geometrically described. It will represent a topology consistent with the projection of the surface of the earth on the coordinate surface, i.e. the ellipsoid or the cartographic projection plane. When transmitted, the elevations will not be taken into account in defining the topology.

Withdrawn/Retiree

Conceptually, the three possible topological entity types (node, edge and face) provide a complete and consistent topological representation of the two-dimensional space covered by a given dataset, with well-defined topological relations between different entity types.

The different topological levels of vector data allow to choose the level of detail and constraint in topological relations according to the complexity, completeness and consistency of the transmitted data (see 5.1.3 below).

Geographic features in the dataset are then supported by one or more topological elements with a many-to-many mapping between features and entities, as shown in Figure 5-1.

In the DIGEST exchange structure, topological entities and features are linked by a mandatory one-way relation (as shown in Figure 5-2a) and, optionally, the reverse relation (as shown in Figure 5-2b). The use of only the one-way relation reduces the data volume while preserving the structure of the full conceptual scheme. The use of the reverse relationship will improve computational efficiency.

There are eight logical **entity types** in the DIGEST vector data model:

- feature entities — simple point
  — simple line
  — simple area
  — complex
- topological entities — node
  — edge
  — face
- topological construct — ring

(Note that a "feature entity" is commonly referred to as merely a "feature", a "topological node entity" is commonly referred to as a "node", and so on.)

A **topological element** is either a topological entity or a topological construct.

The DIGEST topological vector data model is illustrated for informative purposes in Annex E.

Withdrawn/Retirée

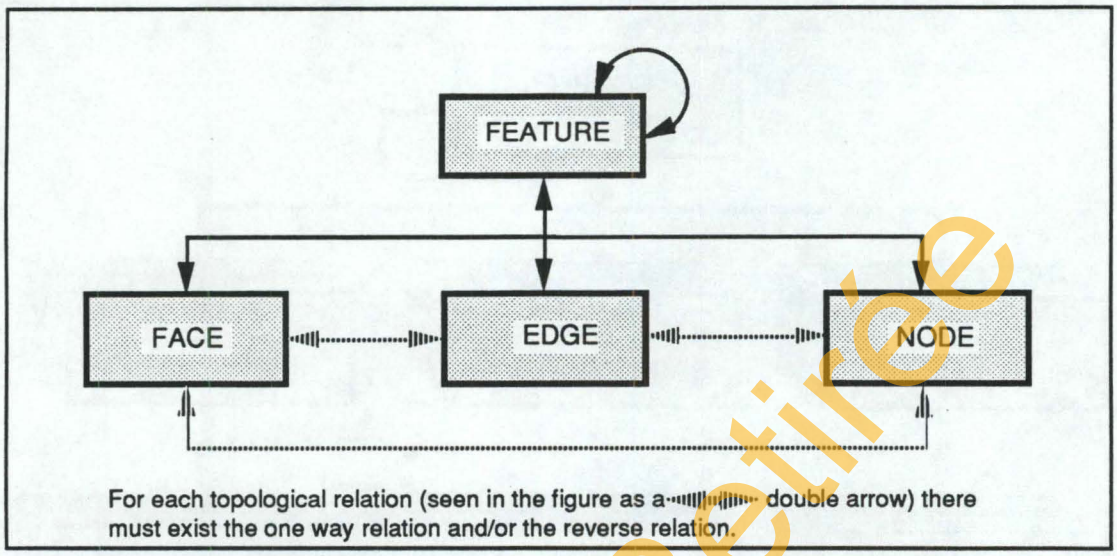


Figure 5-1 Conceptual Scheme (Level 3 — Full Topology)

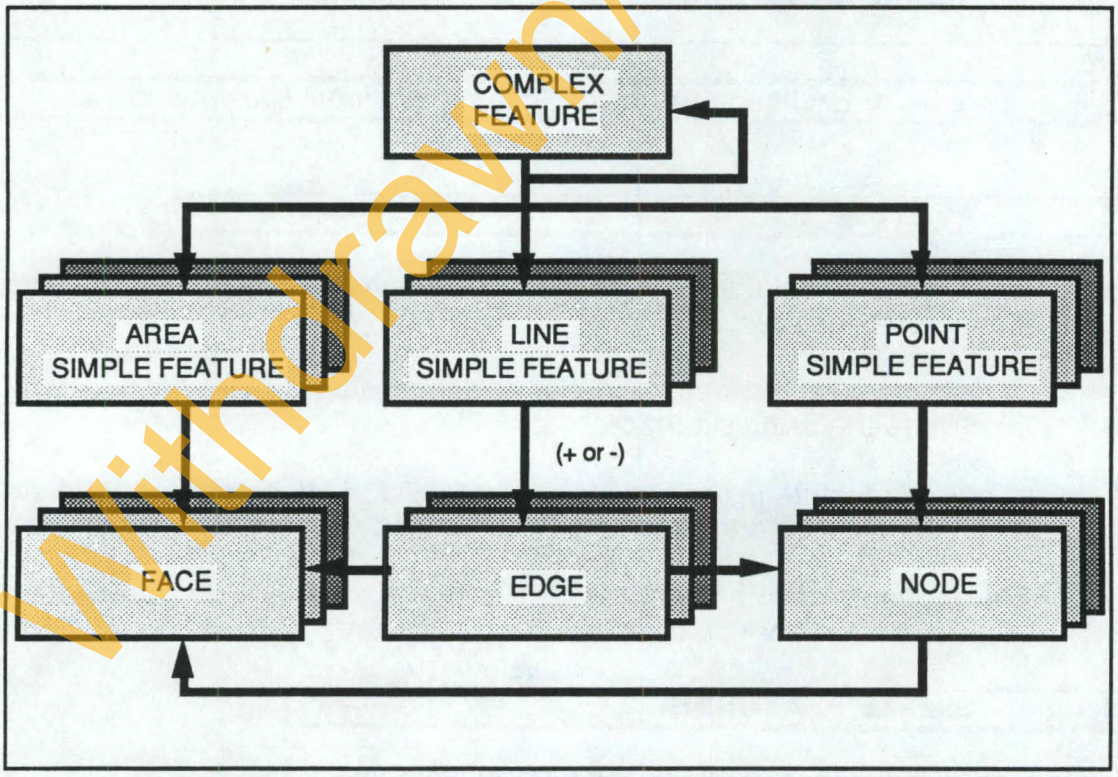


Figure 5-2a Exchange Structure Scheme (Mandatory one-way pointers)

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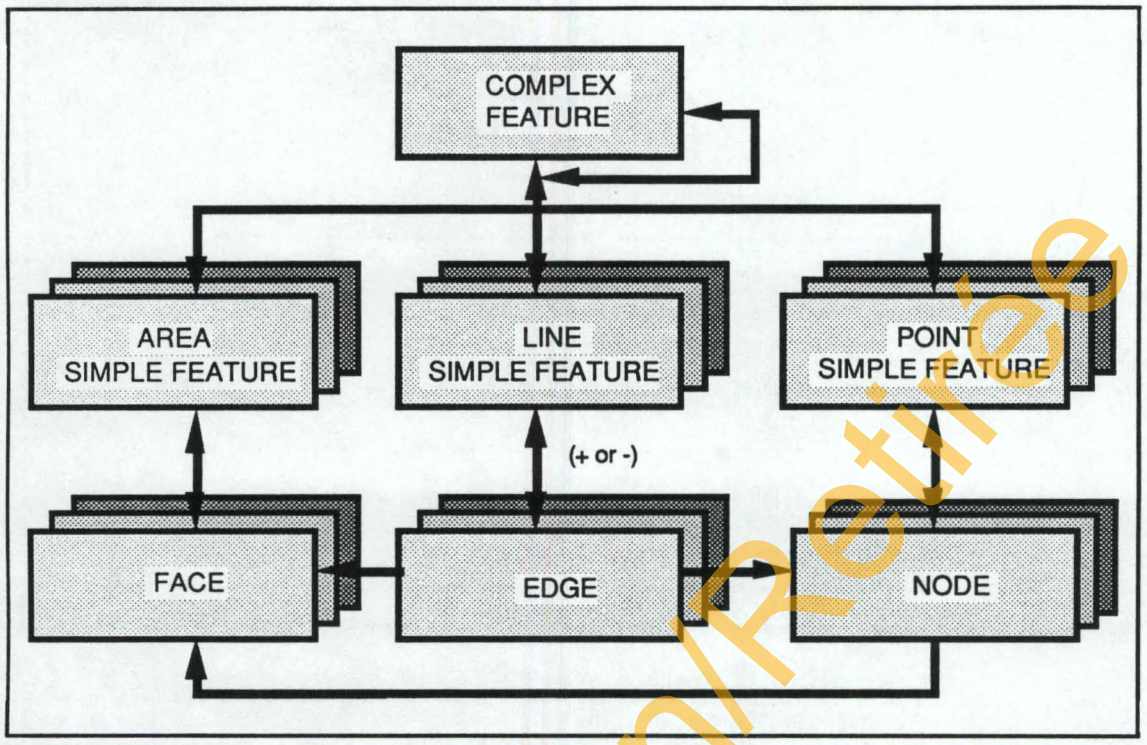


Figure 5-2b Exchange Structure Scheme (Optional two-way pointers)

Withdrawn/Retired

5.1.1 FEATURES

Feature entities shall be used to represent the geographic features, or data about groups of geographic features.

- A feature is a representation of a geographic entity which occurs relative to the Earth's surface.
- A specific feature is defined by: a unique list of attributes; a unique set of attribute codes and associated values; and relations to other entities.
- Relations between features (with the exception of "alternative representation") will be acyclic.

5.1.1.1 SIMPLE FEATURES

A simple feature is composed of only topological elements.

A simple feature will be composed of topological elements of the same type only (i.e. face, edge, node or ring).

Simple features will be homogeneous in attribution. However, those attributes carried at the topological level (source, accuracy, up-to-dateness, security) may vary between topological entities. The simple feature referencing these topological entities may also contain attributes for source, accuracy, up-to-dateness, and security that are an overall statement (usually the worst value) of the related topology and the attributes of the feature. These latter attributes are the only ones which may be transmitted when attributes are not held at the topological level.

Contiguous simple features homogeneous in attribution are permitted but not encouraged.

The three types of simple features are:

- **Simple Point Features**
  - — A simple point feature is composed of one (or more) node(s).
  - — Point features defined at a single (x, y) location with different elevations may be represented in the structure as multiple simple point features composed of the same single isolated node, with elevation defined as the elevation of the surface of the Earth. The actual elevation of each point feature may be computed using attributes attached to the features.
- **Simple Line Features**
  - — A simple line feature is composed of one (or several contiguous and sequential) edge(s).
  - — A simple line feature must be homogeneous in direction.
  - — The composition relation between a simple line feature and its component edges will be oriented and ordered.
  - — A simple line feature may be closed if required.
- **Simple Area Features**
  - — A simple area feature is composed of one (or several contiguous) face(s) or, when no faces exist in the structure, by one outer ring and any number (including zero) of inner rings describing the outline of the feature.

Withdrawn/Retirée

5.1.1.2 COMPLEX FEATURES

A complex feature is composed of more than one simple and/or complex features only (not topological elements).

No feature is composed of itself nor of any feature that is ultimately composed of the original feature. Thus, the "composed of" relationship is acyclic, and all other named relationships (with the exception of "alternative representation") must also be acyclic.

5.1.1.3 RELATIONS BETWEEN FEATURES

DIGEST allows for the following relations between feature entities.

Alternative Representation

In some circumstances it may be necessary, or convenient, to represent the same real world entity in more than one form. These different forms are represented by different simple features/complex features and possibly different topological entities. The simple features/complex features representing the different forms are "alternative representations" of the same real world entity. (For example, the real world entity of a province could be represented by both a line feature (its boundary) and an area feature.)

Composed Of

Complex features are "composed of" complex features or simple features. Simple features are "composed of" topology (nodes, edges, and/or faces).

Component Of

"Component of" is the reverse sense of the "composed of" relation, defined for relating complex features or simple features back to complex features.

Stacked On

A simple feature is "stacked on" another simple feature when it is physically (in the real world) atop that feature.

Stacked under:

A simple feature is "stacked under" another simple feature when it is physically (in the real world) below that feature.

To avoid excessive complexity, "stacked on/under" relations are possible between Simple Features only.

Withdrawn/Retired

5.1.2 TOPOLOGICAL ELEMENTS

5.1.2.1 NODE ENTITY

Node entities shall be used to represent the topological intersection of two edges (see 5.1.3) or the location of point features.

- A node is a unique point on the Earth's surface.
- A node may be a "location of" any number of point features.

There may be topological relations between nodes and edges: "**start node**" and "**end node**" (for Levels 1, 2 and 3).

- A node is defined as an isolated node (called "entity node" in Annex C) if it is not the start or end node of any edge.
- A node is defined as a connected node if it is the start or end node of an edge.
- A node may be the start or end node of any number of edges.

There may be a topological relation between node entities and face entities: "**contained in face**" (for Level 3 only).

- An isolated node is contained in a single face only.

5.1.2.2 EDGE ENTITY

Edge entities shall be used to represent the topological boundary of a face (see 5.1.3) or the location of line features.

- An edge is defined as the set of straight line segments connecting consecutive coordinates, representing all or part of the extent of a feature and/or the boundary of a feature.
- Each edge, which is a component of a simple line feature, should be interpreted according to the directional sense of the pointer identifying it in, or opposite to, the direction of digitization (i.e. the order of the coordinates in the coordinate list). A "**directed edge**" is interpreted as an edge modified by its directional pointer.
- An edge may be a component of any number of simple line features.
- An edge need not be a component of any simple line feature.

Withdrawn/Retirée

There may be topological relations between nodes and edges: "start node" and "end node" (for Levels 1, 2 and 3).

- An edge is an oriented curve joining a start node and an end node (which may be the same).
- Seen in the direction of digitization, each edge refers to exactly one start, and one end node, which may be identical. The relations "start/end node" must be interpreted depending on the direction of digitization. An edge with the same start and end node must have at least four sets of coordinates.
- The start node of an edge will be located at the same (x, y) position as the first coordinate of the edge (both the edge and start node carry these coordinates). The "z" or elevation coordinate must agree, if present.
- The end node of an edge will be located at the same (x, y) position as the last coordinate of the edge (both the edge and end node carry these coordinates). The "z" or elevation coordinate must agree, if present.
- Two edges are contiguous if and only if they have a common node.
- An **isolated edge** (see Figure 5-5 for an example) is defined as an edge whose start and end nodes are not connected to any other edges. Isolated edges do not subdivide a face; as a consequence the left and right faces are identical.

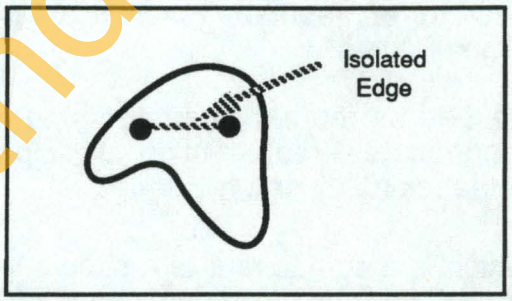


Figure 5-3 Isolated Edge

- A **hanging edge** (see Figure 5-6 for an example) is defined as an edge for which one of its start/end nodes is connected to another edge, while the other is not.

Withdrawn/Retired

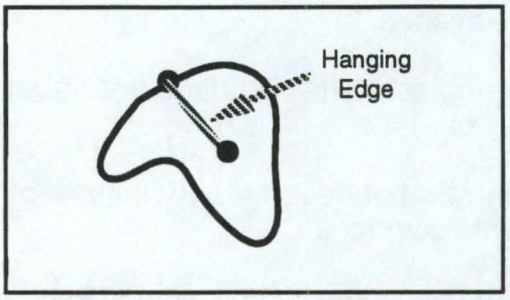


Figure 5-4 Hanging Edge

There may be topological relations between faces and edges: **"left face"** and **"right face"** (for Level 3 only):

- Each edge refers to exactly one left, and one right face, which may be identical. The relations "left/right face" must be interpreted depending on the direction of digitization.

There may be topological relations between edges: **"previous left edge"** and **"next right edge"** (for Levels 1, 2 and 3):

- Each edge refers to exactly one "previous left-face edge" and one "next right-face edge", according to the direction of digitization. The "previous left-face edge" and "next right-face edge" may be the same.

- The "previous left-face edge" is the edge connected to the start node of the current edge which has a face (or implied face for Levels 1 and 2) which is the same as the left face (or implied face for Levels 1 and 2) of the current edge with the smallest counter-clockwise angle at the start node (measured from the current edge).

- The "next right-face edge" is the edge connected to the end node of the current edge which has a face (or implied face for Levels 1 and 2) which is the same as the right face (or implied face for Levels 1 and 2) of the current edge with the smallest counter-clockwise angle at the end node (measured from the current edge).

5.1.2.3 FACE ENTITY

Face entities shall be used to represent topological faces (Level 3 only).

- A face is a maximal, connected area in the complement of the Edge-Node Planar Graph, representing all or part of the extent of a feature or an unattributed area.

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- No two faces overlap.
- Any point on the coordinate surface not on an edge or at a node is in one (and only one) face.
- Each face can be bounded by any number of edges and contain any number of isolated nodes.
- Two faces are contiguous if they have at least one common edge.
- Each face can be a component of any number of simple area features.
- Faces will not necessarily be components of features (e.g. if the dataset does not contain area features).
- The first face record in the exchange format is called "Face 1". Face 1 represents all area on the coordinate surface outside the bounds of the dataset.
- Face 1 is unbounded, but by convention its Minimum Bounds shall always be defined as zero or null.
- An area covered by a face is defined by those edges bounding the face, which may be gathered in rings (see 5.1.2.4 below).
- A face is "**bounded by**" one single outer ring and may be "bounded by" any number of inner rings

5.1.2.4 RING CONSTRUCT

The ring topological construct shall be used to represent the boundaries of topological faces (for Level 3 only) or the location of area features (for Levels 0, 1 and 2). Many faces in one area is a Level 3 construct. Areas at the lower levels of topology must be a feature.

- A ring is a connected set of edges that composes the border of faces or area features.
- A ring may not intersect itself.
- A ring may compose the outer or the inner border of a face or area feature. A face or area feature may not be bounded by more than one outer ring.

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- A ring pertains to a single topological face or area feature. When the same set of edges is shared by two topological faces or area features, two different rings are composed of the same set of edges.

- A ring is described either by an ordered list of edges (each edge must have a common node with the previous and following edge in the list) or by a "**start edge**" and the topological relation between edges (previous left/next right edge) from which the ordered list may be computed.

5.1.2.5 ATTRIBUTION OF TOPOLOGICAL ENTITIES

Attributes may be attached to topological entities. The only attributes permitted for topological entities are (these attributes are optional):

- source;
- accuracy;
- up-to-dateness/currency; and
- security classification.

These attributes are described in greater detail in 7 below.

5.1.3 TOPOLOGICAL LEVELS

Each topological level is defined by:

- a list of mandatory and optional topological elements;
- a list of mandatory and optional topological relations; and
- a list of topological rules or constraints applying to the existing set of topological elements.

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5.1.3.1 LEVEL 3 — FULL TOPOLOGY

Topological Elements

- Simple features will be composed of nodes, edges and/or faces.
- Rings may be used to describe the boundaries of faces.

Topological Relations

- The "start/end node", "left/right face", and "contained in face" topological relations are mandatory.
  - — No edge will be transmitted without a consistent description of its start node, end node, left face, and right face.
  - — No isolated node will be transmitted without a consistent description of its containing face.
- The "previous left/next right edge" and "start edge" topological relations are optional.

Topological Rules

- The coordinate surface is considered to be partitioned in a set of mutually exclusive and collectively exhaustive faces. The boundaries of the faces are composed of edges and connected nodes. The faces may contain isolated nodes.
  - — No two nodes may occupy the same (x, y long, lat) coordinate point.
  - — A node will intersect edges only at their start/end point.
  - — No edge will intersect nor overlap any other edge, or itself.
  - — No two faces overlap.
  - — An isolated node is contained in a single face. A face may contain any number of isolated nodes.
  - — Any location on the coordinate surface not on an edge or at a node is in one (and only one) face.

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- As a result of the above rules, topological entities may exist without being a component of any simple feature.

  — Faces will be created to fill the whole extent of the coordinate surface.

  — Edges will be created as part of the border of faces.

  — Nodes will be created as the intersection of two contiguous edges.

5.1.3.2 LEVEL 2 — PLANAR GRAPH

Topological Elements

- Simple features will be composed of nodes, edges and/or rings. There is no face entity.

Topological Relations

- The "start/end node" topological relations are mandatory.
- The "previous left/next right edge" and "start edge" topological relations are optional.

  — No edge will be transmitted without a consistent description of its start node end node.

Topological Rules

- The set of nodes and edges will constitute a planar graph.

  — No two nodes may occupy the same (x, yl long, lat) coordinate point.

  — A node will intersect edges only at their start/end point.

  — No edge will intersect or overlap any other edge, or itself.

- As a result of the above rules, topological entities may exist without being a component of any simple feature.

  — Topological nodes will be created as the intersection of two contiguous edges.

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5.1.3.3 LEVEL 1 — CHAIN-NODE

Topological Elements

- Simple features will be composed of nodes, edges and/or rings. There is no face entity.

Topological Relations

- The "start/end node" topological relations are mandatory.
  - — No edge will be transmitted without a consistent description of its start node and end node.
- The "previous left/next right edge" and "start edge" topological relations are optional.

Topological Rules

- The organization of the set of nodes and edges is driven by a semantic point of view, as opposed to a geometric one (e.g. a communication network).
  - — Two nodes may occupy the same (x, y | long, lat) coordinate point.
  - — A node may intersect an edge at any point.
  - — Edges may intersect or overlap any other edge, or itself.

5.1.3.4 LEVEL 0 — SPAGHETTI

Topological Elements

- Simple features will be composed of nodes, edges and/or rings. There is no face entity.

Topological Relations

No topological relations will be transmitted. Topological entities are considered to be independent from each other. Rings can be used to transmit area features.

Topological Rules

The edge record will be defined as "closing on itself" and is used for defining the boundary of an area feature. The first coordinate equals the last coordinate while all other topology remains nodeless.

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5.1.4 LOGICAL CONSISTENCY

A vector dataset is defined as being logically consistent when all of the following conditions are true:

- All mandatory relations between topological entities for the chosen topological level are present and non-null (e.g. pointers to "left face", "right face", "start node", "end node" and "contained in face" are present for Level 3—full topology);
- All topological entities necessary to represent simple features within the exchange dataset are present;
- All relational pointers are satisfied (i.e. the record pointed to will be present in the dataset);
- No feature has any relations (i.e. "composed of", "stacked on", "alternative representation") to itself; and
- Chains of relations, in which a feature is ultimately related to itself through a series of intermediate features and relations, shall not be allowed, with the exception of a chain consisting solely of "alternative representation" relations.

5.2 RASTER DATA

Raster Graphics (RGs) are produced to support various uses including air, land, and sea based electronic map displays, and mission planning systems. In addition, they may be used as source material for production of other products.

RGs are digital replicas of graphic products. To digitally replicate the multiple colours present on many graphic products, each multicolour graphic or its colour separates is scanned and digitally separated into red, green, and blue components, or colour-coded layers. The result can be several image bands that when combined, provide a multicolour digital replica of the original graphic product. The total format of a graphic including margin, border, and legend areas shall be scanned at a resolution to be determined by the producer, dependent upon the digitizing device and the graphic to be scanned. The resultant data which consists of one graphic product is provided with geographic control on the original datum and projection so that transformation and seaming of the data can be performed at user discretion. Scanned data will normally be exchanged at a resolution of 100 microns or better (e.g. 50 microns), unless negotiated otherwise bi-laterally, with digital images consisting of three image bands for RGB (one each for red, green, and blue) or at least one image band for colour-coded data.

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RGs consist of scanned graphic data, a support file that contains geographic coordinates with which to register the digital data to the original graphic's projection, a map information file that contains textual information about the graphic, and optional supplementary text that contains textual descriptions of selected items depicted on the original graphic.

5.2.1 ACCURACY REQUIREMENTS

Raster data will be captured and processed in a way which satisfies the following accuracy requirements.

Raster data collected from source graphics at scales of 1:100,000 or smaller may retain the horizontal accuracy of the original source graphic, since the inaccuracy added as a result of digitization is generally less than the error tolerances built into the original source graphics' horizontal accuracy figure.

Horizontal accuracy for Raster data collected from source graphics at scales larger than 1:100,000 may be determined after the image has been rectified (if needed) using the method detailed below:

Coordinates of control points are determined in terms of the nominal sampling interval times the reciprocal scale of the graphic (i.e. the ground distance defined by the number of pixels from the origin of the cartographic image). The Standard Error (at 90% confidence limit) of their deviations, from the cartometrically derived coordinates, is calculated for both X and Y. These are compounded with "Source Graphic's Horizontal Accuracy Value" (AAH) to form the total "Raster Horizontal Accuracy Value" (HAV) as follows:

$$HAV = (AAH^2 + X^2_{ERROR} + Y^2_{ERROR})^{1/2}$$

An example is for a 1: 50,000 scale map where:

- AAH = 50 metres
- The sampling interval is 100 microns
- The Standard Error at 90% confidence limit is 200 microns (i.e. 2 pixels) which gives 2 x 100 x 50,000 = 10 meters in both X and Y.

This would give a total $HAV = (50^2 + 10^2 + 10^2)^{1/2} = 52$ metres

Ninety per cent of the points per graphic will fulfil the above condition.

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5.2.2 OVERVIEW OF DATA MODEL

Raster Graphics are a collection of red, green and blue, or colour-coded digital images in unsigned binary integer format. The total format of a graphic product may be scanned including margin, border and legend areas. Each image, which nominally consists of one graphic product, is provided with geographic control on the original datum or projection so that transformation and seaming of the data can be performed at user discretion. A raster image is usually an RGB digital image consisting of three image bands or a colour-coded image consisting of at least one image band.

The image is considered to comprise of one or more image bands (see Figure 5-17). The image bands will be formatted into **N** columns of subblocks in the east-west direction and **M** rows of subblocks in the north-south direction. The subblock size is **P** pixels (north-south) by **Q** pixels (east-west).

The convention adopted for sequencing (numbering) subblocks within an image, and pixels within a subblock, is analogous to the Cartesian coordinate system. For a normally oriented image (i.e. North at the top and west on the left) the origin is at the SW corner and the columns are numbered from left to right (x-axis), the rows from bottom to top (y-axis), and the bands from lower to higher (z-axis).

The positive directions of the x and y axes (rows and columns) may be reversed in relation to a normally oriented image but not exchanged (see 11.2.3 for details). For the conventional case the sequence of the subblock numbers begins at the lower left corner (SW corner) of the image/graphic. That position will be (1), and subblock numbers are incremented by 1 along the row to N. Therefore the subblock to the east will be (2). The subblock to the north of Subblock (1) will be Subblock (N+1). The subblock in the northeast corner will be Subblock (N x M). Pixel values within a subblock are recorded in the same order, P rows by Q columns.

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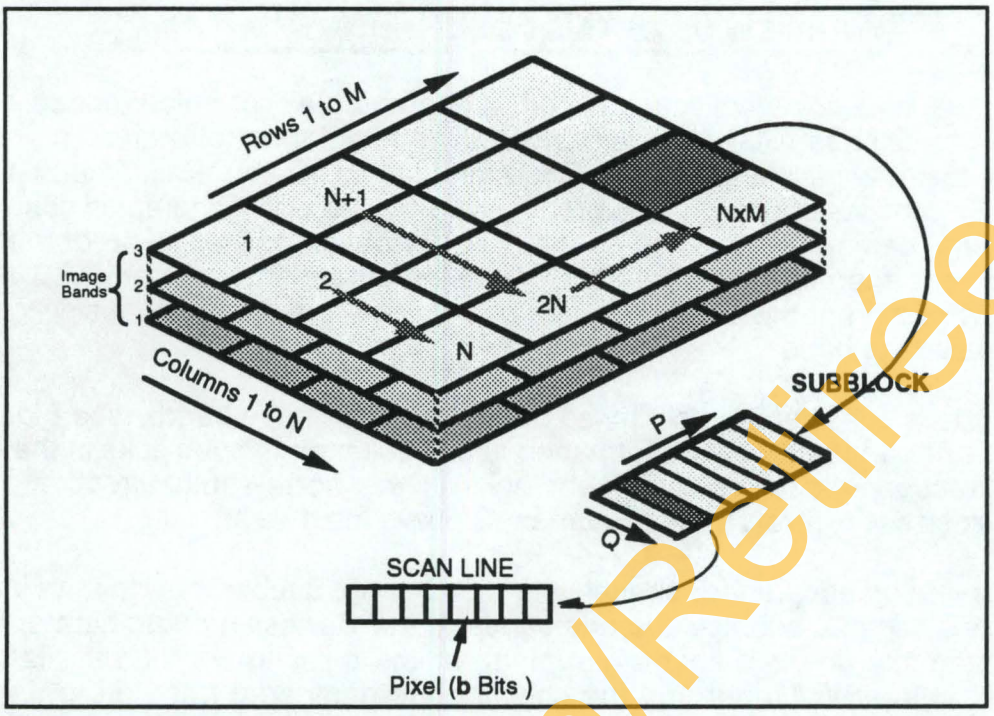


Figure 5-5 Raster Dataset Logical Structure

Zero fill is defined as zero intensities for RGB, or the colour code zero. Zero fill will be used within a subblock at the beginning or end of each line. If the actual number of samples per line is not an integer multiple of **Q**, zero fill will be added to produce the next integer multiple of **Q** samples. Zero fill will be used preceding the first line or following the last line of actual image data in a subblock. If the actual number of lines is not an integer multiple of **P**, zero fill will be added to produce the next integer multiple of **P** lines. Therefore, zero fill for a map or chart may be on any edge. Each line of **Q** pixels within a subblock is a separate "scan line" and is ordered as defined in the above three paragraphs. That is in order of row 1 through **P** for Subblock (1), followed similarly by Subblocks (2) through **(N** x **M)** for each image band.

The "scan line" consists of the following logical data elements:

Pixel Run 1	Pixel Run 2	*	*	*	Pixel Run 'n'

The following data items are repeated for each pixel run until all the pixels in a line/scan (i.e.. **Q** pixels) are accounted for.

- Pixel Count — The number of adjacent pixels with the same value as the following "Pixel Value" data item.

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- Pixel Value — For RGB type data this is the intensity of the radiation. For colour coded data this is a numeric code which represents a colour or quality, defined in a lookup table.

5.3 MATRIX DATA

Matrix data are arrays of non-radiometric information pertaining to points at regularly identified intervals (e.g. grid, Cartesian, latitude/longitude) and characteristics which are present at that particular location. Such characteristics could be soil type or elevation. Each array of matrix information will consist of a uniform number of locations as described in the sections which follow. The basic structure described in these sections is identical to the raster structure.

The matrix is considered to be comprised of one or more bands (see Figure 5-18). The bands will be formatted into **N** columns of subblocks in the east-west direction and **M** rows of subblocks in the north-south direction. The subblock size is **P** elements (north-south) by **Q** elements (east-west).

The convention adopted for sequencing (numbering) subblocks within a matrix, and elements within a subblock, is analogous to the Cartesian coordinate system. For a normally oriented matrix (i.e. North at the top and west on the left) the origin is at the SW corner and the columns are numbered from left to right (x-axis), the rows from bottom to top (y-axis), and the bands from lower to higher (z-axis).

The positive direction of the x- and y-axis (rows and columns) may be reversed in relation to a normally oriented matrix but not exchanged (see 11.3.3 for details). For the conventional case the sequence of the subblock numbers begins at the lower left corner (SW corner) of the matrix. That position will be (1), and subblock numbers are incremented by 1 along the row to **N**. Therefore the subblock to the east will be (2). The subblock to the north of Subblock (1) will be Subblock (**N**+1). The subblock in the northeast corner will be Subblock (**N** x **M**). Element values within a subblock are recorded in the same order, **P** rows by **Q** columns.

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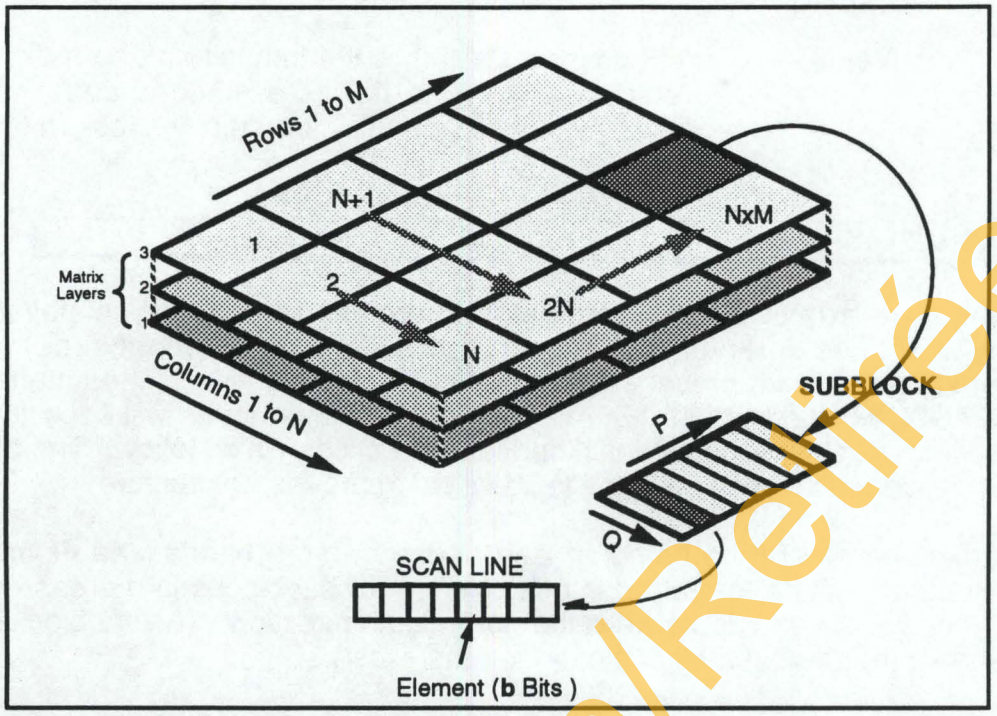


Figure 5-6 Matrix Dataset Logical Structure

A value for null data may be defined by the user. If the actual number of elements per line is not an integer multiple of **Q**, null values will be added to produce the next integer multiple of **Q** elements. Null values will be used preceding the first line or following the last line of actual matrix data in a subblock. If the actual number of lines is not an integer multiple of **P**, null values will be added to produce the next integer multiple of **P** lines. Therefore, null values for a matrix may be on any edge.

Each line of **Q** elements within a subblock is a separate "profile" and the lines are ordered as defined in the above three paragraphs. That is in order of row 1 through **P** for Subblock (1), followed similarly by Subblocks (2) through (**N** x **M**) for each matrix band.

The standard allows variations on this order to be specified in a dataset.

The "profile" consists of the following logical data elements:

Element Run 1	Element Run 2	*	*	*	Element Run 'n'

The following data items are repeated for each element run until all the elements in a profile (e.g. **Q** elements) are accounted for.

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- Element Count — The number of adjacent elements with the same value as the following "Element Value" data item.

- Element Value — For "Value" type data this is the actual quantity/quality. For colour coded data this is a numeric code which represents a quality/quantity, defined in a lookup table.

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6 FEATURE AND ATTRIBUTE CODING

Standards for DGI exchange require a standard scheme for documenting features and attributes necessary to distinguish those features commonly found in a GIS and for the orderly exchange of such data between MC&G organizations.

6.1 FEATURE AND ATTRIBUTE CODING CATALOG

DIGEST Part 4 is the Feature and Attribute Coding Catalog (FACC), which provides a common menu along with a standardized coding system of features (Annex A to Part 4) and attributes (Annex B to Part 4). Where particular applications require the definition of a few specialized features and attributes not yet contained in the FACC, a Data Dictionary may be used (see 6.2 below). Otherwise, features and attributes shall be encoded using the FACC standard.

FACC provides guidance in Annex C — Features and Associated Attributes, as to which attributes might typically be associated with certain features. It has not been developed to the requirements of any single application, or level of resolution, and in itself cannot support a digital product. For a product, the menus of features and attributes must be employed in concert with a product specification.

The product specification determines which features and attributes will be collected as well as defining specific collection criteria such as positional accuracy and feature granularity.

FACC can be modified and updated to keep pace with the dynamic technology improvements and changing requirements, as it is not tied to any specific database or product line. In this way, it is intended that the FACC should be extended so as ultimately to meet the requirements of every application.

Consult Part 4 for details of the coding structure for features and attributes, as well as for the rules for documenting new features and attributes.

6.2 DATA DICTIONARY

The purpose of the Data Dictionary, as described in Part 2 – 11.1.11, is to permit the definition (and therefore the use) of features and attributes which are not possible to represent with an existing combination of feature and attribute codes in FACC. For this use, the feature or attribute is being defined in a FACC format temporarily until such time as it is submitted to the Document Change Control Program for inclusion in FACC. A second possible use of the Data

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Dictionary is to describe the features and attributes contained in a dataset so that a receiver of a dataset would have a complete description of all features and attributes as part of the dataset.

The Data Dictionary is implemented through the:

- Feature/Attribute Entry Record (see 11.1.11.1);
- Feature/Attribute Association Record (see 11.1.11.2); and
- Attribute/Value Association Record (see 11.1.11.3).

Any non-FACC features and attributes used in such a Data Dictionary must be in accordance with the Coding Structure described in Part 4.

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7 DATA QUALITY

7.1 DATA QUALITY DESCRIPTORS

Data quality descriptors are necessary in order to evaluate the quality of exchanged Geo Data referring to features/attributes and geometry and to integrate them into a receiving database without ambiguity. Therefore quality statements are required for a single datum as well as for certain data levels. Special statements are required for:

- specification;
- source;
- accuracy (positional and attribute);
- up-to-dateness/currency;
- logical consistency;
- completeness (feature and attribute);
- clipping indicator*;
- security classification*; and
- releasability*.

* Included in this clause because of their logical similarity to data quality descriptors.

Data are organized in structures that comprise several levels, e.g.:

- Volume level;
- Dataset level;
- Feature level;
- Topological/Spatial Data Records (Face, Edge, Node) level; and
- Attribute level.

These structures are described in greater detail in Section Two.

To each of these levels quality descriptors may be assigned. It is apparent that some quality statements are required on a high level (say, dataset) and therefore these descriptors are of a general nature. They possibly are computed average values, or the security classification for example, in which case the higher level inherits the descriptor from lower level entities. (If one feature is CLASSIFIED, the whole dataset will be CLASSIFIED at the same classification level.)

Other Data Quality Descriptors (e.g. attribute accuracy) make sense only for a limited number, or even one feature. If all occurrences of a feature class (e.g. Bridges) have their attribute (e.g. width) from the same source and evaluation method, the feature may carry a pointer to an accuracy statement in the quality file. If bridges stem from various sources and are captured by various methods, each single feature will require its own descriptor for this attribute.

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On the lower levels, i.e. feature, topological, and attribute level, a descriptor will normally refer to only **one** Geo-datum, as opposed to the higher levels, where descriptors refer to large number of Geo-data (e.g. Tiles, Files, Volumes etc).

Data descriptors are assigned to the neutral Geo Data and will be provided during data exchange.

7.2 ASSIGNMENT OF DATA QUALITY DESCRIPTORS TO THE STRUCTURE LEVELS

Corresponding to the rule "as deep as necessary, but as high as possible" (without losing any information), data quality descriptors are assigned to the various levels. Data descriptors on a higher level are "optional", if their information can be computed by interpretation of lower level data descriptors (except security classification).

Table 7-1 shows the assignment of data quality descriptors to the structure levels supported by the exchange format.

Table 7-1 Data Quality Matrix

Quality Descriptor	Volume Level	Dataset Level	Feature Level	Topo/Spatial Level	Attribute Level
Specification	√	√	-	-	-
Source	-	√	√	√	√
Positional Accuracy	-	√	√	√	-
Attribute Accuracy	-	-	-	-	√
Up-to-Dateness/Currency	-	√	√	√	√
Logical Consistency	-	√	-	-	-
Attribute Completeness	-	√	-	-	-
Feature Completeness	-	√	-	-	-
Security Classification	√	√	√	√	√
Clipping Indicator	-	-	√	-	-
Releasability	√	√	√	√	√

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7.3 DEFINITION OF DATA QUALITY DESCRIPTORS

The quality descriptors are implemented as attributes, and are defined as follows.

7.3.1 SPECIFICATION

The **Specification** explicitly describes, if relevant, the specific Edition and Amendment number of the Dataset or Product Specification against which the data within the Dataset or Volume was transformed for transmittal. It also describes the specific Edition and Amendment number of DIGEST against which, directly or indirectly, the data within the Dataset was transformed for transmittal.

7.3.2 SOURCE

The **Source** describes the origin/derivation of a single datum or Dataset with regard to processing techniques and of data source used.

Source information consists of:

- data source used (e.g. chart, air photograph, statistics);
- name, designation;
- scale;
- producer/editor;
- edition number;
- edition date / source date;
- accuracy indication;
- other documents; and
- control and check data.

Source processing statements consist of:

- date of processing;
- operator;
- hardware used;
- program used; and
- transformation algorithm.

The **Descriptor Value** consists of the Key indicating the identity of the source record.

7.3.3 POSITIONAL ACCURACY

Positional Accuracy describes the geometry of a real-world object referring to its horizontal accuracy (e.g.: X-value,Y-value = +/-1 m) and its vertical accuracy (e.g.: Z-value = +/-1 m). Positional Accuracy must be specified without relation to scale and should contain all errors influenced by source documents, data

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capture, transformation, etc. It must be assigned to the Edge or Node record. When an accuracy is assigned to a Feature, it pertains to the association of the Feature to its underlying topology.

The **Descriptor Value** for Positional Accuracy is expressed as a circular error for X,Y-value and as linear error for Z-value or a key identifying an accuracy recorded in the Quality Section. (The description is according to STANAG 2215.)

Refer to Part 2—12 for a discussion of horizontal and vertical accuracy regions.

7.3.4 ATTRIBUTE ACCURACY

The **Attribute Accuracy** describes the accuracy/reliability of the data capture for an attribute. Attribute Accuracy of quantitative attributes is a quantitative value, which expresses the standard deviation of the attribute value (e.g. height = 1 m). Attribute Accuracy of qualitative attributes is a qualitative value, which expresses the reliability of the attribute value (e.g. red = 90%).

The **Descriptor Value** is the standard deviation of the quantitative attribute value (e.g. height = +/- 1 m) or the reliability of the qualitative attribute value in percentage (e.g. red = 90 %) or a key identifying an accuracy record in the Quality Section.

7.3.5 UP-TO-DATENESS / CURRENCY

The **Currency** represents the date at which the data was introduced or modified in the database. This date of entry is used as a proof of modification for a single datum, permits statistical interpretation of several data and supports localization of defective data. Further information pertaining to Currency is contained in the source data.

The **Descriptor Value** for Up-to-Dateness is YYYYMMDD but may be completed by HH (hours), i.e. YYYYMMDDHH. Refer to ISO 8601 for further information.

7.3.6 LOGICAL CONSISTENCY

Consistency means that the logical rules of structure and attribute rules are followed and it describes the compatibility of a datum with other data of the dataset. Only consistent data is recommended to be exchanged.

The **Descriptor Value** is of the form of Text (Test performed and/or inconsistencies identified). Individual inconsistencies may be identified by the feature code ZD003.

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7.3.7 ATTRIBUTE COMPLETENESS

Completeness expresses the completeness of the attributive descriptions of a feature. It is 100% if all the relevant attributes of a feature are captured corresponding to a given capture specification. As an attribute or a record is written to the data base only if its data descriptors are complete, a statement to completeness of data descriptor (on the level of attributes and records) is not required.

The **Descriptor Value** is the Attribute Completeness in percent.

7.3.8 FEATURE COMPLETENESS

All **data base features** of one type of Feature are captured corresponding to the data capture specifications. The reference value of the data capture specification is an empirically determined value.

The **Descriptor Value** is the Feature Completeness in percent.

7.3.9 CLIPPING INDICATOR

The **clipping indicator** consists of a **descriptor value** which will indicate the number of times the remaining feature has been clipped. Zero or null indicates no clipping.

7.3.10 SECURITY CLASSIFICATION

Security Classification expresses the degree of protection against unauthorized access to data. Volumes, features and single attributes may be security classified.

The **Descriptor Value** is the Security Classification as given by Security Classification Code:

T = TOP SECRET
S = SECRET
C = CONFIDENTIAL
R = RESTRICTED or alternatively "FOR OFFICIAL USE ONLY" (Administrative Classification only)
U = UNCLASSIFIED

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7.3.11 RELEASABILITY

Releasability is the key to information or instructions for distributing or releasing this data to another internal and/or external organization.

The **Descriptor Value** is text or a key indicating the ID of the releasability record.

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8 CARTOGRAPHIC TEXT

The DIGEST exchange data models for vector data (i.e. topological, chain-node and spaghetti) each provide a complete representation of the dataset to be transferred. However, in many applications it is also necessary to carry cartographic text for the purposes of annotation. This annotation will typically involve both text that is related to specific features in the dataset and "free floating" or isolated text that is not related to any feature.

It is important to note that text annotation is an aspect of symbolization that is independent of the particular DIGEST data model used for a given dataset. Accordingly, the structure used to support cartographic text has been defined so that the logical consistency and completeness of the DIGEST data models is maintained irrespective of the presence or absence of cartographic text records in the dataset. In practical terms, this implies that the text records must contain elements pointing to records in the existing data model rather than the other way round.

In addition to the text string itself and the relation (if any) with a specific feature, it is also necessary to define the plotting position and presentation attributes (e.g. text character cell size) for the text.

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SECTION TWO EXCHANGE STRUCTURE

The exchange may be structured by using either a sequential structure or a tree-like one. In both cases the philosophy remains the same. The guiding philosophy has been to organize the required information for the transmittal of any geo data into the following logical types of data subsets relating to:

- the contents of the transmittal or database (which may comprise one or several datasets [libraries][1] encoded on one or several media volumes). This first data subset type forms the subject of the Transmittal Header File (THF) [tables of the database level (DHT.LAT)];

- the supporting information specific to each transmitted Geo dataset [Library]. This second data subset type forms the subject of the Header Data Subset (HDS) [tables of the library level (LHT.GRT.CAT)]; and

- the actual data of each transmitted Geo dataset [Library]. This third data subset type forms the subject of the Geo Data Subset (GDS) [library].

The THF [database level] occurs once for each transmittal or database. A transmittal [database] is composed of one or more datasets [libraries], with a dataset [library] consisting of two or more subsets of data: a Header Data Subset [tables of the Library Level] and a Geo Data Subset composed of one or more layers [coverages] (see Figure 9-1).

The Geo Data Subset is defined as a collection of digital information representing physical and cultural characteristics of the Earth's surface. The collection of information shall be geographically contiguous except for raster insets which may not be contiguous to the primary source. These data must utilize the same geographic reference system and projection.

The Geo Data Subset is composed of one or more layers and the data in each layer must be represented by the same data structure.

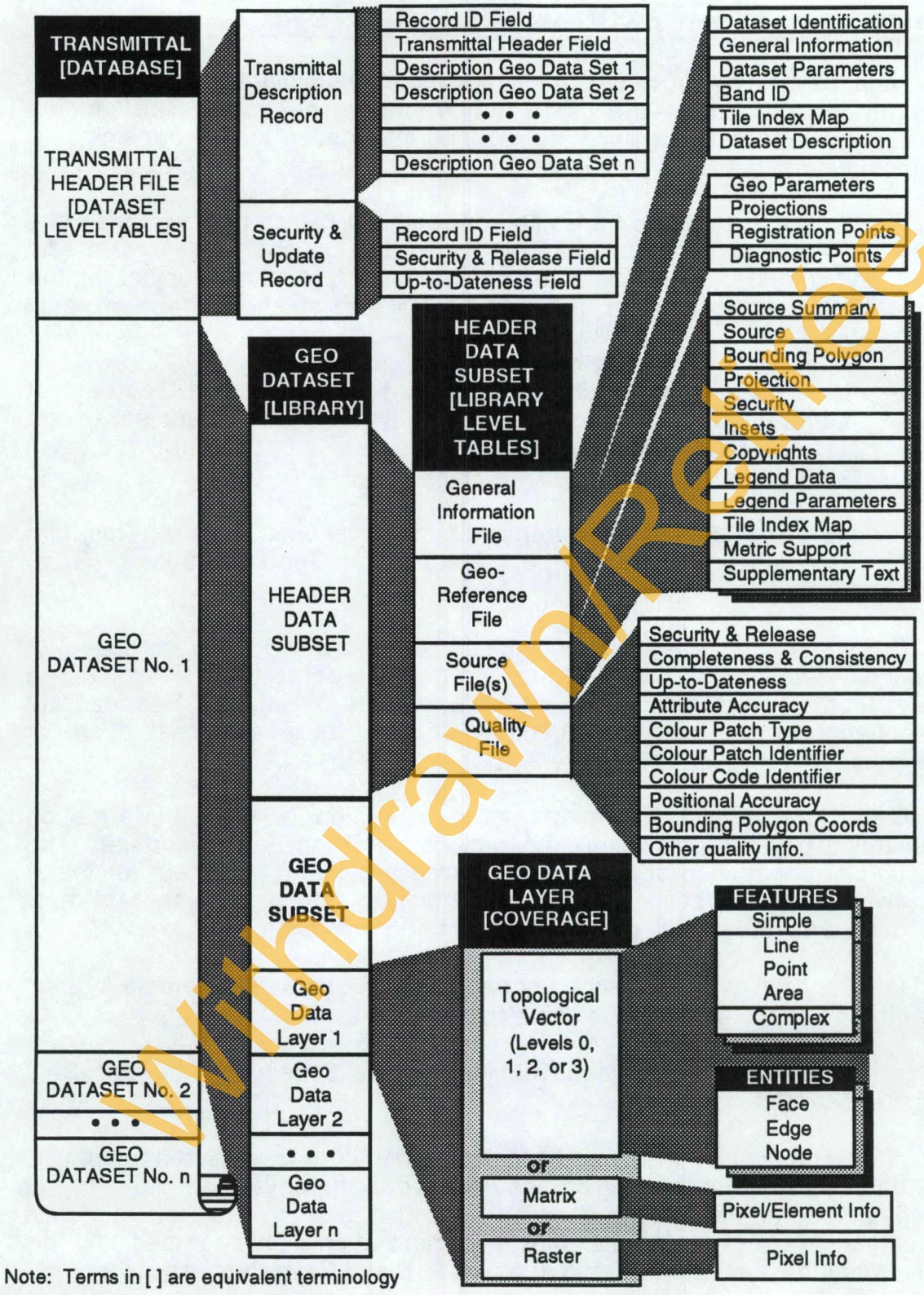
The general relationship between the Header Data Subset and the Geo Data Subset is depicted in Figure 9-1.

In the following clauses (9, 10 and 11) the words file, record, field and subfield must be understood in their logical (as opposed to the physical) meaning. For example, the term "File" as it is used in this section refers to a logical set of data elements and not to how the data may be organized on a physical medium. This differs from the meaning of "File" in Annexes A, B and C which refers to the

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1 Terms enclosed in brackets [ ] refer to the equivalent Vector Relational Format terminology.

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Note: Terms in [ ] are equivalent terminology

Figure 9-1 Structure of a DGI Transmittal

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encapsulation of data on physical media. There is not necessarily a direct correspondence in logical and physical files on a medium. In a telecommunications sense the term "file" refers to a block of data which is part of a telecommunications stream.

In Clauses 9, 10, and 11 below, the DIGEST use code is given in brackets [ ] after its description. *Optional* means not required unless otherwise noted below. Explanatory notes on optionality/dependency of entities are included where appropriate.

DIGEST Use Codes

Applicable dataset codes:

C = **C**ommon to all datasets
V = **V**ector dataset
Vn = **V**ector dataset at topological data level **n**
R = **R**aster dataset
A = m**A**trix dataset

Requirement codes:

M = **Mandatory**
Mandatory fields will be present and will be filled with meaningful values. Their absence or inadequate completion would gravely reduce the uses to which the dataset could be put.

S = **Strongly recommended**
Strongly recommended fields should be present and should be filled with meaningful values because:
a. their absence or inadequate completion could reduce the uses to which the dataset can be put, or
b. their presence is required for administrative/security handling.

O = **Optional**
Optional fields are not required, but if present, will be filled with meaningful values or null values.

D = **Dependent**
The presence or absence of dependent fields will depend upon a specified value or values being present in one or more other specified fields or sub-fields; or upon special characteristics of the dataset being transferred. The conditions for inclusion will be explicitly stated.

In the following tables each file, record, field and subfield description is preceded by a digit representing the rank in the Mandatory/Optional hierarchy .

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Level 1 in the hierarchical scheme is the top level. The hierarchical rank is followed by the code for the applicable dataset (C, V, R, A, described above) followed by the requirement code. Higher level data items confer their optionality to all items at a lower level until another item of equal or higher rank to the original is encountered. For instance:

1[C,O]	**Data Item A**

denotes that the item is a file;

2[C,M]	**Data Item B**

denotes that the item is record;

3[C,O]	**Data Item C**

denotes that the item is a field, and;

4[C,O]	Data Item D

denotes that the item is not a field but merely identifies a group of subfields, following, that have similar dependency requirements.

In this example, Item A may be absent, and if it is, then both B and C must be absent. If A is present then B must also be present. Note that if A were mandatory then at least one item at a lower level must be mandatory.

An asterisk preceding the level indicates that all the following items up to the next item with a higher level may be repeated.

9 TRANSMITTAL HEADER FILE (THF) - DATABASE LEVEL

The transmittal information is contained in a specific file or tables which occurs only once for each transmittal or database.

The Transmittal Header Information, in conjunction with the volume labels, replicates most of the information present on the "Volume Transmittal Form" (Annex D) and is intended to enable the following:

- production of the "Volume Transmittal Form" with the minimum of error (clerical or otherwise);
- rapid determination of the security classification covering the media volumes part of the transmittal; and
- rapid determination of the data type and coverage of any dataset in the transmittal, as well as its location in the sequence of datasets (i.e. an index to the datasets). Coverage is always given in this location in longitude and latitude to enable easy reference.

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The THF must contain nearly all the information present on the "Volume Transmittal Form". The only information not in the THF is as follows:

- Dispatch Reference Number normally added by Dispatch Section;
- Date Dispatched manually added by Dispatch Section; and
- all information relating to Receipt, Internal Routing and Remarks column.

The THF defines the contents of the transfer. A transmittal may comprise one or several datasets, that means at least three different files (THF [Database], HDS [Library Level Tables], and GDS [Coverage]), encoded on one or more media volumes.

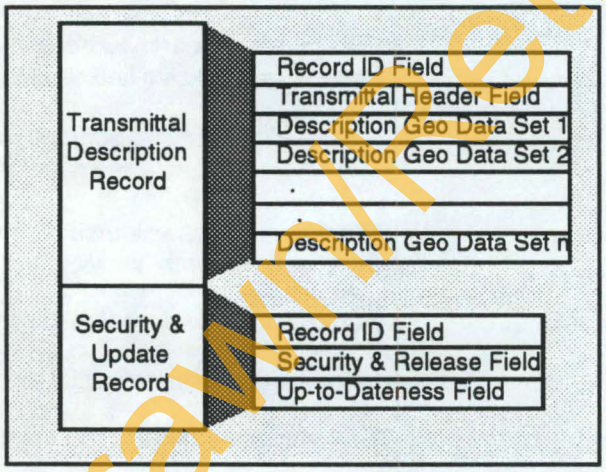


Figure 9-2 Transmittal Header File

For each transmittal, there will be only one THF. Each THF comprises two separate records:

- the Transmittal Description Record; and
- the Security and Update Record.

The THF supplements rather than replaces the normal volume labels (Section Three). The logical entities of the THF are as follows:

- TRANSMITTAL DESCRIPTION RECORD
  - — TRANSMITTAL HEADER FIELD
  - — DATASET DESCRIPTION FIELD
- SECURITY AND UPDATE RECORD
  - — SECURITY AND RELEASE FIELD
  - — UP-TO-DATENESS FIELD

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	Entity Name	Description or Contents
1[C,M]	**TRANSMITTAL HEADER FILE**	
2[C,M]	**TRANSMITTAL DESCRIPTION RECORD**	
3[C,M]	**TRANSMITTAL HEADER**	Identifies the following group of entities that relate to the entire transmittal.
4[C,O]	Media Standard	Media recording standard used for the transmittal. (See Section Three for applicable media standards)
4[C,O]	(originator - addressee)	
5[C,M]	Originator	Free text for title and address of originator. (A back slash "\" is used as a line separator.)
5[C,M]	Addressee	Free Text for title and address of addressee. (A back slash "\" is used as a line separator.)
4[C,S]	Number of Volumes	Number of media volumes comprising the transmittal. (May be a null entry for Magnetic Tapes.)
4[C,M]	Number of Datasets	Number of Datasets within this transmittal.
4[C,M]	Transmittal ID	Unique ID for this transmittal.
4[C,M]	Edition Number	Edition Number for this transmittal.
4[C,M]	Date	Creation date of this transmittal.

The following set of entities is repeated for each dataset of the transmittal.

***3[C,M]**	**DATASET DESCRIPTION**	Identifies the group of entities that relate to a particular dataset in the transmittal.
4[C,M]	Dataset ID	Name of this dataset: e.g. the dataset reference number.
4[C,M]	Data Structure	Code of Data Structure used primarily for this dataset: 1 = Matrix (values) 2 = Matrix (Coded) 3 = Raster (RGB) 4 = Raster (Colour Coded) 5 = Vector (Level 0 Topology—Cartographic Spaghetti) 6 = Vector (Level 1 Topology—Chain-node) 7 = Vector (Level 2 Topology—Planar Graph) 8 = Vector (Level 3 Topology—Full Topology)

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		9 = Mixed data Structures
4[C,M]	Dataset Type	Product type and level (e.g. ASRP , TAD ...) (See Part 3—14).
4[C,M]	Longitude of SW Corner of MBR	Westernmost Longitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Latitude of SW Corner of MBR	Southernmost Latitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Longitude of NE Corner of MBR	Easternmost Longitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Latitude of NE Corner of MBR	Northernmost Latitude of Minimum Bounding Rectangle of this Dataset.

2[C,M]	**SECURITY AND UPDATE RECORD**	
3[C,M]	**SECURITY AND RELEASE**	Identifies the group of entities that relate to the security and release restriction for the complete transmittal.
4[C,M]	Security Classification	Security classification of transmittal. (Never inferior to the highest security classification of any dataset comprising the transmittal.) T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY" (Administrative classification only)) U = UNCLASSIFIED
4[C,M]	Downgrading	Originator's permission for downgrading required. (Yes or No)
4[C,M]	Date	Date of downgrading. (Blank if answer to previous entity is YES or if security classification is equal to "U")
4[C,M]	Releasability	Releasability restrictions for this transmittal. If no release restriction exists, "UNRESTRICTED" shall be entered in this entity.

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The following set of entities is repeated for each Dataset of the Transmittal in the same order as the Dataset Description Fields in the Transmittal Description Record. When the detail for all Datasets in the Transmittal is identical then a single field may be used to globally define the detail.

***3[C,M]**	**UP-TO-DATENESS**	Identifies the group of entities that relate to the currency of the Dataset.
4[C,M]	DIGEST Edition ID	Free text -Identifier of DIGEST edition number used for this Dataset (e.g. the identification of this edition would be DIGEST 1.2).
4[C,M]	DIGEST Edition Date	Publication date of that edition of DIGEST (e.g. the date of this edition would be 19940131).
4[C,M]	DIGEST Amendment Number	DIGEST amendment number (e.g. the number of this amendment will be 0).
4[C,D[1]]	Product Specification Edition ID	Free text -Identifier of the product specification (with edition number) used for this dataset (e.g. ASRP 1.2).
4[C,D[2]]	Product Specification Edition Date	Publication date of the product specification (e.g. 19921031). This entity is mandatory unless the product type is UNKNOWN or UNSPECIFIED.
4[C,D[3]]	Product Specification Amendment Number	The product specification amendment number (e.g. 6). This entity is mandatory unless the product type is UNKNOWN or UNSPECIFIED.

The following set of entities does not belong to the THF but is encoded at the beginning of each media volume as part of the relevant media label (see Section Three).

Volume ID	ID for this specific volume part of the transmittal.
Sequence Number	Sequential number of this volume within the number of volumes of the transmittal.
Transmittal ID	ID for transmittal to which this volume belongs.
Number of Datasets	Number of Datasets in this volume.
Security Classification	Security Classification of this volume. T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY" (Administrative classification only)) U = UNCLASSIFIED

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DEPENDENCY CONDITIONS

1 **Specification Edition ID**: The specification edition ID will be transmitted unless the dataset type is UNSPECIFIED.

2 **Specification Edition Date**: The specification edition date will also be transmitted when the specification edition ID is transmitted.

3 **Specification Amendment Number**: The specification amendment number will also be transmitted when the specification edition ID is transmitted.

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10 HEADER DATA SUBSET (HDS) OR LIBRARY LEVEL TABLES

The Header Data Subset (HDS) [Library Level Tables] are logical entities grouping all supporting information required for exchanging geo data.

Supporting information relating to the Geo Data Subset is contained in the HDS [Library Level Tables]. Such items as projection, quality, control parameters and datums are included in this subset providing the information necessary to interpret the Geo Data Layers(s) [Coverage(s)] composing the Geo Data Subset. Figure 10-1 is a graphic representation of an HDS.

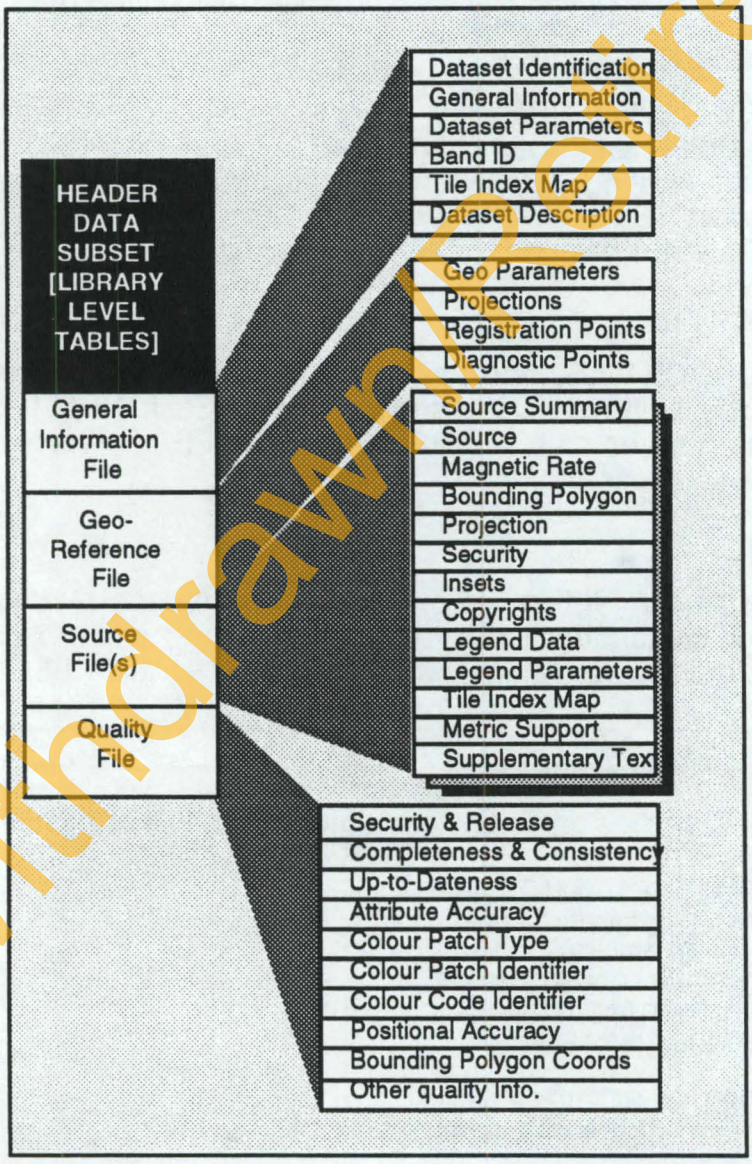


Figure 10-1 Header Data Subset [Library Level Tables]

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The HDS [Library Level Tables] is composed of different file types, which are utilized depending on the nature of the exchanged dataset. As a general rule the HDS [Library Level Tables] are composed of the following file types:

- **GENERAL INFORMATION FILE**

  The GENERAL INFORMATION FILE contains information pertaining to formatting, sequencing and Layer(s) [Coverage(s)] organization within the Geo Data Subset which is helpful for the user and machine reading of the Geo Data files. This file also includes other general information about the actual contents of the Geo Data Subset. Each HDS [Library Level Tables] contains a single GENERAL INFORMATION FILE.

- **GEO REFERENCE FILE**

  The GEO REFERENCE FILE refers to the whole Geo Data Subset and contains parametric information used to transform and/or integrate the data into existing data bases by evaluation of the given geodetic parameters. Each HDS [Library Level Tables] contains a single GEO REFERENCE FILE.

- **SOURCE FILE**

  The SOURCE FILE provides information about source documents to which the Layer(s) [Coverage(s)] refers. Each HDS [Library Level Tables] may contain multiple SOURCE FILES, corresponding to multiple sources.

- **QUALITY FILE**

  The QUALITY FILE gives information about the Geo Data Subset quality in conformance with recommendations made in 7 above. Each HDS [Library Level Tables] contain a single QUALITY FILE.

10.1 GENERAL INFORMATION FILE

The possible logical entities of the General Information File are as follows:

- GENERAL INFORMATION RECORD
  - DATASET IDENTIFICATION FIELD
  - GENERAL INFORMATION FIELD
  - DATASET PARAMETERS FIELD
  - BAND IDENTIFICATION FIELD
  - TILE INDEX MAP FIELD

- DATASET DESCRIPTION RECORD
  - DATASET DESCRIPTION FIELD

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Entity Name	Description or Contents
1[C,M]	**GENERAL INFORMATION FILE**

The following record is repeated once for each layer in the dataset.

*2[C,M]	**GENERAL INFORMATION RECORD**	
3[C,M]	**DATASET IDENTIFICATION**	Identifies the following group of entities that define the dataset identity.
4[C,M]	Dataset Type	Product type and level (e.g. ASRP, TAD, ...) (See Part 3 — 14)
4[C,M]	Dataset ID	Name of Dataset — Unique Dataset ID.
3[C,M]	**GENERAL INFORMATION**	Identifies the following group of entities that give structuring control and processing information about the Layer
4[C,M]	Data Structure	Data Structure code for the Geo Data Later. 1=Matrix (values) 2=Matrix (Coded) 3=Raster (RGB) 4=Raster (Colour Coded) 5=Vector(Level 0 Topology—Cartographic Spaghetti) 6=Vector (Level 1 Topology—Chain-node) 7=Vector (Level 2 Topology—Planar Graph) 8=Vector (Level 3 Topology—Full Topology)
4[R/A,D[1]]	Data Density	Data Density along the cartographic axes
5[R/A,M]	Data Density E/W	Data Density in E/W direction.
5[R/A,M]	Data Density N/S	Data Density in N/S direction.
5[R/A,M]	Data Density Units (see Part 3—10)	Unit of measure used for Data Density in E/W and N/S directions.
4[A,M]	Matrix Units (see Part 3—10)	Unit of measure used for values of matrix data elements.
4[V,D[2]]	MBR/GRP Units (see Part 3—10)	Units of measure used for the Minimum Bounding Rectangle (MBR) and for the Geographic Reference Point (GRP) of each individual feature and topological entity. This entity is required when relative or table coordinates are used to store data.
4[V/A,O]	Data Cover	Percentage data cover within the dataset MBR. ("Total Area" minus "Void Area") times 100 divided by "Total Area". (((TA-VA)*100)/TA) = Percentage Data Cover.
4[V,O]	Feature Count	Total number of features in the Layer

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4[V,O]	Point Feature Count	Number of point features in the Layer.
4[V,O]	Line Feature Count	Number of line features in the Layer
4[V,O]	Area Feature Count	Number of area features in the Layer
4[V,O]	Segment/Edge Record Count	Number of segments in the Layer
4[V,O]	Node Record Count	Number of node records in the Layer
4[V,O]	Face Record Count	Number of face records in the Layer
4[V,O]	Simple Feature Record Count	Number of simple feature records in the Layer
4[R/A,D[3]]	Zone Number	Zone Number. (The primary zone number of the main raster image of a raster dataset.
4[C,M]	Longitude of SW Corner of MBR	Westernmost Longitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Latitude of SW Corner of MBR	Southernmost Latitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Longitude of NE Corner of MBR	Easternmost Longitude of Minimum Bounding Rectangle of this Dataset.
4[C,M]	Latitude of NE Corner of MBR	Northernmost Latitude of Minimum Bounding Rectangle of this Dataset.
	(**Note**: The above four values must be a latitude and longitude reference inWGS 84.)	
4[C,M] [V/A,O]	Reciprocal Scale	Reciprocal scale of Layer (e.g. 50,000 for 1:50,000). This is usually the scale of the source material.
4[R,M]	Pixel Spacing	Sample pixel spacing in microns.
4[R,O]	Rectified Image	Image rectified during scanning. (Yes or No)
4[R/A,D[4]]	Pixel Ground Spacing	Pixel/Element spacing along parallels and meridians.
5[R/A,M]	Pixel Ground Spacing (E/W) (number of pixels in 360 degrees	Pixel ground spacing in E/W direction. (Number of pixels in 360°)
5[R/A,M]	Pixel Ground Spacing (N/S)	Pixel ground spacing in N/S direction. (Number of pixels in 360°)
4[R/A,M] [V,O]	Longitude/Easting of Origin	Longitude/Easting of origin of dataset. (LSO | default = 0)
4[R/A,M] [V,O]	Latitude/Northing of Origin	Latitude/Northing of origin of dataset. (PSO | default = 0)
4[V,O]	Coordinates scale factor	Integer value used to scale the coordinates (CSF | default = 1).
4[C,O]	Free Text	Free text (e.g. description of digitizing equipment).
3[R/A,M] [V,D[5]]	**DATASET PARAMETERS**	Identifies the following group of entities that describe the name of the layer and the location and ordering of a raster dataset. See 11.2 and 11.3 for explanations of the values required for the following entities.
4[R/A,O]	Corners of MBR	
5[R/A,M]	row number of upper right corner	Row number, upper right corner of the MBR in pixels/elements
5[R/A,M]	column number of upper right corner	Column number, upper right corner of the MBR in pixels./elements
5[R/A,M]	row number of lower left corner	Row number, lower left corner of the MBR in pixels/elements.

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5[R/A,M]	column number of lower left corner	Column number, lower left corner of the MBR in pixels/elements.
4[R/A,M]	Number of Subblocks Vertically (Bottom to Top)	Self-explanatory.
4[R/A,M]	Number of Subblocks Horizontally (Left to Right)	Self-explanatory.
4[R/A,M]	Number of Pixels or elements Left to Right	Number of pixels/elements per subblock left to right.
4[R/A,M]	Number of Pixels or elements Top to Bottom	Number of scan lines per subblock.
4[R/A,M]	Column Sequence	Numbering sequence of the columns.
4[R/A,M]	Row Sequence	Numbering sequence of the rows.
4[R/A,M]	Pixel or element Order	Order of pixels or elements.
4[R/A,M]	Pixels or elements Count Length	Number of bits per pixel or element count.
4[R/A,M]	Pixels or elements Value Length	Number of bits per pixel or element value.
4[C,M]	Layer File Name	Name of Layer File.
4[R/A,M]	Tile Index Map Flag	Flag (Y or N) indicating presence or absence of Tile/Subblock Index.
3[R/A,M]	**BAND IDENTIFICATION**	Identifies the following group of entities that define the content of each band of an image or a matrix.
*4[R/A,M]	Band ID	Raster: Identification of the band (e.g. RED). Repeat as necessary. Matrix: Identification of the Nominal code (see Quality file- Nominal Code identifier.
4[R,D[6]]	Band description	
5[R,M]	Wavelength Lower Limit	Lower limit of wavelength span or "ON" colour code. Repeat as necessary. This entity is required if colour coded or multi-spectral data are used.
5[R,M]	Wavelength Upper Limit	Upper limit of wavelength span or "OFF" colour code - Repeat as necessary. This entity is required if colour coded or multi-spectral data are used.
3[R/A,D[7]]	**TILE INDEX MAP**	Provides information about presence or omission and/or address of a Tile/Subblock. Provides information about presence or omission and/or address of a Tile/Subblock.
*4[R/A,M]	Tile Index Value	Values of Tile Index Map (a zero or null value corresponds to an omitted subblock). This entity is required only if the Tile Index Map Flag = "Y"

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2[C,O]	**DATASET DESCRIPTION RECORD**	
3[C,M]	**DATASET DESCRIPTION**	Provides information about the number of sub-regions of accuracy, Layer files and source graphics.
4[C,M]	Total Number of Horizontal Accuracy Sub-regions	Identifies the number of Horizontal Accuracy Sub-regions appearing in the dataset
4[C,M]	Total Number of Vertical Accuracy Sub-regions	Identifies the number of Vertical Accuracy Sub-regions appearing in the dataset
4[C,M]	Total Number of Positional Accuracy Sub-regions	Identifies the number of Positional Accuracy Sub-regions appearing in the dataset
4[C,M]	Total Number of Layers	Identifies the number of Layers appearing in the dataset.
4[C,M]	Total Number of Source Graphics	Identifies the number of Source Graphics appearing in the dataset.

DEPENDENCY CONDITIONS

1 **Data density** (see Pixel ground spacing): Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on cartographic coordinates or Cartesian coordinates (USRP), the LOD, LAD and UNIloa subfields must be used. There is no default value for UNIloa.

2 **MBU:** Required when not the same as coordinates UNITS defined in the Georeference file

3 **Zone Number**: Must be used when transferring raster or matrix data using either UTM/UPS or ARC projection

4 **Pixel Ground Spacing** (see data density): Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on geographic coordinates (ASRP), the ARV and BRV subfields must be used.

5 **Layer file name**: The dataset parameters will be transmitted for vector data when the Geodataset comprises more than one layer.

6 **Band description**: The Band identification must be present for any raster or matrix data: counting the number of BID subfields is the only way to specify the number of raster or matrix bands. WS1 and WS2 are mandatory in case of multi-banded raster data.

7 **Tile index Map**: Mandatory if TIF = "Y"

10.2 GEO REFERENCE FILE

The logical entities of the GEO REFERENCE FILE are as follows:

- GEO REFERENCE RECORD
  - — GEO PARAMETERS FIELD
  - — PROJECTION FIELD
  - — REGISTRATION POINTS FIELD
  - — DIAGNOSTIC POINTS FIELD

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Entity Name		Description or Contents
1[C,D1]	**GEO REFERENCE FILE**	
2[C,M]	**GEO REFERENCE RECORD**	
3[C,D2]	**GEO PARAMETERS**	Identifies the following group of entities that describe and aid the interpretation of the geodetic system of the data.
4[C,M]	Data Type	Type of data comprising the Dataset . (Geographic (GEO), Table (DIG), Grid (MAP))
4[C,M]	Units (see Part 3 — 10)	Units of measure used for coordinates in this Dataset. (see Part2 —12.1)
4[C,M]	Ellipsoid (see Part 3 — 8)	Name of ellipsoid to which the Dataset refers.
4[C,M]	Ellipsoid Details	Details about ellipsoid to which the Dataset refers. (See Part 3 — 8)
4[C,D3]	Vertical Datum	
5[C,M]	Datum Vertical Reference	Name of vertical reference used for the Dataset.
5[C,M]	Vertical Datum Category (Part 3 — 9)	Category (Part 3 — 9) of vertical datum reference.
4[C,D4]	Sounding Datum	
5[C,M]	Sounding Datum	Name of sounding datum. Must be present if soundings appear in data.
5[C,M]	Sounding Datum Category (PART 3 — 9)	Category (PART 3 — 9) of vertical datum reference used for soundings. Must be present if soundings appear in data.
4[C,M]	Datum Geodetic Name	Name of Geodetic Datum.
4[C,M]	Datum Geodetic Code (see Part 3— 9)	Code of Geodetic Datum.
4[C,D5]	**PROJECTION**	Identifies the following group of entities that describe the projection of the data. (See Part 3 — 6)
5[C,M]	Projection Name	Name of the projection used in the Dataset.
5[C,M]	Projection Code	Code of the projection if any. Null if geographic coordinates. Must be present if projection name is present.
5[C,M]	Parameter 1	Projection Parameter 1. Must be present if projection name is present.
6[C,D6]	Parameter 2	Projection Parameter 2. May be present if projection name is present.
7[C,D7]	Parameter 3	Projection Parameter 3. May be present if projection name is present.
8[C,D8]	Parameter 4	Projection Parameter 4. May be present if projection name is present.

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5[C,D[9]]	Projection False Origin	
6[C,M]		X (easting) false origin of projection.
6[C,M]		Y (northing) false origin of projection.
5[C,D[10]]	Z Values False Origin	Elevation and depth false origin for Z values.
3[C,O]	**REGISTRATION POINTS**	Identifies the following group of entities that describe each registration point.
*4[C,M]	Registration Point	Registration Point ID.
4[C,M]	Longitude	Longitude/Easting of Registration Point.
4[C,M]	Latitude	Latitude/Northing of Registration Point.
4[C,D[11]]	Elevation	Elevation and depth false origin for Z values.
4[C,M]	X table coordinate	X table coordinate of digitized registration points.
4[C,M]	Y table coordinate	Y table coordinate of digitized registration points.
4[C,D[11]]	Z table coordinate	Z table coordinate of digitized registration points.
3[C,O]	**DIAGNOSTIC POINTS**	Identifies the following group of entities that describe each diagnostic point
*4[C,M]	Diagnostic Point	Diagnostic Point ID.
4[C,M]	Longitude	Longitude/Easting of Diagnostic Point.
4[C,M]	Latitude	Latitude/Northing of Diagnostic Point.
4[C,D[12]]	Elevation	Elevation of Diagnostic Point.
4[C,M]	X table coordinate	X table coordinate of digitized diagnostic points.
4[C,M]	Y table coordinate	Y table coordinate of digitized diagnostic points
4[C,M[12]]	Z table coordinate	Z table coordinate of digitized diagnostic points.

DEPENDENCY CONDITIONS

1 **Geo reference file**: The presence of Geo reference file is mandatory except for raster data when Dataset type is ASRP or USRP.

2 **Geo Parameters**: Mandatory when the Geo Reference File exists except when Dataset type is SRG.

3 **Vertical Datum**: Mandatory if elevation information is present in the dataset (z values).

4 **Sounding Datum**: Mandatory if sounding information is present in the dataset (depth values).

5 **Projection field**: The projection field is mandatory when coordinates type is MAP (cartographic coordinates) or DIG and forbidden otherwise.

6 **Parameter2**: see Part 3—6

7 **Parameter3**: see Part 3—6

8 **Parameter4**: see Part 3—6

9 **Projection False Origin**: when relevant only

10 **Z-values False Origin**: when relevant only

11 **Elevation Registration Point**: Mandatory if z coordinates must be registered. In this case the table coordinates will have a Z value.

12 **Elevation Diagnostic Point**: Mandatory if the table coordinates have a Z value.

Withdrawn NRCan

10.3 SOURCE FILE

The logical entities of the SOURCE FILE are as follows :

- SOURCE RECORD
  - — SOURCE SUMMARY FIELD
  - — SOURCE FIELD
  - — MAGNETIC RATE FIELD
  - — BOUNDING POLYGON COORDINATES FIELD
  - — PROJECTION FIELD
  - — SECURITY AND RELEASE FIELD
  - — INSET FIELD
  - — COPYRIGHT FIELD
- LEGEND RECORD
  - — LEGEND DATA FIELD
  - — LEGEND PARAMETERS FIELD
  - — TILE INDEX MAP FIELD
- METRIC SUPPORT RECORD
  - — NORMALIZATION CONSTANTS FIELD
  - — SOURCE DATUM COEFFICIENTS FIELD
  - — MAP PROJECTION COEFFICIENTS FIELD
  - — DATUM CHANGE CONSTANTS FIELD
  - — SOURCE DATUM COEFFICIENTS COUNTER FIELD
  - — SOURCE DATUM LONGITUDE COEFFICIENTS FIELD
  - — SOURCE DATUM LATITUDE COEFFICIENTS FIELD
  - — GRID ROTATION COEFFICIENTS FIELD
- SUPPLEMENTARY TEXT RECORD
  - — SUPPLEMENTARY TEXT FIELD

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Entity Name		Description or Contents
*1[C,M]	**SOURCE FILE**	
2[C,M]	**SOURCE RECORD**	
3[C,O]	**SOURCE SUMMARY**	Provides information on the number of text records, legend images, and insets associated with a single source.
4[C,D[1]]	Name of Derived Layer	Name of the particular layer derived from this source
4[C,O]	Number of Text Records	Number of text records in the file derived from the source.
4[R,O]	Number of Legend Images	Number of legend images in the file derived from the source.

4[R,O]	Number of Insets	Number of insets in the file derived from the source.
3[C,M]	**SOURCE**	Provides information on the source(s) used or referenced to create the data contained in the Dataset.
4[C,S]	Series	Series Designator (e.g. 1501).
4[C,S]	Source Identification	Source ID - Number or name which when used in conjunction with the Series and Edition will identify a unique source.
4[C,S]	Edition	Source Edition Number.
4[C,S]	Name	Full Name of Source Document.
4[C,S]	Date	A significant date is a designated date that most accurately describes the basic date of the product for computation of the probable obsolescence date. It can be the compilation date, revision date, or other depending on the product and circumstances. (See Part 4, Annex B for date codes (CDP).
4[C,S]	Country	Country Code. A single code identifying the country with the majority of coverage in the dataset. (See Part 3 — 11)
4[C,S]	Perishable Date	Perishable information date code.
4[C,S]	Reciprocal Scale	Reciprocal of cartographic scale (e.g. 50,000 for 1/50,000 scale).
4[C,S]	Cartographic Grid Code	Cartographic Grid. (See Part 3—7)
4[C,O]	Coverage	
5[C,M]	Coverage	Area Coverage. A number, with unit below, specifying how many square units of area coverage (e.g. 43,000 km^2)
5[C,M]	Unit of Measure for Area Coverage	Unit of measure for area coverage. (See Part 3—10)
4[C,O]	Contour Interval	
5[C,M]	Contour Interval	Predominant contour interval.
5[C,M]	Unit	Unit of measure for contour interval.(See Part 3 —10)
4[C,O]	Water Coverage	Percentage covered by water.
4[C,O]	Navigational System Type	Navigational system type (e.g. LORAN). (See Annex B to Part 4)
4[C,D^2]	Ellipsoid	
5[C,M]	Ellipsoid Name	Ellipsoid Name to which the Source refers.
5[C,M]	Ellipsoid Code	Ellipsoid Code to which the Source refers. (See Part 3—8)
4[C,D^3]	Vertical datum	
5[C,M]	Vertical Reference Name	Name of datum of vertical reference.
5[C,M]	Vertical Reference Code	Code of datum of vertical reference.(Part 3 — 9)
4[C,D^4	Sounding Datum	
5[C,M]	Sounding Datum Name	Name of Sounding Datum.

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5[C,M]	Sounding Datum Code	Code of Vertical Datum for sounding.(Part 3 — 9)
4[C,D[5]]	Geodetic Datum	
5[C,M]	Geodetic Datum Name	Name of Geodetic Datum. (See Part 3 — 9)
5[C,M]	Geodetic Datum Code	Code of Geodetic Datum. (See Part 3 — 9)
4[C,O]	Source Reference Number	Library/Source (or history) Reference Number.
4[R,O]	Highest Elevation	
5[R,M]	Highest Elevation	Highest known elevation (on the source).
5[R,M]	Unit (see Part 3—10)	Units of the highest known elevation.
5[R,S]	Highest Elevation Point	
6[R,M]	Longitude	Longitude of the highest known elevation.
6[R,M]	Latitude	Latitude of the highest known elevation.
3[R,O]	**MAGNETIC RATE**	Provides information on the magnetic rate of change on a given source. The field may be repeated if more than one magnetic rate of change applies for a source.
*4[R,M]	Date (magnetic)	Date of magnetic information.
4[R,M]	Rate of Change	Annual angular magnetic rate of change.
4[R,M]	Unit (see Part 3—10)	Units for magnetic rate of change.
4[R,M]	G-M Angle	Grid North - Magnetic North angle (GMA).
4[R,M]	Unit(see Part 3—10)	Units of GMA.
4[R,S]	Magnetic rate reference Point	
5[R,M]	Longitude	Longitude of the GMA reference point.
5[R,M]	Latitude	Latitude of the GMA reference point.
4[R,O]	Grid convergence	
5[R,M]	Convergence Angle	Grid convergence angle.
5[R,M]	Unit (see Part 3—10)	Units of grid convergence angle.
*3[C,D[6]]	**BOUNDING POLYGON COORDINATES**	Lists the coordinates that define the polygons bounding the Source.
*4[C,M]	Longitude	Longitude/ Easting coordinate.
4[C,M]	Latitude	Latitude/ Northing coordinate.
3[C,O]	**PROJECTION**	Provides information about the map projection used in the Source. (See Part 3 — 6)
4[C,M]	Projection Name	Name of the projection used in the Source.
4[C,M]	Projection Code	Code of the projection if any. Null if geographic coordinates. Must be present if projection name is present.

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4[C,M]	Parameter 1	Projection Parameter 1. Must be present if projection name is present.
5[C,D[7]]	Parameter 2	Projection Parameter 2. Must be present if projection name is present.
6[C,D[8]]	Parameter 3	Projection Parameter 3. Must be present if projection name is present.
7[C,D[9]]	Parameter 4	Projection Parameter 4. Must be present if projection name is present.

4[C,D[10]]	Projection False Origin	
5[C,M]	X (easting) false origin	X (easting) false origin of projection.
5[C,M]	Y (northing) false origin	Y (northing) false origin of projection.

3[C,S]	**SECURITY and RELEASE**	Provides information about the security and releasability of the Source to which it refers.
4[C,M]	Security Classification	Security classification of the Source: T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY" (Administrative classification only)) U=UNCLASSIFIED
4[C,M]	Downgrading	Originator's permission for downgrading required. (Yes or No)
4[C,M]	Date	Date of downgrading. (Blank if answer to previous entity is Yes)
4[C,M]	Releasability	Releasability restrictions for data from this source. If no release restrictions exist, "UNRESTRICTED" shall be entered in this entity.

The following set of entities is repeated for each inset in the dataset.

*3[R,D[11]]	**INSET**	Provides information about the relative and absolute coordinates of the inset.
4[R,M]	Inset Identification	Unique ID for the inset. Dependent on presence of inset.
4[R,M]	Reciprocal Scale	Reciprocal of cartographic scale of Inset (e.g. 50,000 for 1:50,000). Mandatory if inset is present.
4[R,M]	Name	Name of Inset. Mandatory if inset is present.
4[R,M]	Absolute Coordinates	Absolute coordinates of lower and upper left corners and lower and upper right corners of the inset as stated in the host graphic coordinates. Mandatory if inset is present.
4[R,M]		Absolute longitude of lower left corner.
4[R,M]		Absolute latitude of lower left corner.
4[R,M]		Absolute longitude of upper left corner.
4[R,M]		Absolute latitude of upper left corner.
4[R,M]		Absolute longitude of upper right corner.
4[R,M]		Absolute latitude of upper right corner..
4[R,M]		Absolute longitude of lower right corner.
4[R,M]		Absolute latitude of lower right corner.

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4[R,M]	Relative Coordinates	Relative longitude and latitude coordinates of lower and upper left corners and lower and upper right corners of the inset as stated in the host graphic coordinates. Mandatory if inset is present.
4[R,M]		Relative longitude of lower left corner.
4[R,M]		Relative latitude of lower left corner.
4[R,M]		Relative longitude of upper left corner.
4[R,M]		Relative latitude of upper left corner.
4[R,M]		Relative longitude of upper right corner.
4[R,M]		Relative latitude of upper right corner.
4[R,M]		Relative longitude of lower right corner.
4[R,M]		Relative latitude of lower right corner.

3[C,S]	**COPYRIGHT**	Provides information about the copyright restrictions (if any) for the source
4[C,M]	Statement	Free text for the copyright statement. If no copyrights exist, "UNCOPYRIGHTED" shall be placed in this entity.

The following set of entities is repeated for each legend image related to this source.

*2[R,O]	**LEGEND RECORD**	
3[R,M]	**LEGEND DATA**	Provides information on the ID and structure of the image.
4[R,O]	Name	Legend name.
4[R,M]	Data Structure	Data Structure code. 3= Raster (RGB) 4= Raster (Colour Coded)
3[R,M]	**LEGEND PARAMETERS**	Provides parameters to interpret the Legend Image Data.
4[R,O]	Corners	
5[R,M]	row number of upper right corner	Row number, upper right corner of the MBR in pixels/elements.
5[R,M]	column number of upper right corner	Column number, upper right corner of the MBR in pixels/elements.
5[R,M]	row number of lower left corner	Row number, lower left corner of the MBR in pixels/elements.
5[R,M]	column number of lower left corner	Column number, lower left corner of the MBR in pixels/elements.
4[R,M]	Number of Subblocks Vertically (Bottom to Top)	Number of subblocks for the legend, vertically.
4[R,M]	Number of Subblocks Horizontally (Left to Right)	Number of subblocks for the legend, horizontally

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4[R,M]	Number of Pixels/elements (Left to Right)	Number of pixels/elements per subblock left to right.
4[R,M]	Number of Pixels/elements (Top to Bottom)	Number of scan lines per subblock.
4[R,M]	Column Sequence	Numbering sequence of the columns.
4[R,M]	Row Sequence	Numbering sequence of the rows.
4[R,M]	Pixel/element Order	Order of pixels/elements.
4[R,M]	Pixel/elements Count Length	Number of bits per pixel/element count.
4[R,M]	Pixel/elements Value Length	Number of bits per pixel/element value.
4[R,M]	Image File Name	Name of Image File.
4[R,M]	Tile Index Map Flag	Flag (Y or N) indicating presence or absence of Tile/Subblock Index.
3[R,D^{12}]	**TILE INDEX MAP**	Provides information about presence or omission and/or address of a tile/subblock.
*4[R,M]	Tile Index Value	Values of Tile Index Map (a zero or null value corresponds to an omitted tile).
2[R/A,D^{13}]	**METRIC SUPPORT RECORD**	
3[R/A,D^{14}]	Arc system metric support	
4[R/A,M]	**NORMALIZATION CONSTANTS**	To be used only with the ARC system.
5[R/A,M]	Latitude Scale Factor	
5[R/A,M]	Longitude Scale Factor	
5[R/A,M]	Latitude Translation Term	
5[R/A,M]	Longitude Translation Term	
5[R/A,M]	Northing Scale Factor	
5[R/A,M]	Easting Scale Factor	
5[R/A,M]	Northing Translation Term	
5[R/A,M]	Easting Translation Term	
4[R/A,M]	**SOURCE DATUM COEFFICIENTS**	To be used only with the ARC system.
5[R/A,M]	Latitude Coefficient 1	
5[R/A,M]	Latitude Coefficient 2	
5[R/A,M]	Latitude Coefficient 3	
:	:	
5[R/A,M]	Latitude Coefficient 7	
5[R/A,M]	Longitude Coefficient 1	
5[R/A,M]	Longitude Coefficient 2	
5[R/A,M]	Longitude Coefficient 3	
:	:	
5[R/A,M]	Longitude Coefficient 7	
4[R/A,M]	**MAP PROJECTION COEFFICIENTS**	To be used only with the ARC system.

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5[R/A,M]	Northing Coefficient 1	
5[R/A,M]	Northing Coefficient 2	
5[R/A,M]	Northing Coefficient 3	
:	:	
5[R/A,M]	Northing Coefficient 10	
5[R/A,M]	Easting Coefficient 1	
5[R/A,M]	Easting Coefficient 2	
5[R/A,M]	Easting Coefficient 3	
:	:	
5[R/A,M]	Easting Coefficient 10	
3[R/A,D^{15}]	UTM/UPS system metric support	
4[R/A,M]	**DATUM CHANGE CONSTANTS**	To be used only with the UTM/UPS system.
5[R/A,M]	Latitude normalizing offset	Latitude normalizing offset (in degrees and decimal part of a degree).
5[R/A,M]	Longitude normalizing offset	Longitude normalizing offset (in degrees and decimal part of a degree).
5[R/A,M]	Normalizing factor	Normalizing factor
5[R/A,M]	Eastern limit of validity	Eastern limit of validity to use multiple regression equations (in degrees and decimal part of degree).
5[R/A,M]	Western limit of validity	Western limit of validity to use multiple regression equations (in degrees and decimal part of degree).
5[R/A,M]	Northern limit of validity	Northern limit of validity to use multiple regression equations (in degrees and decimal part of degree).
5[R/A,M]	Southern limit of validity	Southern limit of validity to use multiple regression equations (in degrees and decimal part of degree).
4[R/A,M]	**SOURCE DATUM COEFFICIENTS COUNTER**	To be used only with the UTM/UPS system.
5[R/A,M]	Number of longitude coefficients	Number of longitude coefficients.
5[R/A,M]	Number of latitude coefficients	Number of latitude coefficients.
4[R/A,M]	**SOURCE DATUM LONGITUDE COEFFICIENTS**	To be used only with the UTM/UPS system.
*5[R/A,M]	i long index	i index of the coefficient of MRE $b_{i,j}$
5[R/A,M]	j long index	j index of the coefficient of MRE $b_{i,j}$
5[R/A,M]	Coefficient of MRE $b_{i,i}$	Coefficient of MRE $b_{i,j}$. ($b_{i,j}$ coefficients are ordered with respect to increasing i then j).
4[R/A,M]	**SOURCE DATUM LATITUDE COEFFICIENTS**	To be used only with the UTM/UPS system.
*5[R/A,M]	i lat index	i index of the coefficient of MRE $a_{i,j}$.
5[R/A,M]	j lat index	j index of the coefficient of MRE $a_{i,j}$.

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5[R/A,M]	Coefficient of MRE $a_{i,i}$	Coefficient of MRE $a_{i,j}$ ($a_{i,j}$ coefficients are ordered with respect to increasing i then j).
4[R/A,O]	**GRID_ROTATION_ COEFFICIENTS**	To be used only with the UTM/UPS system.
5[R/A,M]	Normalized Eastings shift	Normalized Eastings shift.
5[R/A,M]	Normalized Northings shift	Normalized Northings shift.
5[R/A,M]	Angle of orientation	Angle of orientation from source datum grid to WGS UTM grid.
2[C,O]	**SUPPLEMENTARY TEXT RECORD**	
3[C,M]	**SUPPLEMENTARY TEXT**	Provides information about supplementary text records that cannot be captured graphically and/or are additional information not specified by other entities.
*4[C,M]	Text Field Type	Supplementary text record type. Type Description: CONV: Convergence table information CPYZ: Extended copyright notice DATM: Datum subregion identifier (the subfield DCD in the SOURCE_ FIELD of the SOURCE_RECORD in the SOURCE_FILE contains the first three characters of the datum code) MISC Miscellaneous NOTE Textual CHUM notes XXXX Other codes (when mutually agreed upon).
4[C,O]	Text Field Reference ID	This is a unique identifier that is usually used to identify the type of text specified. The rules for this text field reference identifier are specified in a dataset specification.
4[C,M]	Free text	Free text

DEPENDENCY CONDITIONS

1 **Name of derived layer**: Name of the derived layer will be transmitted whenever the source described in the source record does not apply to all layers in the dataset.

2 **Ellipsoid**: Mandatory if the projection field is transmitted.

3 **Vertical Datum**: Mandatory if elevation information is present in the Source (e.g. contour lines on a raster map). Forbidden if no elevation information is present on the source.

4 **Sounding Datum**: Mandatory if sounding information is present in the source (depth values or sounding information on a raster map). Forbidden if no sounding information is present on the source.

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5 **Geodetic Datum**: Mandatory if the projection field is transmitted.

6 **Bounding polygon**: Mandatory when the source information is not valid for the whole dataset extension.

7 **Parameter 2**: see Part 3—6.

8 **Parameter 3**: see Part 3—6.

9 **Parameter 4**: see Part 3—6.

10 **Projection False Origin**: Mandatory when relevant only.

11 **Inset**: Mandatory when relevant only.

12 **Tile Index Map**: Mandatory if TIF = "Y"

13 **Metric support**: Mandatory when the dataset type is PRT=ASRP or PRT=USRP. Strongly recommended for use of ARC or UTM/UPS systems.

14 **ARC System**: used with ARC system only.

15 **UTM/UPS System**: used with UTM/UPS system only.

10.4 QUALITY FILE

The logical entities of the QUALITY FILE are as follows:

- QUALITY RECORD
  - SECURITY AND RELEASE FIELD
  - COMPLETENESS AND CONSISTENCY FIELD
  - UP-TO-DATENESS FIELD
  - ATTRIBUTE ACCURACY FIELD
  - COLOUR PATCH TYPE FIELD
  - COLOUR PATCH IDENTIFIER FIELD
  - DATASET PARAMETERS FIELD
  - COLOUR CODE IDENTIFIER FIELD
  - NOMINAL CODE IDENTIFIER FIELD
  - OTHER QUALITY INFO FIELD
- ACCURACY RECORD
  - POSITIONAL ACCURACY FIELD
  - BOUNDING POLYGON COORDINATES FIELD
  - HORIZONTAL ACCURACY RECORD
  - VERTICAL ACCURACY RECORD

Entity Name		Description or Contents
1[C,M]	**QUALITY FILE**	
2[C,M]	**QUALITY RECORD**	
3[C,M]	**SECURITY AND RELEASE**	Provides information about security classification, handling and release.
4[C,M]	Security Classification	Highest security classification within the dataset.

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		T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY" (Administrative classification only)) U = UNCLASSIFIED
4[C,M]	Downgrading	Originating agency determination required. (Yes or No)
4[C,M]	Date	Date of downgrading. (Blank if answer to previous entity is Yes, or if the Security classification is "U".)
4[C,M]	Releasability	Releasability restrictions for this dataset. If no release restrictions exist, "UNRESTRICTED" shall be entered in this entity.
3[V,O]	**COMPLETENESS AND CONSISTENCY**	Provides information about the consistency and completeness of the Geo Data Subset.
*4[V,D[1]]	Layer Name	Name of the layer to which the following three subfields refer.
4[V,O]	Feature Completeness	Feature completeness percent. (See 7.3.8)
4[V,O]	Attribute Completeness	Attribute completeness percent. (See 7.3.7)
4[V,O]	Consistency	Logical consistency (Text). (See 7.3.6)
3[C,S]	**UP-TO-DATENESS**	Provides information about the currency of the Geo Data Subset
4[C,M]	Edition Number	Edition number of dataset.
4[C,M]	Creation Date	Date of creation of dataset.
4[C,M]	Revision Date	Date of revision of dataset.
4[C,O]	Recompilation Count	Number of times the dataset has been recompiled.
4[C,O]	Revision Count	Number of times the dataset has been revised.
4[C,M]	Specification ID	ID of product specification (e.g. ASRP...).
4[C,D[2]]	Date	Date of specification.
4[C,D[3]]	Amendment	Specification amendment.
4[C,O]	Earliest Source	Date of earliest source.
4[C,O]	Latest Source	Date of latest source.
3[V,O]	**ATTRIBUTE ACCURACY**	Gives information about standard deviation of quantitative values and reliability of qualitative values of Dataset attributes.
*4[V,D[4]]	Layer Name	Name of the layer to which the following three subfields refer.
4[V,O]	Quantitative Attribute	Standard deviation of quantitative attributes.
4[V,O]	Qualitative Attribute	Percent reliability of qualitative attributes.
4[V,O]	Collection Criteria	Name of collection specification.
3[R,O]	Colour patch transmission	

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4[R,M]	**COLOUR PATCH TYPE**	Identifies the standard colour patch reference.
4[R,M]	Colour Patch Reference	Standard colour patch reference.
4[R,O]	**COLOUR PATCH IDENTIFIER**	Gives Red, Green, Blue values, each averaged over pixels scanned from uniform intensity colour and/or grey scales. Repeat as necessary.
*4[R,M]	Colour Patch Name	Colour patch name (e.g. RED).
5[R,M]	Red	Patch intensity value for the RED.
5[R,M]	Green	Patch intensity value for the GREEN.
5[R,M]	Blue	Patch intensity value for the BLUE.
4[R,D5]	**DATASET PARAMETERS**	Identifies the following group of entities that describe the location and ordering of the colour patch image
5[R,O]	Corners	
6[R,M]	row number of upper right corner	Row number, upper right corner of the MBR in pixels.
6[R,M]	column number of upper right corner	Column number, upper right corner of the MBR in pixels.
6[R,M]	row number of lower left corner	Row number, lower left corner of the MBR in pixels
6[R,M]	column number of lower left corner	Column number, lower left corner of the MBR in pixels.
5[R,M]	Number of Subblocks Vertically (Bottom to Top)	Self-explanatory.
5[R,M]	Number of Subblocks Horizontally (Left to Right)	Self-explanatory.
5[R,M]	Number of Pixels/elements (Left to Right)	Number of pixels/elements per subblock left to right.
5[R,M]	Number of Pixels/elements (Top to Bottom)	Number of scan lines per subblock.
5[R,M]	Column Sequence	Numbering sequence of the columns.
5[R,M]	Row Sequence	Numbering sequence of the rows.
5[R,M]	Pixel/element Order	Order of pixels/elements.
5[R,M]	Pixel/elements Count Length	Number of bits per pixel/element count.
5[R,M]	Pixel/elements Value Length	Number of bits per pixel/element value.
5[R,M]	Image File Name	Name of Image File.
5[R,M]	Tile Index Map Flag = **"N"**	Flag (Y or N) indicating presence or absence of Tile/Subblock Index.

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3[R,D[6]]	**COLOUR CODE IDENTIFIER**	Gives Red, Green, Blue values, each averaged over pixels scanned from uniform intensity colour reference samples intended for colour coded processing. Repeat as necessary for each colour.
*4[R,M]	Name	Name and/or description for first colour code. (Graphic colour)
4[R,M]	Colour Code	Colour code assigned in the dataset.
4[R,O]	CIE color description	
5[R,M]	CIEx	CIE value for "x". (See 11.2.4, Part 2 — A.3.5 and Part 3 —13)
5[R,M]	CIEy	CIE value for "y". (See 11.2.4, Part 2 — A.3.5 and Part 3 —13)
5[R,M]	CIEY	CIE reflectivity value "Y". (See 11.2.4, Part 2 — A.3.5 and Part 3 —13)
4[R,O]	Mathematical relation to other colour codes	Mathematical relation to other colour codes (free text)
4[R,S]	RGB color description	
5[R,M]	Red (recorded)	Actual Red intensity value recorded for this colour code where a single source supplies the image, or a nominal Red intensity value for this colour code where more than one source supplies the image.
5[R,M]	Green (recorded)	Actual Green intensity value recorded for this colour code where a single source supplies the image, or a nominal Green intensity value for this colour code where more than one source supplies the image.
5[R,M]	Blue (recorded)	Actual Blue intensity value recorded for this colour code where a single source supplies the image, or a nominal Blue intensity value for this colour code where more than one source supplies the image.
3[A,M]	**NOMINAL CODE IDENTIFIER**	Used to define the meaning of nominal code or value when used for matrix data.
*4[A,M]	Code Identifier	The identifier of the code. It should be used as the Band ID.
4[A,M]	Description/Meaning of code	Free text description of code (e.g. terrain elevation value, gravity information).
4[A,M]	Nominal code assigned	Integer code assigned to the description.
3[C,O]	**OTHER QUALITY INFO**	Provides information defining specific descriptors related to data quality.
4[C,M]	Free text	Free text
*3[C,D[7]]	**ACCURACY RECORD**	

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4[C,M]	**POSITIONAL ACCURACY**	Provides information about positional accuracy of Geo Data Subset. Repeat as necessary depending on the number of sources and accuracy subregions.
4[C,M]	Absolute Horizontal Accuracy	Absolute horizontal accuracy of Source file/ Region/Subregion.
4[C,M]	Unit of Measure (see Part 3—10)	Unit of measure for absolute horizontal accuracy.
4[C,M]	Absolute Vertical Accuracy	Absolute vertical accuracy of Source file / Region / Subregion.
4[C,M]	Unit of Measure (see Part 3—10)	Unit of measure for absolute vertical accuracy.
4[C,M]	Point to Point Horizontal Accuracy	Point to point horizontal accuracy of Source file / Region / Subregion.
4[C,M]	Unit of Measure (see Part 3—10)	Unit of measure for point to point horizontal accuracy.
4[C,M]	Point to Point Vertical Accuracy	Point to point vertical accuracy of Source file/ Region/Subregion.
4[C,M]	Unit of Measure (see Part 3—10)	Unit of measure for point to point vertical accuracy.
4[C,D[8]]	Layer Name	The former information applies only to the layer with this name.
4[C,D[9]]	**BOUNDING POLYGON COORDINATES**	Provides the geographic coordinates (longitude and latitude) of the polygon which delineates the accuracy region/subregion. Repeat as necessary for each pair of coordinates.
*5[C,M]	Longitude	Longitude coordinate.
5[C,M]	Latitude	Latitude coordinate.
*3[C,D[10]]	**HORIZONTAL ACCURACY RECORD**	Is used in conjunction with the Vertical Accuracy Record and when the horizontal accuracy and vertical accuracy are not homogeneous across the whole dataset extension
4[C,M]	**HORIZONTAL ACCURACY**	Provides information about horizontal positional accuracy of the Geo Data Subset. Repeat as necessary depending on the number of sources and accuracy subregions
4[C,M]	Absolute Horizontal Accuracy	Absolute horizontal accuracy of Source file/ Region/Subregion.
4[C,M]	Unit of Measure	Unit of measure for absolute horizontal accuracy.
4[C,M]	Point to Point Horizontal Accuracy	Point to point horizontal accuracy of Source file / Region / Subregion.
4[C,M]	Unit of Measure	Unit of measure for point to point horizontal accuracy.

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4[C,D[11]]	Layer Name	The former information applies only to the layer with this name.
4[C,D[12]]	**BOUNDING POLYGON COORDINATES**	Provides the geographic coordinates (longitude and latitude) of the polygon which delineates the horizontal accuracy region/subregion. Repeat as necessary for each pair of coordinates.
*5[C,M]	Longitude	Longitude coordinate.
5[C,M]	Latitude	Latitude coordinate.
*3[C,D[10]]	**VERTICAL ACCURACY RECORD**	Is used in conjunction with the Horizontal Accuracy Record and when the horizontal accuracy and vertical accuracy are not homogeneous across the whole dataset extension.
4[C,M]	**VERTICAL ACCURACY**	Provides information about vertical positional accuracy of the Geo Data Subset. Repeat as necessary depending on the number of sources and accuracy subregions.
4[C,M]	Absolute Vertical Accuracy	Absolute vertical accuracy of Source file / Region / Subregion.
4[C,M]	Unit of Measure	Unit of measure for absolute vertical accuracy.
4[C,M]	Point to Point Vertical Accuracy	Point to point vertical accuracy of Source file/ Region/Subregion.
4[C,M]	Unit of Measure	Unit of measure for point to point vertical accuracy.
4[C,D[13]]	Layer Name	The former information applies only to the layer with this name.
4[C,D[14]]	**BOUNDING POLYGON COORDINATES**	Provides the geographic coordinates (longitude and latitude) of the polygon which delineates the vertical accuracy region/subregion. Repeat as necessary for each pair of coordinates.
*5[C,M]	Longitude	Longitude coordinate.
5[C,M]	Latitude	Latitude coordinate.

DEPENDENCY CONDITIONS

1 **Name of layer**: The name of the layer will be transmitted whenever the completeness and consistency information does not apply to all layers in the dataset.

2 **Specification edition date**: The specification edition date will be transmitted with the specification edition ID.

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3 **Specification amendment number**: The specification amendment number will be transmitted with the specification edition ID.

4 **Name of layer**: The name of the layer will be transmitted whenever the attribute accuracy information does not apply to all layers in the dataset.

5 **Colour patch dataset parameters**: The colour patch dataset parameters will be transmitted if the colour patch image file exists.

6 **Color coded**: Must be defined when raster color coded is transmitted (STR=4). Forbidden otherwise.

7 **Accuracy record**: Must be used when both horizontal and vertical accuracy are known and homogeneous on the same area.

8 **Name of layer**: The name of the layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset.

9 **Bounding polygon**: Mandatory when the source information is not valid for the whole dataset extent.

10 **Horizontal and vertical accuracy layer**: Whenever a horizontal accuracy record is transmitted, there must be at least one vertical accuracy record.

11 **Name of layer:** The name of the layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset.

12 **Bounding polygon**: Mandatory when the source information is not valid for the whole dataset extent.

13 **Name of layer**: The name of the layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset.

14 **Bounding polygon**: Mandatory when the source information is not valid for the whole dataset extent.

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11 GEO DATA SUBSET

The Geo Data Subset (GDS) contains the actual collection of digital information representing physical and cultural characteristics of the Earth's surface. The GDS is composed of one or more layers. The GDS can support several data structures (see clause 5 above), however, data structures may not be mixed within a layer. Also, within a single Geo data subset only one geographic reference system and projection is allowed.

Digital information may be represented by one of the following data exchange structure types:

- Spaghetti vector data (Level 0 Topology);
- Chain-node vector data (Level 1 Topology);
- Planar graph vector data (Level 2 Topology);
- Full topological vector data (Level 3 Topology);
- Raster data (radiometric information pertaining to pixels); and
- Matrix data (non-radiometric information pertaining to points at regularly identified intervals).

Figure 11-1 illustrates the content of a Geo Data Layer within the GDS.

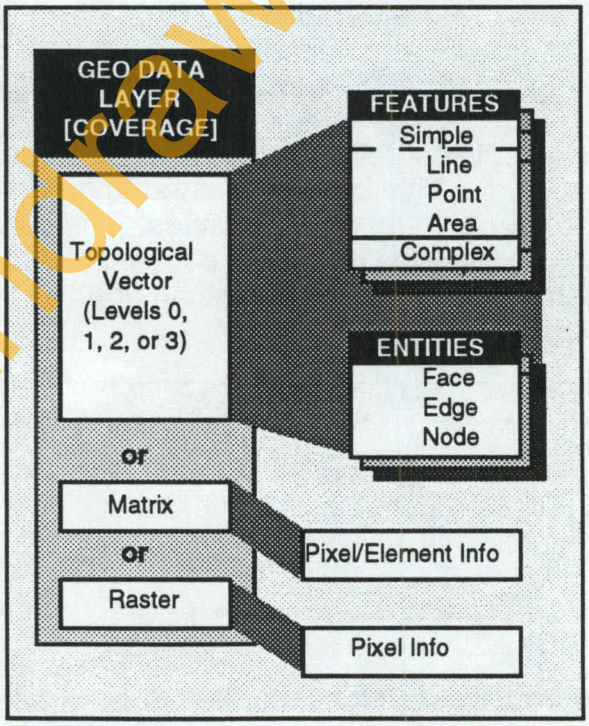


Figure 11-1 Geo Data Layer

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Although a Geo Data Layer, composing the GDS, is a single logical entity, it may be represented as a number of separate files for convenience in processing or transfer. For example, it may be beneficial to group all of the Edge, Node and Face records into separate files.

The detailed information required for each layer of the GDS is specified below.

11.1 VECTOR DATA

The record structures necessary to capture the topological, spatial, descriptive feature/attribute and data quality information are contained in a Geo Data Layer. The Geo Data Layer consists of one or more files. DIGEST allows any order of the occurrence of feature records and topological entity records on the physical medium or in the data stream, however it is strongly recommended that records of the same type be grouped together so as to ease the computational load on parsers and also to aid human readability of the data.

Note that DIGEST distinguishes between Explicit and Implicit Attributes and between Explicit and Implicit Relations. Essentially, attributes or relations that are fundamental to the structure of the dataset are referred to as "Implicit" and are carried using pre-defined fields or subfields within the record structure. All other attributes and relations are referred to as "Explicit" and are carried using a flexible, general purpose mechanism. The rules governing attribute and relation coding are described in greater detail in 12.2 and 12.3.

The vector data may be implemented by either a feature-oriented data structure or a relational data structure. The feature-oriented approach treats the various Entities and Features as objects, with attributes. The relationships existing between them are accomplished by means of pointers. The relational approach stores the Entities, Features and attributes in tabular form and they are related by means of key columns.

11.1.1 RECORD IDENTIFICATION

A vector Geo Data Layer may consist of 11 different record types. Each instance of each record type is uniquely identified through the use of a RECORD_ID_ FIELD comprising two subfields:

- Record Type (RTY); and
- Record ID (RID).

Each use of the RECORD_ID_FIELD in this file must populate the Record type subfield with an appropriate value from the table listed below.

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Record Type (RTY)	feature oriented	relational
LINE_FEATURE_RECORD	FL	*.LFT_ID
POINT_FEATURE_RECORD	FP	*.PFT_ID
AREA_FEATURE_RECORD	FA	*.AFT_ID
COMPLEX_FEATURE_RECORD	FC	*.CFT_ID
EDGE_RECORD	ED	EDG_ID
NODE_RECORD	NO	END_ID | CND_ID
FACE_RECORD	FE	FAC_ID
SPATIAL_DATA_RECORD	SP	- - -
TEXT_PLACEMENT_RECORD	TP	TXT_ID & *.TFT_ID
FEATURE/ATTRIBUTE_ENTRY_RECORD	DD	- - -
FEATURE/ATTRIBUTE_ASSOCIATION_RECORD	DF	- - -
ATTRIBUTE/VALUE_ASSOCIATION_RECORD	DA	

In addition to the Record Type value (RTY), the Record ID (RID) subfield of this field must be given a number unique within the record type such that the combination of RID and RTY uniquely identifies that instance of the record type within the file. Within a file, record instance of the same type will be given, as Record ID values, consecutive numbers starting with 1.

Both subfields of the RECORD_ID_FIELD, optionally combined with a security sub-field, will be used as a pointer or key when describing the relations between entities or features.

11.1.2 LINE FEATURE RECORD

The Line Feature record is used to relate contiguous topological edges into a line geographic object, and describe that object. At least one Simple Feature must exist for each Complex Feature.

- LINE FEATURE RECORD
  - COUNTER FIELD
  - IMPLICIT RELATION POINTER FIELD
  - IMPLICIT ATTRIBUTE FIELD
  - EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - EXPLICIT RELATION POINTER FIELD
  - EXPLICIT RELATION VALUE FIELD

2 [V,D[1]] **LINE FEATURE RECORD**	RTY = FL | *.LFT_ID

3 [V,O] **COUNTER**	Identifies the following group of entities that define the number of explicit attributes and relations present for the feature

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4[V,M]	Number of Explicit Attributes	
4[V,M]	Number of Explicit Relations	
4[V,M]	Total Number of "Composed Of" Relations	

3 [V,M]	**IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe "Composed Of" relationships between the Line Feature and topological Edges

A line feature is an ordered set of line segments starting from one point and ending at another point. Consequently, to keep this notion of continuity, Edge pointers will appear in such a way that they will reflect the ordered sequence of the segments, or in other words, the orientation of the Line Feature. This orientation will not necessarily be the same as the orientation of each component Edge. To reflect this information at the pointer level, the Record Type and Record Id of each Edge will be combined with an orientation flag.
For instance, in feature oriented implementation, the RTY value will be preceded by a "+" or a "-" sign to specify the direction in which the Edge should be followed. A typical Edge pointer would appear as follows: ±ED

*4[V,M]	Flagged Record Type	Combination of the Record type for an Edge and of the orientation flag " ±ED"
4 [V,M]	Record ID	n Record number of the particular Edge
4 [V,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the component Edge

3 [V,M]	**IMPLICIT_ATTRIBUTE**	Identifies the following group of entities that define the FACC code, Minimum bounding rectangle and Geographic Reference point of the Line Feature

Information relating to the coordinate coding (units-format) is given for each Dataset File in the GEO_REFERENCE_FILE of the HEADER_DATA_SUBSET.

4 [V,M]	FACC Identifier Code	A five character FACC code, the first two of which are alphabetic characters and the last three of which are integers.
4 [V,O]	MINIMUM BOUNDING RECTANGLE SECTION	
5 [V,M]	Minimum Easting/Longitude	X Coordinate of the lower left corner of the MBR
5 [V,M]	Minimum Northing/Latitude	Y Coordinate of the lower left corner of the MBR
5 [V,D^2]	Minimum Elevation	Z Coordinate of the lowest elevation within the MB. The presence or absence of this value must correspond to the presence or absence of elevation coordinates of the Edges.
5 [V,M]	Maximum Easting/Longitude	X Coordinate of the upper right corner of the MBR

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5 [V,M]	Maximum Northing/Latitude	Y Coordinate of the upper right corner of the MBR
5 [V,D2]	Maximum Elevation	Z Coordinate of the highest elevation within the MB. The presence or absence of this value must correspond to the presence or absence of elevation coordinates of the Edges

4 [V,O]	GEOGRAPHIC REFERENCE POINT (GRP) SECTION	
5 [V,M]	Easting/Longitude	X Coordinate of the GRP
5 [V,M]	Northing/Latitude	Y Coordinate of the GRP

3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	Identifies the following group of entities that define characteristics of the feature

As described in 12.2, the Labels and Values are combined to permit explicit attributes to be associated to the feature entity. The field is used to encode not only the attribute entries to satisfy recommended Data Quality descriptors (SOURCE, POSITIONAL ACCURACY, UP-TO-DATENESS, SECURITY, CLIPPING INDICATOR and RELEASABILITY), but other attributes as required to fully describe the characteristics of the feature (see Part 4) for attribute values and suggested attribute-to-feature mappings.

For Data Quality the values associated with each of these attributes are actual values. Alternatively, the attribute label "QID" may be substituted for the "Quality" or "Source" labels, in which case the value of QID is a pointer to an entry(ies) in the SOURCE_FILE or the QUALITY_FILE. If used as a pointer, the value associated with the attribute label must be the value of the RECORD_ID_FIELD RTY and RID subfields of that record of the quality or source record pointed to (see 12.2.4 for a description).

*4 [V,D3]	ORDERED ROOTED TREE LINKS SECTION	
5 [V,M]	Left Link	Left Link of the ordered, rooted tree.
5 [V,M]	Right Link	The left and right subfields will exist for all attributes, if there is at least one multi-level attribute.

4 [V,M]	ATTRIBUTE DESCRIPTION SECTION	
5 [V,M]	Attribute Code	The three alphabetic character FACC Attribute Code associated with the FACC Feature Code.
5 [V,M]	Value Format	The format according to which the following Attribute Value will be read: "A" | "I" | "R" | "L"
4 [V,M]	Attribute Value	The value of the FACC attribute. This may be an enumerated value in I format or an "Actual Value" in A, I ,L or R format. See Value Format, above.

*3 [V,O]	**EXPLICIT RELATIONS SECTION** (Repeats)	

The two following fields, when used in conjunction, allow an explicit relation (e.g. "Stacked On").

4 [V,M]	**EXPLICIT_RELATION_POINTER**	Defines the type of explicit relation

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5 [V,M]	Relation Type	The currently defined types are "ALT" | "STK" | "STU" corresponding to Alternative Representation, Stacked On and Stacked Under, respectively. Note: "CPO" (Composed Of) is not allowed for a Simple feature. Also, "STK" | "STU" are not appropriate if "FC " is the Record Type, below (i.e. Stacked On/Under relationships are possible between Simple Features only.)

5 [V,M]	**EXPLICIT_RELATION_VALUE**	Identifies the following group of entities that describe the explicit relation between the Line Feature and other features
*6 [V,M]	Record Type	Record Type of the feature pointed to: "FL " | "FP " | "FA " | "FC " for Line Feature, Point Feature, Area Feature and Complex Feature respectively. See note above for restriction on "FC ".
6 [V,M]	Record ID	n Record number of the feature pointed to.
6 [V,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the feature pointed to.

DEPENDENCY CONDITIONS:

1 **Simple feature**: There must be at least one simple feature in the Geodata layer. There must be at least one simple feature for each complex feature.

2 **Elevation MBR subfields**: If any of the topological entities, composing or bordering the simple feature or any of the simple feature composing the complex feature, contains elevation values in its coordinates field, maximum and minimum elevation values will be transmitted.

3 **Left/Right Link**: Left and right link subfield will exist for all attributes, if there is at least one multi-level attribute.

11.1.3 POINT FEATURE RECORD

The Point Feature record is used to relate a single topological node to a point geographic object, and it also describes that object. It contains the fields and subfields described below.

- POINT FEATURE RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — EXPLICIT RELATION POINTER FIELD
  - — EXPLICIT RELATION VALUE FIELD

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2 [V,D[1]]	**POINT FEATURE RECORD**		RTY = FP I *.PFT_ID
3 [V,O]	**COUNTER**	see Line Feature (11.1.2)	
3 [V,M]	**IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe "Composed Of" relationships between the Point Feature and topological Node(s).	
*4[V,M]	Record Type	Record type for a Node	"NO "
4 [V,M]	Record ID	n Record number of the particular Node	
4 [V,O]	Security	"T" I "S" I "C" I "R" I "U" Security level of the component Node	
3 [V,M]	**IMPLICIT_ATTRIBUTE**	see Line Feature (11.1.2)	
3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	see Line Feature (11.1.2)	
*3 [V,O]	**EXPLICIT RELATIONS SECTION** (Repeats)	see Line Feature (11.1.2)	
4 [V,M]	**EXPLICIT_RELATION_POINTER**	see Line Feature (11.1.2)	
5 [V,M]	**EXPLICIT_RELATION_VALUE**	see Line Feature (11.1.2)	

DEPENDENCY CONDITION:

1 **Simple feature:** There must be at least one simple feature in the Geodata layer. There must be at least one simple feature for each complex feature.

11.1.4 AREA FEATURE RECORD

11.1.4.1 TOPOLOGICAL LEVEL 3

The Area Feature record is used to relate contiguous topological Faces into an area geographic object, and describe that object. It contains the fields and subfields described below.

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- AREA FEATURE RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — EXPLICIT RELATION POINTER FIELD
  - — EXPLICIT RELATION VALUE FIELD

2 [V,D[1]]	**AREA FEATURE RECORD**		RTY = FA I *.AFT_ID
3 [V,O]	**COUNTER**	see Line Feature (11.1.2)	
3 [V,M]	**IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe "Composed Of" relationships between the Area Feature and topological Faces.	
*4[V,M]	Record Type	Record Type for a Face	"FE "
4 [V,M]	Record ID	n Record number of the particular Face	
4 [V,O]	Security	"T" I "S" I "C" I "R" I "U" Security level of the component Face	
3 [V,M]	**IMPLICIT_ATTRIBUTE**	see Line Feature (11.1.2)	
3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	see Line Feature (11.1.2)	
*3 [V,O]	**EXPLICIT RELATIONS SECTION** (Repeats)	see Line Feature (11.1.2)	
4 [V,M]	**EXPLICIT_RELATION_POINTER**	see Line Feature (11.1.2)	
5 [V,M]	**EXPLICIT_RELATION_VALUE**	see Line Feature (11.1.2)	

DEPENDENCY CONDITION:

1 **Simple feature**: There must be at least one simple feature in the Geodata layer. There must be at least one simple feature for each complex feature.

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11.1.4.2 TOPOLOGICAL LEVEL 2, 1 AND 0

The Area Feature record is used to relate topological Edges into boundaries of an area geographic object, and describe that object. It contains the fields and subfields described below.

- AREA FEATURE RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — EXPLICIT RELATION POINTER FIELD
  - — EXPLICIT RELATION VALUE FIELD

2 [V,D[1]]	**AREA FEATURE RECORD**	RTY = FA | *.AFT_ID
3 [V,O]	**COUNTER**	see Line Feature (11.1.2)

3 [V,O]	**IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe "Composed Of" relationships between the Area Feature and topological Edges composing its boundary.

The boundary of an area feature is an ordered set of line segments starting from one point and ending at another point. The boundary may be composed of one or more contiguous ring. Consequently, to keep this notion of ring, Edge pointers will appear in such a way that they will reflect the ordered sequence of the segments. The orientation of the ring will not necessarily be the same as the orientation of each component Edge. To reflect this information at the pointer level, the Record Type and Record Id of each Edge will be combined with an orientation flag.

*4[V,M]	Flagged Record Type	Combination of the Record type for an Edge and of the orientation flag	"+ED" | "-ED" | "IED" | "JED"
4 [V,M]	Record ID	n	Record number of the particular Edge
4 [V,O]	Security	"T" | "S" | "C" | "R" | "U"	Security level of the component Edge

"+" — Forward:
Used for the beginning segment of a feature and any subsequent segments except when using "D", "E", "I", and "J" as defined herein.

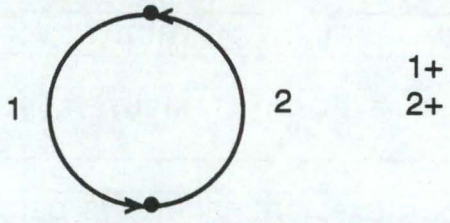


Figure 11-2 Code for *Forward*

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"-" — Reverse:
Used for the beginning segment of a feature and any subsequent segments except when using "D", "E", "I", and "J" as defined herein.

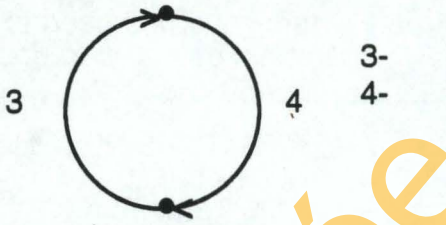


Figure 11-3 Code for *Reverse*

"I" — Inside Forward:
Used for the beginning segment of a hole or island within an area feature.

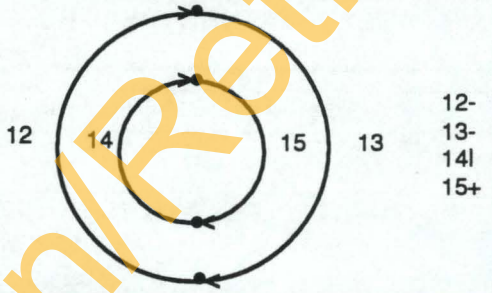


Figure 11-4 Code for *Inside Forward*

"J" — Inside Reverse:
Used for the beginning segment of a hole or island within an area feature.

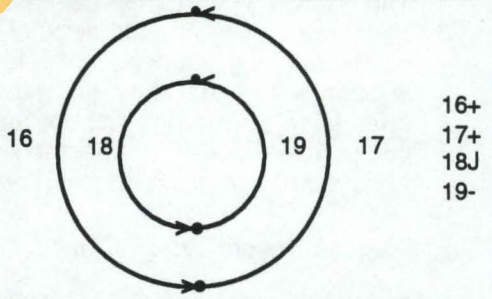


Figure 11-5 Code for *Inside Reverse*

3 [V,M] **IMPLICIT_ATTRIBUTE** see Line Feature (11.1.2)

3 [V,O] **EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES** see Line Feature (11.1.2)

*3 [V,O] **EXPLICIT RELATIONS SECTION** (Repeats) see Line Feature (11.1.2)

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4 [V,M]	**EXPLICIT_RELATION_POINTER**	see Line Feature (11.1.2)

4 [V,M]	**EXPLICIT_RELATION_VALUE**	see Line Feature (11.1.2)

DEPENDENCY CONDITION:

1 **Simple feature**: There must be at least one simple feature in the Geodata layer. There must be at least one simple feature for each complex feature.

11.1.5 COMPLEX FEATURE RECORD

The Complex Feature record is used to relate any combination of Simple features and other Complex features so long as the Complex feature remains acyclic. It contains the fields and subfields described below.

- COMPLEX FEATURE RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — EXPLICIT RELATION POINTER FIELD
  - — EXPLICIT RELATION VALUE FIELD

2 [V,O]	**COMPLEX FEATURE RECORD**	RTY = FC I *.CFT_ID

3 [V,O]	**COUNTER**	see Line Feature (11.1.2)

3 [V,M]	**IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe "Composed Of" relationships between the Complex Feature and other Simple and/or Complex Feature(s).

The ordered sequence of the pointer fields will conform to the feature pointer sequence as follows: Line, Point, Area, Complex. Line feature pointers will be ordered when possible.

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*4[V,M]	Record Type	Record type for Line, Point, Area or Complex Feature "FL " I "FP " I "FA "I "FC "
4 [V,M]	Record ID	n Record number of the particular Feature
4 [V,O]	Security	"T" I "S" I "C" I "R" I "U" Security level of the component Feature

3 [V,M]	**IMPLICIT_ATTRIBUTE** see Line Feature (11.1.2)
3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES** see Line Feature (11.1.2)
*3 [V,O]	**EXPLICIT RELATIONS SECTION** (Repeats) see Line Feature (11.1.2)
4 [V,M]	**EXPLICIT_RELATION_POINTER** see Line Feature (11.1.2)
5 [V,M]	**EXPLICIT_RELATION_VALUE** see Line Feature (11.1.2)

11.1.6 EDGE RECORD

The Edge record is used to encode the spatial, topological and attributional characteristics of topological Edges (as defined in 5.1 (topological relationships) and Part 4 (feature attributes)). It contains the fields and subfields described below. At least one Edge Record must exist for every Line Feature.

- EDGE RECORD
  - — COUNTER FIELD
  - — EDGE IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT RELATIONS POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — COORDINATE FIELD

2 [V,D[1]]	**EDGE RECORD**	RTY = ED I EDG_ID
3 [V,O]	**COUNTER**	Identifies the following group of entities that define the number of explicit attributes, coordinate sets, and composed of Feature(s) for the Edge.

4[V,M] Number of Explicit Attributes

Withdrawn/Retirée

4[V,M]	Number of Coordinate sets	
4[V,D^2]	Number of Features "Composed Of" this Edge	

3 [V3,M] [V1-2,O]	**EDGE_IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe the relationships between the Edge and the other topological entities (Faces and Nodes)

For an Edge, six relations may be established. "Left", "Right", "Start" and "End" are based on the digitizing sense of the Edge. These relations are mandatory or optional depending on the topological level to which the vector layer pertains.

4 [V3,M]	FACE TOPOLOGY	
5 [V3,M]	Left Face ID	Identification of the Face to the left of the Edge
6[V3,M]	Record Type	Record type for a Face "FE"
6 [V3,M]	Record ID	n Record number of the left Face
6 [V3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the left Face
5 [V3,M]	Right Face ID	Identification of the Face to the right of the Edge
6[V3,M]	Record Type	Record type for a Face "FE"
6 [V3,M]	Record ID	n Record number of the right Face
6 [V3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the right Face
4 [V3,M] [V1-2,O]	EDGE-NODE TOPOLOGY	
5 [V1-3,M]	Start Node ID	Identification of the Connected Node at the start of the Edge
6 [V1-3,M]	Record Type	Record type for a Node "NO"
6 [V1-3,M]	Record ID	n Record number of the start Node
6 [V1-3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the start Node
5 [V1-3,M]	End Node ID	Identification of the Connected Node at the end of the Edge
6 [V1-3,M]	Record Type	Record type for a Node "NO"
6 [V1-3,M]	Record ID	n Record number of the end Node
6 [V1-3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the end Node
4 [V1-3,O]	WINDGED-EDGE TOPOLOGY	

Withdrawn/Retirée

5 [V1-3,M]	Next Right Edge ID	Identification of the Next Right Edge
6 [V1-3,M]	Record Type	Record type for an Edge "ED"
6 [V1-3,M]	Record ID	n Record number of the Next Right Edge
6 [V1-3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the Next Right Edge
5 [V1-3,M]	Previous Left Edge ID	Identification of the Previous Left Edge
6 [V1-3,M]	Record Type	Record type for an Edge "ED"
6 [V1-3,M]	Record ID	n Record number of the Previous Left Edge
6 [V1-3,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the Previous Left Face Edge

3 [V,O] **IMPLICIT_RELATIONS_POINTER**
Identifies the following group of entities that describe relationships between the Edge and the features to which the Edge belongs.

This field must contain the RTY and RID of the feature being referenced. The RTY field may contain in addition the following feature orientation parameter which defines the referenced feature's location relative to the Edge Record which represents it.
C: Coincident with the spatial coordinates of the Edge record.

*4[V,M]	Record Type	Record type for Line or Area feature "CFL" | "CFA"
4 [V,M]	Record ID	n Record number of the particular Feature
4 [V,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the component Feature

3 [V,O] **IMPLICIT_ATTRIBUTE** Identifies the following group of entities that contains the two coordinate sets defining the extent of the MBR of the Edge.

Information relating to the coordinate coding (units-format) is given for each Dataset File in the GEO_REFERENCE_FILE of the HEADER_DATA_SUBSET.

4 [V,M]	Minimum	Coordinates of Lower Left corner of the Minimum Bounding Rectangle (MBR)
5 [V,M]	Easting/Longitude	X Coordinate of the MBR
5 [V,M]	Northing/Latitude	Y Coordinate of the MBR
5 [V,D3]	Elevation	Z Coordinate of the MBR
4 [V,M]	Maximum	Coordinates of Upper Right corner of the Minimum Bounding Rectangle (MBR)
5 [V,M]	Easting/Longitude	X Coordinate of the MBR
5 [V,M]	Northing/Latitude	Y Coordinate of the MBR

Withdrawn/Retirée

5 [V,D[3]]	Elevation	Z Coordinate of the MBR. The presence or absence of this value must correspond to the presence or absence of the elevation of the Lower Left corner of the MBR.

3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	Identifies the following group of entities that define quality of the Edge

As described in 12.2 the Labels and Values are used in conjunction to permit explicit data quality attributes to be associated to the topological entity (e.g. edge). The field is used to encode up to four potential edge attribute entries to satisfy recommended Data Quality descriptors (see clause 7). These attributes are SOURCE, POSITIONAL ACCURACY, UP-TO-DATENESS and SECURITY. No other attributes may be associated with the Edge topological entity.

The values associated with each of these attributes are actual values. Alternatively, the attribute label "QID" may be substituted for the "Quality" or "Source" labels, in which case the value of QID is a pointer to an entry(ies) in the SOURCE_FILE or the QUALITY_FILE. If used as a pointer, the value associated with the attribute label must be the value of the RECORD_ID_FIELD RTY and RID subfields of that record of the quality or source record pointed to (see 12.2.4 for a description).

*4 [V,M]	Attribute Code	The three alphabetic character FACC Attribute Code associated with the FACC Feature Code.
4 [V,M]	Value Format	The format according to which the following Attribute Value will be read. "A" | "I" | "R"
4 [V,M]	Attribute Value	The value of the FACC attribute. This may be an enumerated value in I format or an "Actual Value" in A, I or R format. See Value Format, above.

3 [V,M]	**COORDINATE**	Identifies the following group of entities that describe the geometry of the Edge

Each instance of this field contains a coordinate set (see 12.1). Information relating to the coordinate coding (units, format) used in a given GEO_DATA_FILE is found in the GEO_REFERENCE_FILE of the HEADER_DATA_SUBSET.

*4 [V,M]	Easting/Longitude	X Coordinate of a digitized point on the Edge
4 [V,M]	Northing/Latitude	Y Coordinate of a digitized point on the Edge
4 [V,D[4]]	Elevation	Z Coordinate of a digitized point on the Edge. This value must be either consistently absent or consistently present.

DEPENDENCY CONDITIONS

1 **Edge record**: Vector geodata files containing only nodes and no edges or faces may exist. Edge record is mandatory if Vector geodata file contains Line or Area feature records. At Level0, it may be replaced by Spatial data record.

Withdrawn/Obsolete

2 **Number of Features**: The Number of Features counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

3 **Elevation MBR subfield** : Minimum and maximum elevation must be transmitted if the transmitted coordinates (COR) contain elevation value(s).

4 **Elevation Coordinates subfield** : Elevation must be absent or present for all transmitted coordinates.

11.1.7 NODE RECORD

The Node record is used to encode the spatial, topological and attributional characteristics of topological Nodes (as defined in 5.1 (topological relationships) and Part 4 (feature attributes)). It contains the fields and subfields described below.

- NODE RECORD
  - — COUNTER FIELD
  - — EDGE IMPLICIT RELATION POINTER FIELD
  - — IMPLICIT RELATIONS POINTER FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — COORDINATE FIELD

2 [V,D[1]]	**NODE RECORD**	RTY = NO I END_ID I CND_ID

3 [V,O]	**COUNTER**	Identifies the following group of entities that define the number of explicit attributes, coordinate sets, and composed of Feature(s) for the Node.

The value for the "number of expected coordinate sets " must be "1" .

4[V,M]	Number of Explicit Attributes	
4[V,M]	Number of Coordinate sets	"1"
4[V,D[2]]	Number of Features "Composed Of" this Node	

3 [V3,M]	**NODE_IMPLICIT_RELATION_POINTER**	Identifies the following group of entities that describe the relationships between the isolated Node and its containing Face

The following group of subfield will contain null values for a connected node

4 [V,M]	Record Type	Record type for a Face	"FE " or Null
4 [V,M]	Record ID	n or Null	Record number of the particular Face

Withdrawn/Retirée

4 [V,O]	Security	"T" | "S" | "C" | "R" | "U"	Security level of the Containing Face.

3 [V,O]	**IMPLICIT_RELATIONS_POINTER**	Identifies the following group of entities that describe relationships between the Node and the Point features to which the Node belongs.

This field must contain the RTY and RID of the feature being referenced. The RTY field may contain in addition the following feature orientation parameter which defines the referenced feature's location relative to the Node Record which represents it.

C: Coincident with the spatial coordinates of the Node record..

*4 [V,M]	Record Type	Record type for Point feature	"CFP"
4 [V,M]	Record ID	n	Record number of the particular Point Feature
4 [V,O]	Security	"T" | "S" | "C" | "R" | "U"	Security level of the Point feature

3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	(see Edge Record 11.1.6)

3 [V,M]	**COORDINATE**	Identifies the following group of entities that describe the coordinate set of the Node

This field contains a coordinate set (see 12.1). Information relating to the coordinate coding (units, format) used in a given GEO_DATA_FILE is found in the GEO_REFERENCE_FILE of the HEADER_DATA_SUBSET.

4 [V,M]	Easting/Longitude	X Coordinate of the Node
4 [V,M]	Northing/Latitude	Y Coordinate of the Node
4 [V,O]	Elevation	Z Coordinate of the Node.

DEPENDENCY CONDITIONS:

1 **Node record**: Vector geodata files without any node record may exist. Node record is mandatory if Vector geodata file contains Point feature records or if Edge record contains edge-node topology description. At Level0, it may be replaced by Spatial data record.

2 **Number of Features**: The Number of Features counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

11.1.8 FACE RECORD

The Face record is used to encode the spatial, topological and attributional characteristics of topological Faces (as defined in 5.1 (topological relationships) and Part 4 (feature attributes)). It contains the fields and subfields described below.

Withdrawn/Retired

- FACE RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATIONS POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD

2 [V3,M]	**FACE RECORD**	RTY = FE I FAC_ID

3 [V3,O]	**COUNTER**	Identifies the following group of entities that define the number of explicit attributes, coordinate sets, and composed of Feature(s) for the Face.

The number of coordinate set is null but is carried for the sake of consistency with other counter fields at the topological level.

4[V3,M]	Number of Explicit Attributes	
4[V3,M]	Number of Coordinate sets	Null
4[V3,D[1]]	Number of Features "Composed Of" this Face	

3 [V,O]	**IMPLICIT_RELATIONS_POINTER**	Identifies the following group of entities that describe relationships between the Face and the Area features to which the Face belongs.

This field must contain the RTY and RID of the feature being referenced. The RTY field may contain in addition the following feature orientation parameter which defines the referenced feature's location relative to the Face Record which represents it.

C: Coincident with the spatial coordinates of the Face record.

*4 [V,M]	Record Type	Record type for Face feature	"CFA"
4 [V,M]	Record ID	n Record number of the particular Face Feature	
4 [V,O]	Security	"T" I "S" I "C" I "R" I "U" Security level of the Face feature	

3 [V,O]	**IMPLICIT_ATTRIBUTES**	(see Edge Record 11.1.6)

3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	(see Edge Record 11.1.6)

Withdrawn/Retired

DEPENDENCY CONDITION

1 **Number of Features**: The Number of Features counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

11.1.9 SPATIAL DATA RECORD

The Spatial Data record is used to encode the spatial characteristics of spaghetti structured data. This single record type is defined below to support Spatial Data records of spaghetti structured data (level 0).

- SPATIAL RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATIONS POINTER FIELD
  - — IMPLICIT ATTRIBUTE FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — COORDINATE FIELD

2 [V0,D[1]]	**SPATIAL DATA RECORD**	RTY = SP

3 [V0,O]	**COUNTER**	Identifies the following group of entities that define the number of explicit attributes, coordinate sets, and composed of Feature(s) for the Spatial data.

4[V0,M] Number of Explicit Attributes

4[V0,M] Number of Coordinate sets

4[V0,D[2]] Number of Features "Composed Of" this Spatial data

3 [V0,O]	**IMPLICIT_RELATIONS_POINTER**	Identifies the following group of entities that describe relationships between the Spatial data and the features to which the Spatial data belongs.

This field must contain the RTY and RID of the feature being referenced. The RTY field may contain in addition the following feature orientation parameter which defines the referenced feature's location relative to the Spatial Record which represents it.

C: Coincident with the spatial coordinates of the Spatial record.

Withdrawn/Retirée

*4 [V0,M]	Record Type	"CFL" I "CFP" I "CFA"	Record type for a Feature
4 [V0,M]	Record ID	n	Record number of the particular Feature
4 [V0,O]	Security	"T" I "S" I "C" I "R" I "U"	Security level of Simple feature

3 [V0,O]	**IMPLICIT_ATTRIBUTES**	(see Edge Record 11.1.6)

3 [V0,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	(see Edge Record 11.1.6)

3 [V0,O]	**COORDINATE**	(see Edge Record 11.1.6)

DEPENDENCY CONDITIONS

1 **Spatial data record**: Spatial data record will be present at Level 0 if neither node record nor edge record are present.

2 Number of Features: The Number of Features counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

11.1.10 TEXT PLACEMENT RECORD

The Text Placement record is used to encode the characteristics of cartographic text for the purposes of annotation. This record contains the following fields and subfields:

- TEXT PLACEMENT RECORD
  - — COUNTER FIELD
  - — IMPLICIT RELATIONS POINTER FIELD
  - — EXPLICIT ATTRIBUTE LABELS AND VALUES FIELD
  - — TEXT FIELD
  - — COORDINATE FIELD

2 [V,O]	**TEXT PLACEMENT RECORD**	RTY = TP I TXT_ID & *.TFT_ID

3 [V,O]	**COUNTER**	Identifies the following group of entities that define the number of explicit attributes, coordinate sets, and number of Feature(s) pointed to by the Text Placement Record.

4 [V,M] Number of Explicit Attributes
4 [V,M] Number of Coordinate Sets

Withdrawn/Retirée

4 [V,M] Number of Features Pointed to by this text.

3 [V,O]	**IMPLICIT_RELATIONS_POINTER**	Identifies the following group of entities that describe the relationships between the Text Placement data and the features to which the Text Placement applies.

For isolated or "free floating" text, this field may be null. Otherwise, the field must contain the RTY and RID of the feature being referenced.

4 V,M]	Record Type	Record type for a Line, Point, Area or Complex Feature "FL " | "FP " | "FA " | "FC ", or Null
4 [V,M]	Record ID	n Record number of the particular Feature
4 [V,O]	Security	"T" | "S" | "C" | "R" | "U" Security level of the Previous Edge of the current Edge.

3 [V,O]	**EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES**	(see Edge Record 11.1.6)

Note that the attributes relevant to Text Placement records are concerned solely with the presentation of text. While such attributes will vary from application to application, the first presentation attribute is defined to be the text character cell size.

3 [V,M]	**TEXT**	Identifies the following entity that describe the actual text as a string of characters

4 [V,M]	Text	Text associated with the identified feature.

3 [V,M]	**COORDINATE**	Identifies the following group of entities that describe the geometric base for the Text placement

Each instance of this field contains a coordinate set (see 12.1). Information relating to the coordinate coding (units, format) used in a given GEO_DATA_FILE is found in the GEO_REFERENCE_FILE of the HEADER_DATA_SUBSET.

*4 [V,M]	Easting/Longitude	X Coordinate of a digitized point on the geometric base line or X Coordinate of the geometric base point.
4 [V,M]	Northing/Latitude	Y Coordinate of a digitized point on the geometric base line or Y Coordinate of the geometric base point.

11.1.11 DATA DICTIONARY

The purpose of the data dictionary is to define new features or new attributes which may be used in the same manner as those predefined in FACC. Therefore the definition must take the same form as FACC.

Withdrawn/Retiree

A FACC definition of a **feature** consists of a:

- code consisting of two characters followed by 3 numerics
- a short name
- a descriptive definition.

A FACC definition of an **attribute** consists of:

- a code consisting of 3 character acronym (e.g. BFC, AAH)
- a short name (e.g. Building Function Category, Absolute Horizontal Accuracy)

Either for each entry of an enumerated list of values the following must be defined:

- an integer value number (e.g. 93)
- an attribute value definition (e.g. "Armoury" for BFC 93)

Or for an attribute which takes on an actual value the following must be defined:

- an attribute value format (A | I | R, e.g. R)
- an attribute value definition (e.g. "Actual Value (Metres, Real Number)" for Absolute Horizontal Accuracy)
- attribute value measurement unit (see Part 3—10) (e.g. M for metres)

11.1.11.1 FEATURE/ATTRIBUTE ENTRY RECORD

The Feature/Attribute Entry record is used to define additional feature or attribute codes as part of the data dictionary facility (see 6.2). This record contains the following fields and subfields:

- FEATURE/ATTRIBUTE ENTRY RECORD
  - — FEATURE ASSOCIATION FIELD
  - — ATTRIBUTE ASSOCIATION FIELD

2 [V,D[1]]	**FEATURE/ATTRIBUTE ENTRY RECORD**	RTY = DD

3 [V,M]	**FEATURE/ATTRIBUTE_ENTRY_FIELD** Identifies the group of following entities that define an attribute or a feature

This field is used to define the attribute or feature in terms of both its code or label and its definition. In addition, this field can be used to describe both the originator of the feature or attribute and the source of its definition. The lexical level is given and is to be applied to all the free text subfields in this field.

4 [V,M]	Feature or Attribute	"1" | "2"	This is a Feature (1) or Attribute (2)
4 [V,M]	Feature FACC Code or	The five character Feature code corresponding to	

Withdrawn/Retirée

	Attribute Label	FACC, i.e. two alphabetic characters followed by three integers, or the three character Attribute code corresponding to FACC, i.e. normally the English acronym for the attribute.
4 [V,O]	Source for the Feature or Attribute	Free Text
4 [V,O]	Description of the Originator and/or Source	Free Text
4 [V,O]	Short Name	Free Text
4 [V,M]	Feature or Attribute definition	Free Text

DEPENDENCY CONDITION

1 **Feature/attribute entry record**: Feature (or attribute) entry record will be present if any Feature (or attribute) transmitted in the Vector Geodata file is not described in FACC (DIGEST Part4)

11.1.11.2 FEATURE/ATTRIBUTE ASSOCIATION RECORD

The Feature/Attribute Association record is used to describe the association between a particular feature and a set of attributes as part of the data dictionary facility (see 6.2).

FACC allows any attributes in the catalogue to be associated with a feature as long as there is a reasonable and logical connection. Nevertheless, it may be useful to describe a set of attributes which would normally be associated with a feature. The following fields and subfields describe that relationship. The existence of the list of associated attributes does not restrict other attributes from being implemented.

This record contains the following fields and subfields:

- FEATURE/ATTRIBUTE ASSOCIATION RECORD
  - — FEATURE/ATTRIBUTE ENTRY FIELD

2 [V,O]	**FEATURE/ATTRIBUTE ASSOCIATION RECORD**	RTY = DF
3 [V,M]	**FEATURE_ASSOCIATION_FIELD** identifies the following entity specifying the feature label for the given feature.	
3[V,M]	Feature Label	The five character Feature code corresponding to FACC, i.e. two alphabetic characters followed by three integers.

Withdrawn/Retirée

3 [V,M]	**ATTRIBUTE_ASSOCIATION_FIELD** identifies the following entity specifying the attribute label for the associated attribute.	

3[V,M]	Attribute Label	The three character Attribute code corresponding to FACC, i.e. normally the English acronym for the attribute.

11.1.11.3 ATTRIBUTE/VALUE ASSOCIATION RECORD

The Attribute/Value Association record is used to define the set of allowable values for a given attribute as part of the data dictionary facility (see 6.2). This record contains the following fields and subfields:

- ATTRIBUTE/VALUE ASSOCIATION RECORD
  - — ATTRIBUTE FORMAT DESCRIPTION FIELD
  - — ATTRIBUTE VALUE DESCRIPTION FIELD

2 [V,D[1]]	**ATTRIBUTE/VALUE ASSOCIATION RECORD**	RTY = DA

3 [V,M]	**ATTRIBUTE_FORMAT_DESCRIPTION** identifies the following group of entities that define the format for a given attribute	

4 [V,M]	Attribute Label	The three character Attribute code corresponding to FACC, i.e. normally the English acronym for the attribute.
4 [V,M]	Enumerated or Actual Value	"EN" | "AV" for Enumerated or Actual Value
4 [V,D]	Attribute value format	"A" | "I" | "R" | "L" Format type: alphanumeric, integer ,real or Lexical. For Actual Value attributes only for Actual Values.

3 [V,D]	**ATTRIBUTE_VALUE_DESCRIPTION** identifies the following group of entities that define the allowable values for the given attribute	

*4 [V,M]	Attribute Values	The value of an enumerated attribute.
4 [V,M]	Attribute value definition	Free Text, e.g. "Armoury " (for BFC 093)

DEPENDENCY CONDITION

1 **Attribute/value association record**: Attribute/value association record will be present for each attribute transmitted in the Vector Geodata file and not present in FACC .

Withdrawn/Retirée

11.2 RASTER DATA FORMAT

11.2.1 FIELD STRUCTURE

For raster data, the Geo Data Subset provides the actual data (pixels) of a raster image, and contains two fields as follows:

- PADDING FIELD
- PIXEL/ELEMENT FIELD

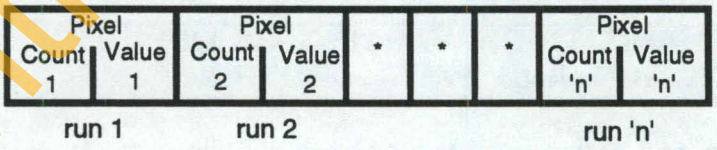
The PADDING FIELD is optional, and is used to ensure that the following PIXEL/ELEMENT Fields start at the beginning of a physical block on the transfer media. The field contains sufficient characters to achieve this result.

The PIXEL/ELEMENT FIELD which consists of a string of bytes should be considered to be subdivided into logical subfields in accordance with 11.3.2 below.

11.2.2 SCAN LINES

Each scan line contains the pixel data for a line of pixels in a subblock. Because of the repetitive nature of pixel/raster data, the pixel is defined to contain two implicit elements which are fixed length binary integers with no separators between them. Each scan line starts on a byte boundary, and any remaining bits in the final byte are ignored (i.e., padding with any combinations of 0's and 1's). The implicit elements of each pixel have the logical form as depicted below, where each run of pixels is composed of two elements:

- Pixel count
- Pixel value



Given that PNC represents the number of pixels per subblock E-W, and PNL represents the number of pixels per subblock, N-S, then the following example is based on an E-W scan direction. For a N-S scan direction, PNL would replace PNC.

The Pixel Count subfield defines the number of pixels with the value of the following Pixel Value. The sum of all the Pixel Counts will be equal to PNC pixels.

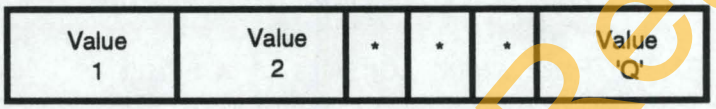
Withdrawn/Retirée

$$\text{i.e. PNC} = \sum_{i=1}^{n} (\text{pixel count})_i$$

The length of the binary integer subfields are defined (in bits) in the General Information Record of the General Information File by the following parameters:

PCB = Size of Pixel Count element in Bits.
PVB = Size of Pixel Value element in Bits.

If PCB is set to 0 (zero) then there is no count subfield and the value of the count is assumed to be one in all cases and the scan line structure reduces to an uncompressed form as follows:



In the case of colour coded images separated into bands, each containing only two colours (e.g. black and white, or brown and transparent), then attribute PVB can be set to 0 (zero) and the scan line reduces to a string of count elements as follows:



The convention used is that the first count in this scan line refers to the colour defined for the "off" state, which is the Upper Wavelength Limit in the GENERAL INFORMATION FILE. This count element may therefore be zero. Subsequent count elements alternate in the colour they apply to. As before, the sum of the Pixel Counts will be equal to PNC pixels.

11.2.3 MECHANISM FOR VARYING SCAN DIRECTION AND PIXEL ORDERING

The scan direction and ordering of the scan lines within the total image may be varied from image to image, if required, by the use of Dataset Parameters defined in the GENERAL INFORMATION FILE. These parameters and their permissible values are:

Withdrawn/Retirée

Parameter	Description and range of values
Column sequence (COD)	0 = left to right 1 = right to left
Row sequence (ROD)	0 = bottom to top 1 = top to bottom
Pixel Order (POR)	0 = Column in row in band in subblock 1 = Row in column in band in subblock 2 = Column in row in subblock in band 3 = Row in column in subblock in band 4 = Column in band in row in subblock 5 = Row in band in column in subblock

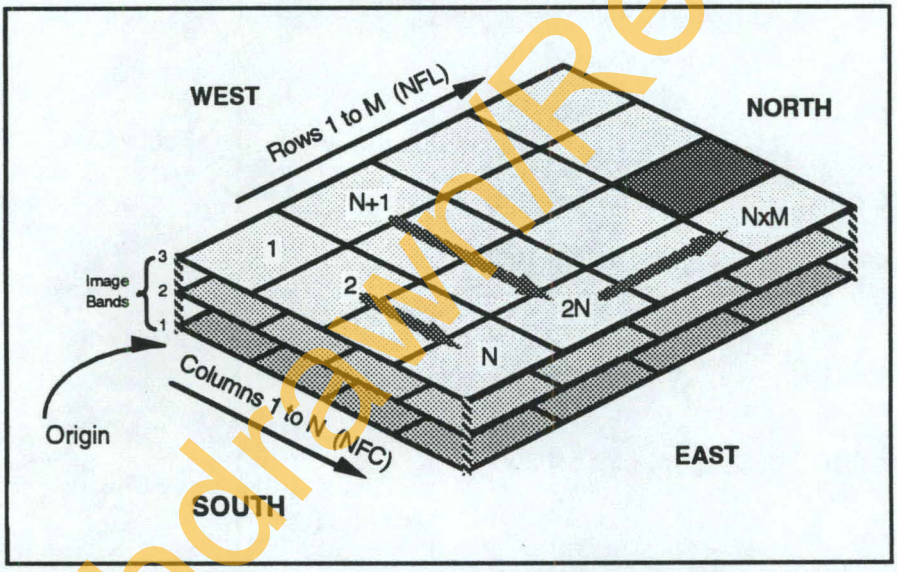


Figure 11— 6 Raster Scan Lines (a)

To interpret the meaning of COD, ROD and POR, the convention adopted is as defined in 5.3. The convention used is analogous to the Cartesian coordinate system in that on a normally oriented image the columns are numbered from left to right (x-axis), the rows bottom to top (y-axis), and the layers from the lower to higher (z-axis), as defined by the ordering in Band Identifications in the General Information File. This is assumed for these examples to be red (first), green (second) and blue (third).

A normally oriented image of a map would be as shown in Figure 11-11a with the origin of the numbering system at the SW corner of the lower (red) band, and the scan direction along the rows. The value of the fields COD, ROD and POR would be zero.

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The subblocks may be of any agreed size of rectangle (defined by PNC and PNL), and sub-divide the image into sub-images for convenience of access. They are ordered in precisely the same order as the pixels within them, as shown in Figure 11-11a.

The scan lines for this pixel ordering, for subblocks where PNL=200 pixels and PNC=100 pixels, with the column and row numbers referred to in absolute terms, would be as follows :

```
row 1, col 1.....   to.....  col 100   )              )
row 2, col 1.....   to.....  col 100   )              )
row 3, col 1.....   to.....  col 100   )              )
                :                     ) red band     )
                                      )              )
                :                     )              )
                :                     )              )
row 200,col 1....   to.....  col 100   )              )

row 1, col 1.....   to.....  col 100   )              )
                :                     )green band    )   Subblock 1
                :                     )              )
row 200,col 1....   to.....  col 100   )              )

row 1, col 1.....   to.....  col 100   )              )
                :                     )              )
                :                     ) blue band    )
                :                     )              )
row 200, col 1...   to.....  col 100   )              )


row 1, col 101...   to.....  col 200   )              )
                                      )              )
                :                     ) red band     )
                :                     )              )
row 200,col 101..   to.....  col 200   )              )

row 1, col 101...   to.....  col 200   )              )
                :                     )              )
                :                     )green band    )   Subblock 2
                :                     )              )
row 200,col 101..   to.....  col 200   )              )

row 1,col 101....   to.....  col 200   )              )
                :                     )              )
                :                     ) blue band    )
                :                     )              )
row 200,col 101..   to.....  col 200   )              )

                etc.
```

Withdrawn/Retirée

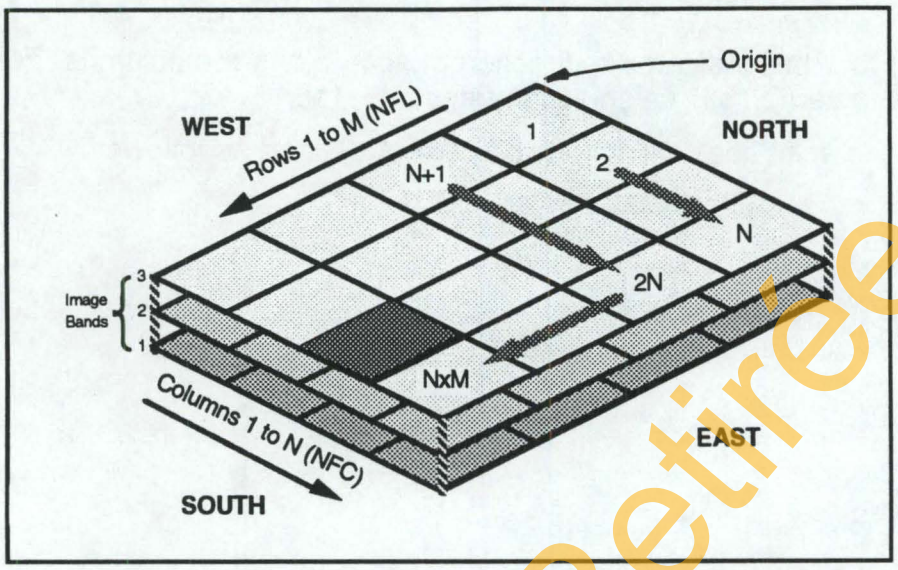


Figure 11— 7 Raster Scan Lines (b)

If ROD is set to 1 then the rows are ordered in reverse from top to bottom and the subblock ordering follows suit as shown in Figure 11-11b. The origin is now at the NW corner of the lower (red) band. The scan lines will follow the same numbering pattern as in the example in the previous paragraph.

If ROD and COD are both 1, then the origin is at the NE corner. If ROD is zero and COD is 1, the origin is at the SE corner. In all the above cases the scan lines will follow the pattern defined above. ROD and COD are used merely to indicate the location of the origin.

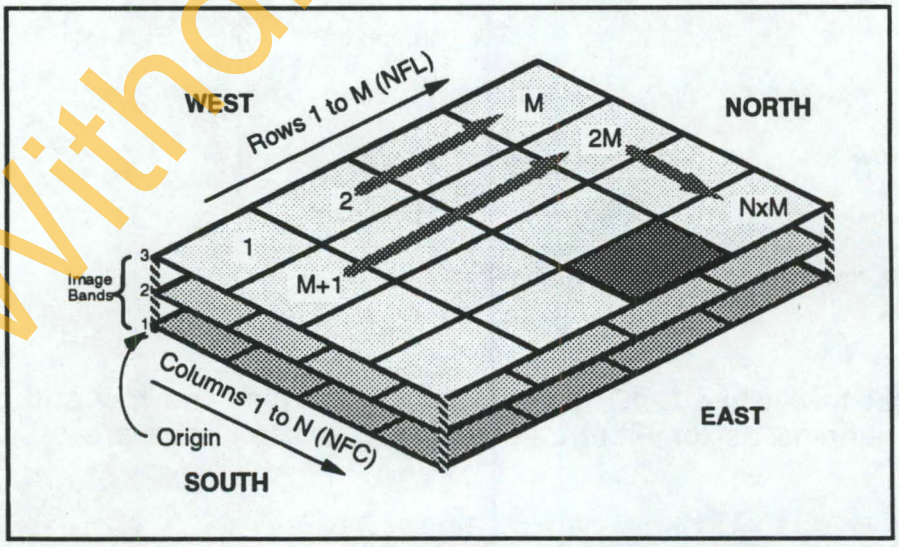


Figure 11— 8 Raster Scan Lines (c)

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If POR is set to 1 this indicates a direction of scan along the columns. For COD and ROD set to zero this is as shown in Figure 11-11c.

In this case, the scan lines will follow the pattern defined as follows:

```
col 1, row 1.....   to.....  row 200  )              )
col 2, row 1.....   to.....  row 200  )              )
col 3, row 1.....   to.....  row 200  )              )
                :                     ) red band     )
                :                     )              )
col 100, row 1...   to.....  row 200  )              )
                                                     )
col 1, row 1.....   to.....  row 200  )              )
                :                     )              )  Subblock 1
                :                     )green band    )
                :                     )              )
col 100, row 1...   to.....  row 200  )              )
                                                     )
col 1, row 1.....   to.....  row 200  )              )
                :                     )              )
                :                     )              )
                :                     ) blue band    )
                :                     )              )
col 100, row 1...   to.....  row 200  )              )


col 1, row 101...   to.....  row 200  )              )
                                      )              )
                                      ) red band     )
                                      )              )
col 100, row 201.   to.....  row 400  )              )
                                                     )
col 1, row 201...   to.....  row 400  )              )
                :                     )              )
                :                     )green band    )  Subblock 2
                :                     )              )
col 100, row 201.   to.....  row 400  )              )
                                                     )
col 1, row 201...   to.....  row 400  )              )
                :                     )              )
                :                     ) blue band    )
                :                     )              )
col 100, row 201.   to.....  row 400  )              )

                    etc.
```

If POR is set to 4 while COD and ROD are zero then the row and column numbering remains as for Figure 11-11a but the scan lines are ordered as follows:

Withdrawn/Retirée

```
row 1, col 1.....to.....col 100  (red band)          )
row 1, col 1.....to.....col 100  (green band)        )
row 1, col 1.....to.....col 100  (blue band)         )
                  :                                  )      Subblock 1
row 200, col 1.....to.....col 100  (red band)        )
row 200, col 1.....to.....col 100  (green band)      )
row 200, col 1.....to.....col 100  (blue band)       )

row 1 , col 101.....to.....col 200  (red band)       )
row 1 , col 101.....to.....col 200  (green band)     )
row 1 , col 101.....to.....col 200  (blue band)      )
                  :                                  )      Subblock 2
row 200, col 101.....to.....col 200  (red band)      )
row 200, col 101.....to.....col 200  (green band)    )
row 200, col 101.....to.....col 200  (blue band)     )

                        etc.
```

The combinations are numerous but the above examples and explanations should indicate the manner in which the COD, ROD and POR subfields are to be used. When there is only one band in the image the level of complexity is considerably reduced.

11.2.4 COLOUR REPRESENTATION

Colour representation is in the form of colour-code. Each colour-code is stored in a colour look-up table together with its CIE (x, y, Y) reference and nominal RGB intensity values. Where a colour-code represents a transition colour which is a known additive of two or more other coded colours then an equation defining the mixture will be given in subfield FRM. Where given, the equation will be of the following form :

P1 * (CC1) + P2 * (CC2) +. . . P n * (CCn);

where P is the proportion,

CC is the colour-code (i.e. label CCD),

and $\sum_{i=1}^{n} P_i = 1$

Example:

If the colour that is coded 5 (CC5) is an additive mixture of 0.25 of CC3 and 0.75 of CC6 then the equation for CC5 will be :

0.25* (3) + 0.75* (6)
or 0.75* (6) + 0.25* (3)

Withdrawn/Retirée

The use of the equation is to allow easy modification of the colours for display purposes. For example, if it is necessary to alter the displayed colour for colours 3 and for 6 then the changes to the related colour 5 can be directly computed as follows:

Where R3, G3, B3 and R6, G6, B6 are the desired signal strengths/luminosities of the colours 3 and 6 respectively then :

$$R5 = 0.25 * R3 + 0.75 * R6$$
$$G5 = 0.25 * G3 + 0.75 * G6$$
$$B5 = 0.25 * B3 + 0.75 * B6$$

Note: The CIE stimuli (X,Y,Z) may be substituted for R,G,B in the above equations giving.

$$X5 = 0.25 * X3 + 0.75 * X6$$
$$Y5 = 0.25 * Y3 + 0.75 * Y6$$
$$Z5 = 0.25 * Z3 + 0.75 * Z6$$

Where given the CIE reference (x,y,Y) then :

$$X = \frac{x * Y}{y}$$

$$Y = Y$$

$$Z = \frac{Y}{y} * (1 - x - y)$$

11.3 MATRIX DATA FORMAT

11.3.1 FIELD STRUCTURE

For matrix data, the Geo Data Subset provides the actual data (elements) of a matrix, and contains two fields as follows:

- PADDING FIELD
- ELEMENT FIELD

The PADDING FIELD is optional, and is used to ensure that the following ELEMENT Fields start at the beginning of a physical block on the transfer media. The field contains sufficient characters to achieve this result.

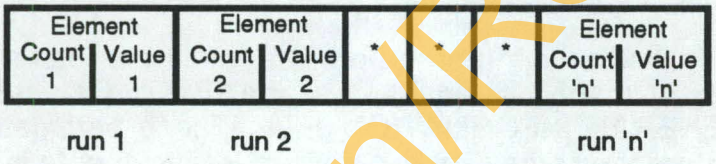
Withdrawn/Retirée

The ELEMENT FIELD which consists of a string of bytes should be considered to be subdivided into logical subfields in accordance with 11.2.3.

11.3.2 PROFILES

Each profile contains the data elements for a line of elements in a subblock. Because of the repetitive nature of some matrix data, each Element Run contains two implicit parts which are fixed length binary integers with no separators between them. Each profile starts on a byte boundary, any remaining bits in the final byte are ignored (i.e., padding with any combinations of 0's and 1's). The implicit elements of the Element Run have the logical form as depicted below, where each run of elements is composed of two parts:

- Element count
- Element value



Given that PNC represents the number of elements per subblock E-W, and PNL represents the number of elements per subblock, N-S, then the following example is based on an E-W profile direction. For a N-S profile, PNL would replace PNC.

The Element Count subfield defines the number of elements with the value of the following Element Value. The sum of all the Element Counts will be equal to PNC Elements.

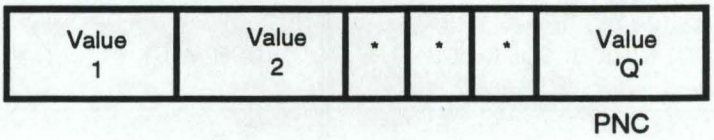
$$\text{i.e. PNC} = \sum_{i=1}^{n} (\text{element count})_i$$

The length of the binary integer subfields are defined (in bits) in the General Information Record of the General Information File by the following parameters:

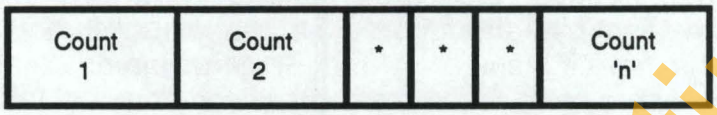
PCB = Size of Element Count element in Bits.
PVB = Size of Element Value element in Bits.

If PCB is set to 0 (zero) then there is no count subfield and the value of the count is assumed to be one in all cases and the profile structure reduces to an uncompressed form as follows:

Withdrawn/Retired



In the case of coded matrices separated into bands, each containing only two codes (e.g. Land and Sea), then attribute PVB can be set to 0 (zero) and the profile reduces to a string of count elements as follows:



11.3.3 MECHANISM FOR VARYING PROFILE DIRECTION AND ELEMENT ORDERING

The profile direction and ordering of the profiles within the total matrix may be varied from matrix to matrix, if required, by the use of Dataset Parameters defined in the GENERAL_INFORMATION_FILE. These parameters and their permissible values are the same as those defined for raster data in 11.2.3.

The explanation and use for raster data are also applicable to matrix.

Withdrawn/Retirée

12 MISCELLANEOUS RULES

12.1 RULES GOVERNING THE COORDINATE CODING

Coordinate coding will be in conformance with the following rules.

- Angular measures are recorded by default using the code SEC (seconds of arc) in Part 3—10.
- The standard ground reference system to be used is grid Longitude and Latitude, or Eastings and Northings.
- For each geographic point, Longitude or Easting is specified first, followed by Latitude or Northing.
- Each individual point location may be specified with two or three coordinates (Longitude, Latitude, Elevation or Easting, Northing, Elevation).
- Coordinates shall be encoded as follows:

  — Longitude (+/- seconds of arc [SEC])
  or +/- degrees of arc [DEG])
  or Easting (+/- metres [M])

  — Latitude (+/- seconds of arc)[SEC])
  or +/- degrees of arc [DEG])
  or Northing (+/- metres [M]))

  — Elevation (+/- metres [M]))

  where for longitude, "+" represents the eastern hemisphere (and "-" for western) and for latitude, "+" represents northern hemisphere (and "-" for southern). Easting and Northing signs are dependent on the grid system used. The MBR in the Transmittal Header File and the General Information File is always given in longitude and latitude.

- Information relating to coordinates type and unit, datums and projection is given in the GEO_REFERENCE_ FILE.

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12.2 RULES GOVERNING ATTRIBUTE CODING

12.2.1 EXPLICIT ATTRIBUTE CODING

Explicit attributes are used to describe some characteristic of vector data. Within DIGEST, attributes are permitted to have multiple values and can occur hierarchically (that is, one can attribute attributes). Each attribute is described within DIGEST using attribute labels to represent a category of information, attribute value format (e.g., real, alphanumeric, etc.), statements to provide a computer interpretation for the attribute value data type, and attribute values to give meaning to the attribute label. Thus, an attribute can be logically depicted as shown below:

Attribute label	Attribute Value Format	Attribute Value
BFC	A	6

where "BFC" represents a building function category, "6" represents the code of the function (in this case hospital), and "I" represents the format of the code (in this case Integer).

12.2.2 MULTI-LEVEL EXPLICIT ATTRIBUTE CODING

The data structure for attribution is appropriately an ordered, rooted tree to be represented by its corresponding binary tree which has a more compact description.

The trees for the example are shown in Figure 12-1. Refer to A.6.4 for the ISO 8211 encapsulation of this example.

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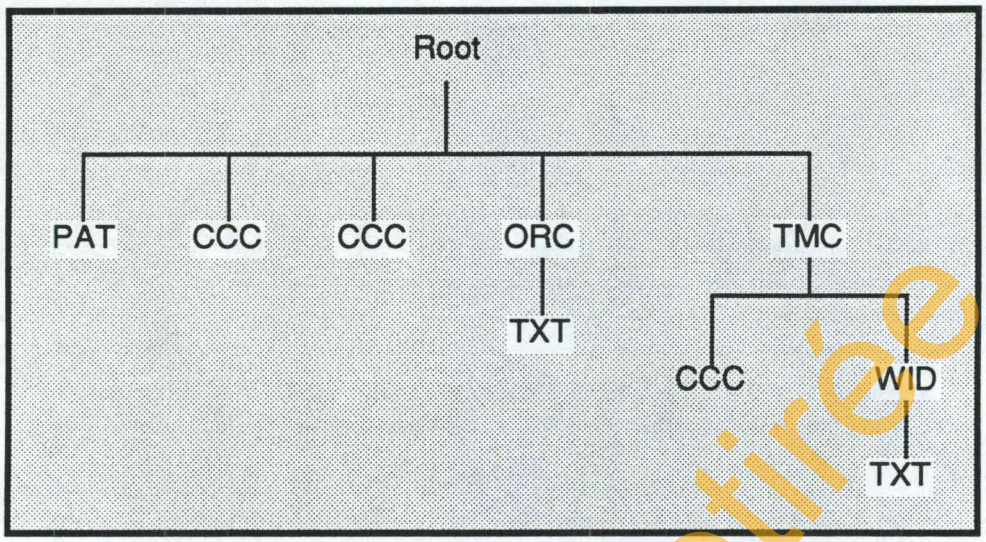


Figure 12-1 Ordered, Rooted Tree

A corresponding binary tree is formed from an ordered, rooted tree as shown in Figure 12-2.

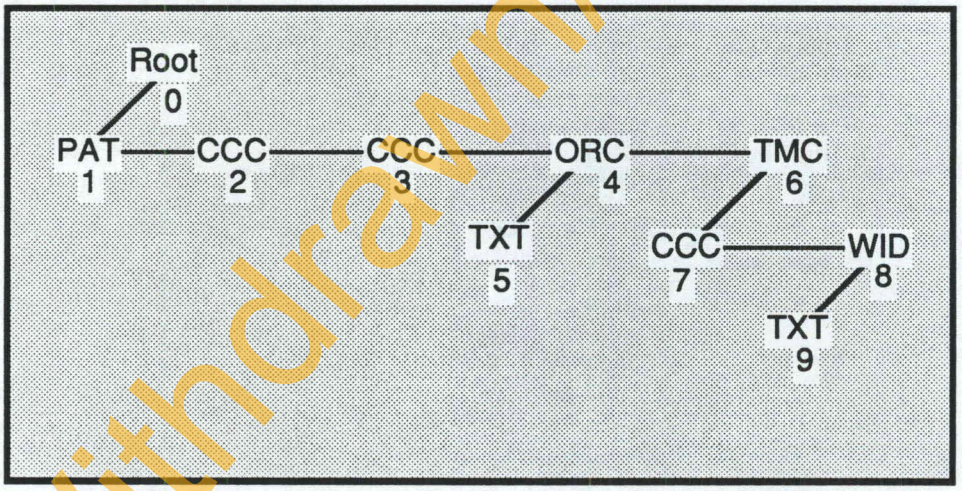


Figure 12-2 Corresponding Binary Tree

For any parent node in the ordered rooted tree, the link to its first (left-most) offspring node becomes the left-hand link in the binary tree. The ordered siblings of the first offspring are connected through a series of right-hand links from sibling to sibling. The root node of the tree has no right-hand link. The preorder traversal sequences of the trees are the same. Since the record (feature/topological entity) is the root and the left/right links are always the same, this data is not carried, but shown here for completeness.

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The left- and right-hand links of a corresponding binary tree are described by the sequential indices of the offspring nodes in the preorder traversal sequence of the tree as shown in Table 12-1.

Table 12-1 Links of a Binary Tree

index	0	1	2	3	4	5	6	7	8	9
	root	PAT	CCC	CCC	ORC	TXT	TMC	CCC	WID	TXT
left	1	0	0	0	5	0	7	0	9	0
right	0	2	3	4	6	0	0	8	0	0

See: Knuth, D. E.; *The Art of Computer Programming, Vol. 1, Fundamental Algorithms*, p 305ff; Addison-Wesley, Reading MA USA

An example of multi-level attribution is for a buoy (feature code BC020) where it is desired to qualify the Operating Range (ORC) according to weather conditions and to attribute the Top Mark (TMC) with a colour and a width at the base. The following example (Table 12-2) illustrates the details of how multi-level attribution may be accomplished.

Table 12-2 Example of Multi-Level Attribution

Attribute = PAT
Beacon/Buoy
Pattern Category
FORMAT=I
VALUE=4
Horizontal Bands

Attribute = CCC
Color Code
Category
FORMAT=I
VALUE=1 & 19
Black and Yellow

Attribute = ORC
Operating Range
Category
FORMAT=R
VALUE=2.5
Value

Attribute = TXT
Text
FORMAT=A
VALUE=
"Varie selon les conditions atmosphériques"

Attribute = TMC
Top Mark
Category
FORMAT=I
VALUE=3
2 cones point up

Attribute = CCC
Color Code
FORMAT=I
VALUE=1
Black

Attribute = WID
Width
FORMAT=R
VALUE=0.33
Value

Attribute = TXT
Text
FORMAT=A
VALUE=
"à la base"

Note: The lexical level has been defined in the encapsulation controls as being level 1, permitting accents in the French language.

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This buoy (a north cardinal buoy) has horizontal black and yellow bands, an Operating Range of 2.5 units, where the units are explicitly defined in FACC for the Operating Range which varies according to atmospheric conditions. The description of the variability of Operating Range may contain accented characters and thus must be in Extended ASCII text. The Top Mark consists of 2 cones pointing up. The Top Mark is coloured Black and is 0.33 units wide at the base. These units are also defined within FACC for the attribute WID. The width is defined to be at the base which also may contain accented characters.

12.2.3 IMPLICIT ATTRIBUTE CODING

An implicit attribute is a constant component of a given record type. Consequently, a specific field may be dedicated for the encoding of this attribute, but not necessarily within a (NAME, FORMAT, VALUE) triplet form. The mechanism used to reduce the extent of a record comprising implicit attributes consists in dedicating, to a given ordered list of attributes, a related sequence of subfields for receiving the value(s) and only the value(s) of these attributes. If an implicit attribute, for any reason, has no value, its related subfield in the field is encoded with a null value in order to keep the ordered structure of the subfields within the field.

12.2.4 QUALITY AND CONTROL ATTRIBUTION

The following is a list of attributes which may be used to define the quality, or control the subsequent processing of the Volume, Dataset, Feature Topology and other attributes (see Table 7-1).

Type	Attribute Name
Source	(See QID)
Up-to-Dateness/Currency	CDP (= 24) used in conjunction with CDV
Security	SEC
Horizontal Accuracy	AAH
Vertical Accuracy	AAV
Standard Deviation of quantitative attribute	QUT
Percentage reliability of qualitative attribute	QUL
Releasability	QLE
Clipping Indicator	CLI
Quality/Source Record Identifiers	QID

A definition for all of the above attribute values is given at 7.3, except for QID. QID enables the facility to use pointers to records in the Quality and Source Files.

When used in the THF or HDS, these attributes are defined as labels (i.e., subfields). Otherwise they are implemented as Explicit Attributes (see 12.2.1) at

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the first level for feature and topological records and at the second level when qualifying other attributes (see Table 7.1 for definition of permitted usage for each attribute).

Some examples of usage follow:

Method 1: Attribute values are actual values.

With this method, the value associated to the attribute label is the value of the attribute itself. For example, if an edge had a positional accuracy of 3, then the attribute field would appear (using ISO 8211 coding as an example) as follows:

Attribute Label	Format	Value
AAH	I	3

Method 2: Attribute values are pointers to record instances in the Source or Quality Files.

In this case, the attribute label "QID" (followed by a pointer) will be repeated. Each pointer value will consist of the values contained in the RTY and RID subfields (of the Record_ID_Field) of the record pointed to. For example, if we wished to point to a particular record of the quality file to satisfy the up-to-dateness quality description then it might appear (using ISO 8211 coding as an example) as follows:

Attribute Label	Format	Value
QID	A	QAL 4

Alternatively, since the Quality record of the Quality file contains security, completeness and consistency and up-to-dateness fields, one pointer could be used to point to a record containing all these values as well.

12.3 RULES GOVERNING RELATION CODING

12.3.1 IMPLICIT RELATION CODING

An implicit relation is a constant component of a given vector data record type, e.g. the "Composed of" relation by which Simple Features are composed of Topological Entities. By definition, relations that are fundamental to the structure of the dataset are carried as implicit relations.

The mechanism used to reduce the extent of a record comprising an implicit relation with pointers carrying several types of information (Record ID or Signed Record ID and Security Code) consists in dedicating, to a given ordered list of

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relation pointers, a related sequence of subfields for receiving the pointers and only these pointers. The number of pointers for a given implicit relation becomes an implicit attribute of the record.

12.3.2 EXPLICIT RELATION CODING

An explicit relation is any relation that is not a constant component of a given vector data record type, e.g. the "Stacked on" relation. By definition, explicit relations are not a necessary part of the basic exchange structure and their inclusion is optional and to be agreed bi-laterally between interested parties.

In certain cases, especially when implicit relations do not apply, it might be useful to include explicit relations. However, they ought to be clearly described, so that they are self-explanatory to the data recipient. This will also provide maximum flexibility in accordance with the geographic/topographic object-structure. Therefore one may also deviate from the rule of the 3-character alphanumeric code. Such relations can be, e.g., stacked on, stacked under, component of, right of, left of, at, in, used by. The names of currently defined relations (see 5.1.1.3) are as follows:

Relation	Name
Alternative Representation	ALT
Component of	CPO
Stacked on	STK
Stacked under	STU

12.4 GUIDELINES GOVERNING THE TREATMENT OF INSETS IN RASTER DATA

Insets which are on the same projection or a projection which is not significantly different from the overall map or chart should be treated as follows.

- The actual pixels which represent the Inset should remain in the same position as they exist on the chart or map and should be part of the dataset.
- The INSET_INFORMATION_FIELD will be used to describe the coordinate characteristics of the inset.

Insets on a significantly different projection from the overall map or chart should be treated as follows.

- Replace the pixels in the area which contained the inset on the chart or map with pixels having a user selected value.

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- Create a completely new dataset.
- Include a new header data subset containing general info, geo reference, source and quality.
- Include a new data subset containing the inset data.

12.5 RULES GOVERNING THE USE OF BOUNDING SOURCE POLYGONS

Coordinate pairs should be selected such that:

- The geographic extent of the source is unambiguously delineated by the resultant polygon.
- Coordinates should proceed in a sequential order.
- First and last coordinate pairs should be the same.

12.6 RULES GOVERNING THE INCLUSION OF SUPPLEMENTARY/AUGMENTARY DATA

The user may wish to transmit in the HEADER_DATA_SUBSET or GEO_DATA_SUBSET, data additional to that defined in this specification, or data in a different form than already present in the specification. In this case supplementary or augmentary files, records, fields and subfields may be defined. Such supplementary or augmentary information shall not replace or modify existing or specified forms of data already defined in this specification.

As an example, if the user wishes to transform data files to some other characteristics, two possible supplementary record structures have been identified (others are possible) which could be used to transfer the required formulae and parameters.

- For neutral non-product specific data to be transferred, a free format text field/record could be used to transfer the necessary information.
- In the case of minimum standard specifications, a metric support record may be defined and utilized for this type of information. (E.g., for use with ASRP , the "MSD" record has been defined which uses specific field and subfield structures rather than free text (see ASRP minimum standard specifications for a description of its use). In the event this does not satisfy the requirement, a free format field/record as mentioned above could be used.)

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In the example above, the inclusion of either method for representing Metric Support data into the minimum standard specification does not violate the above stated rule. They are both supplementary, and could be ignored by the receiver of the data without degradation of his understanding of the dataset.

12.7 RULES GOVERNING THE USE OF LEGEND IMAGES

- Legend images are data contained in a separate geo data subset file. They are explanatory graphics which fall outside the neat line on the scanned source. Legend images generally contain information which cannot be easily represented textually.
- A legend image has no direct relationship to geographic location.
- Each legend image is contained in its own file and is related to the source graphic by the LEGEND_IMAGE_RECORD in the SOURCE_FILE.

12.8 RULES GOVERNING THE USE OF THE TILE INDEX MAP

Full tiles of zero (null) pixels may be omitted from an image. Tiles (subblocks) containing non-zero (non-null) pixels are placed into the image file in sequential order, as indicated in 11.4.3, but without leaving space for omitted tiles. A rectangular array of integers, the Tile Index Map ($M_{c,r}$), is used to indicate which tiles are present.

There is one row of integers in the tile map for each row of tiles in the image, and each integer in the row corresponds with a tile in the row of tiles in the image. The value of each entry $M_{c,r}$ indicates whether or not tile (c,r) of the image is present in the image file, and for a tile which is present, tells the tile's sequence position or starting byte address, in the image file. $M_{c,r}$ is defined by:

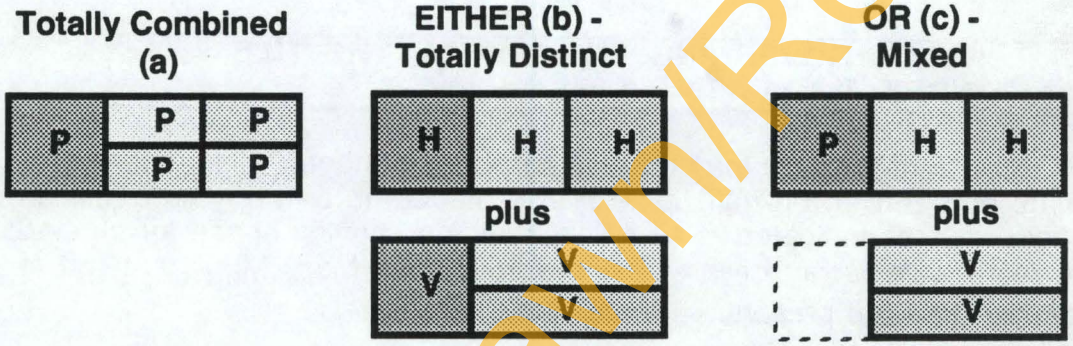
$M_{c,r}$ =	0 or null	if tile (c,r) is omitted
$M_{c,r}$ =	(sequence number >0 or start byte address)	if tile (c,r) is present

If the image is compressed (i.e. Run Length Encoded) then the start byte address of each tile is the byte number within the image data numbering from zero (the first byte). If the image is uncompressed (i.e. not Run Length Encoded) then it is the tile's sequence position in the image file and when $M_{c,r} > 0$ the value $M_{c,r}$ -1 indicates how many tiles of stored data in the image file must be skipped to access the tile in column *c*, row *r* of the image. The tile Index Map is present only when tiles have been omitted from the image file or optionally the data is Run Length Encoded. A flag is provided to indicate whether tiles have been omitted and the tile map is present.

Withdrawn/Retired

12.9 RULES COVERING THE DEFINITION OF DATASET ACCURACY

At the dataset level there is a need for generalised statements of positional accuracy within the region or sub regions (c.f. Clause 7). There must be 100% areal coverage of the MBR of the dataset for the total area of the horizontal accuracy regions and 100% areal coverage of the MBR of the dataset for the sum of the vertical accuracy regions. Where the information is unknown or not applicable it will be noted with "Not a Number" value (see Part 3—5). Where the region or sub region boundaries are coincident with both horizontal and vertical accuracy accuracy regions then the accuracy regions may be combined in the same accuracy record (figure 12-3a). Where the horizontal and vertical boundaries differ in whole or in part, then either totally distinct horizontal and vertical sub regions may be defined (e.g. Figure 12-3b), or the two approaches may be mixed (e.g. Figure 12-3c).



Where P = Positional (Horizontal and Vertical) Accuracy Record
H = Horizontal Accuracy Record
V = Vertical Accuracy Record

Figure 12-3 Alternatives for Defining Mixed Positional Accuracy Areas

Withdrawn/Retired

SECTION THREE ENCAPSULATION/ENCODING AND MEDIA STANDARDS

The aim of these standards is to reduce the difficulty of exchanging information between different users and different computing systems. Use of the standards in the following paragraphs will facilitate the exchange of digital data, by defining:

- syntax/data encoding;
- character representation; and
- media standards, including file naming/labeling conventions.

13 ENCAPSULATION/ENCODING

13.1 SYNTAX/ENCODING RULES

Encapsulations are defined in this document making use of two ISO syntax/encoding standards, as well as one table oriented format specified within this document. These encapsulations are:

- ISO 8211 — Specification for a data descriptive file for information interchange (Annex A);
- ISO 8824[1] — Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1) (Annex B); and
- Vector Relational Format (VRF) — (Annex C).

13.2 CHARACTER REPRESENTATION

Two types of character encoding are defined in this standard. Basic Text is used for all text sub fields which are alphanumeric identifiers, labels etc. or must be in ASCII only. It makes use of the ISO 646 International reference Version standard which corresponds to ASCII. A General Text format is used for all text fields that may contain descriptions or names expressed in any language. Four lexical levels of alphabetic repertoire of General text characters are defined (Lexical Level 0 corresponds to Basic Text). (A complete description is given in Part 3—5.)

0 - Primary ASCII text (ISO 646)
1 - Extended ASCII (including accents for Western European Latin alphabet based languages ISO 8859 Part 1 (Latin Alphabet 1))

---

[1] Although DIGEST refers to ISO 8824 (ASN.1), it should be understood that this reference also includes ISO 8825 (Basic encoding rules for ASN.1).

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2 - Full Latin alphabet text ASCII (all accents, diacritical marks and special characters for Latin alphabet based languages (ISO 6937 repertoire))

3 - Universal Character Set (Base Multilingual plane of ISO 10646) (note: 2 bytes per character)

13.3 SPECIAL SYMBOL

Line Separator Symbol — a back slash (\) is used for the Line separator symbol in The Originator and Addressee fields in Transmittal Header File. The function of the Line separator symbol is to allow a particular portrayal of a text, without changing its logical structure. The Line separator symbol is not a delimiter symbol and must be interpreted as a "carriage return". An example of the use of this symbol is depicted below:

D MIL SVY \ ELMWOOD AVENUE \ FELTHAM;

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14 MEDIA STANDARDS

14.1 MAGNETIC TAPE

Magnetic tape volumes containing data interchange files shall conform to ISO 1001, level 3, with one fixed length media record per physical block.

14.1.1 PHYSICAL BLOCK SIZE

The computer system writing the magnetic tape may be constrained to physical block sizes with multiples of a certain number of bits. The block sizes are fixed and should be chosen such that they are also even multiples of eight bits, to ensure that they are generally readable. The recommended block size, and that chosen by DGIWG for 9 track tape media, is 8,192 Bytes (other block sizes may be chosen by mutual agreement). DGIWG recommends 5,120 byte block size for 8 mm media. The completion of a block, if necessary, from the end of specified recorded information shall be by use of ISO 646 (5/E) characters .

14.1.2 RECORD STRUCTURE

Only fixed length records may be used, and these shall be equal to the physical block size or a whole subdivision of it. Any unused bytes in the last magnetic tape record of the file shall be filled with 5/E characters.

14.1.3 PHYSICAL RECORDING ALTERNATIVES

There are three physical recording alternatives:

- 6,250 GCR — Defined in FIPS PUB 50 which adopts ANSI X3.54-1976 (ISO 5652).
- 1,600 PE — Defined in FIPS PUB 25 which adopts ANSI X3.39-1973 (ISO 3788).
- 8 Millimetre — Defined in ANSI X3.202-1978.

The preferred density is 6250 cpi for 9 track tape and 2.3 Gigabytes for 8 mm tapes. Other densities are permitted as required (e.g., 1,600 PE).

14.1.4 RECORDED LABELS

Magnetic tapes shall have labels recorded as defined in FIPS PUB 79 which adopts ANSI X3.27-1978 (ISO 1001). Option labels defined in this standard may be used by particular implementations as desired, but must only contain data that *may* be ignored by the receiver, with the exception of the user volume label

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(UVL1). Volume Header Label one (VOL 1) and User Volume Label one (UVL1) shall be present and shall contain the information defined at the end of Clause 9.

This information will be located as follows:

First Volume Header Label (Vol 1)

Entity Name	Definition	ISO 1001 Byte Position (BP) and field name	
Volume ID	ID for this specific volume	5 - 10	Volume identifier
Security Classification	Security Classification of this volume T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED U = UNCLASSIFIED	11	Volume Accessibility

User Volume Label one (UVL1)

Sequence Number	Sequential number of this volume within the volume set (transmittal)	5 - 7	Reserved for implementation use
Transmittal ID	Unique ID for the transmittal (volume set) to which this volume belongs.	8 - 37	Reserved for implementation use
Number of Datasets	Number of Datasets on, or starting on, this volume (may be left blank)	38 - 40	Reserved for implementation use

Notes:

- All fields shall be a-characters*, even the numeric fields (which are numeric character fields).
- The "Number of Datasets" field may be left blank. It is suggested that for Classified data that this field be completed by leaving sufficient empty space on the magnetic tape to ensure that completion of a known number of Datasets before the End of "Tape Mark".

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- The "Security Classification" of individual files may be defined by setting BP54 of the "First File Header Label" to T, S, C, R or U as defined above for the Volume Label.

* special type of character defined by ISO 9660

When using 8 mm tapes for preprocessing into the ISO 9660 format, the 8 — mm tape shall be compliant with ISO 9660 for single volume output (reference Section 14.2.1). Block size 8,192 bytes using ANSI X3.27 — 1978 tape labels for volume tapes. Tapes shall contain the following:

VOL1
HDR1
HDR2
File Mark
VRF Data in ISO 9660 Format
File Mark
EOF1
EOF2
File Mark
File Mark

Level 1 implementation of Section 10 of ISO 9660 and Level 1 implementation of Section 13.5 of ISO 9660 shall be utilized.

14.2 OPTICAL DISK

14.2.1 CD-ROM INTERCHANGE

CD-ROM volumes shall conform to ISO 9660 and may use an "Extended Attribute Record" in any of the files in which case the "Record format" (BP 79) shall be = 0. The unused portion of the last block shall be padded with characters (5/E). Supplementary labels defined in this standard may be used by particular implementations as desired, but must only contain data that *may* be ignored by the receiver.

The information defined at the end of Clause 9 will be located as follows:

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Primary Volume Descriptor

Entity Name	Definition	ISO 9660 Byte Position (BP) and field name	
Volume ID	ID for this specific volume	41-72	Volume identifier
Sequence Number	Sequential number of this volume within the sequence number volume set (transmittal)	125-128	Volume sequence number
Transmittal ID	Unique ID for the transmittal (volume set) to which this volume belongs	191-318	Volume set identifier
Number of Datasets	Number of Datasets on, or starting on, this volume	884-887	Application use
Security Classification	Security Classification of this volume T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED U = UNCLASSIFIED	888	Application Use

Note: The first three fields shall be recorded according to ISO 9660. The "Number of Datasets" shall be recorded according to paragraph 7.2.3 of ISO 9660 and the "Security Classification" shall be a d-character*.

* special type of character defined by ISO 9660

14.2.2 CLASSIFICATION AT THE FILE LEVEL

Where present the classification of a file shall be defined by the first character in the system user area at the end of the directory record.

T = TOP SECRET
S = SECRET
C = CONFIDENTIAL
R = RESTRICTED
U = UNCLASSIFIED

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14.3 OTHER MEDIA

DGIWG is reviewing the implementation of Compact Disc — Write Once (CD—WO) media standards. Initial reports are to comply with ISO 9660 using Level 1 Implementation of Section 10 of ISO 9660 and Level 1 of Section 13.5 of ISO 9660.

Other media will be reviewed as the need arises.

14.4 FILE NAMING CONVENTIONS FOR USE WITH MEDIA LABELS

The TRANSMITTAL HEADER FILE NAME is always

"TRANSH01.THF"

All other file names conform to the following rules.

The purpose of this set of rules is to provide a mechanism to identify those files which together comprise a single dataset. Each file label will be of the form:

ZZZZZZDD.XXX, where:

"ZZZZZZ" are six alphanumeric characters which uniquely identify the dataset to which the file belongs;

"DD" are two alphanumeric characters which identify the occurrence of the file type within the dataset; and

"XXX" is a three character extension which must be selected from the sets below.

For Transmittal and Header Data Subset files, use:

XXX	File Type
THF	Transmittal Header File
GEN	General Information File
GER	Geographic Reference File
SOU	Source File
QAL	Quality File

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For the Geo Data Subset files, use:

XXX	File Type
VEC	Edges, Nodes, Faces, Features of a Layer in a single file
Vcc	Edges or Nodes or Faces or Features of a Layer with multiple files (where "cc" is the number assigned to the file within the Layer)
IMG	Main Raster Image
Lcc	Raster Legend Image (where "cc" is the number assigned to the image's source graphic)
MTX	Matrix data

The table of two-character codes representing the file number within the Layer or source graphic number (in bold) is shown below:

1 = **00**	37 = **10**	...	325 = **90**	361 = **A0**	...	1225 = **Y0**	1261 = **Z0**
2 = **01**	38 = **11**		326 = **91**	362 = **A1**		1226 = **Y1**	1262 = **Z1**
: :	: :		: :	: :		: :	: :
: :	: :		: :	: :		: :	: :
10 = **09**	46 = **19**		334 = **99**	370 = **A9**		1234 = **Y9**	1270 = **Z9**
11 = **0A**	47 = **1A**	...	335 = **9A**	371 = **AA**	...	1235 = **YA**	1271 = **ZA**
12 = **0B**	48 = **1B**		336 = **9B**	372 = **AB**		1236 = **YB**	1272 = **ZB**
: :	: :		: :	: :		: :	: :
: :	: :		: :	: :		: :	: :
36 = **0Z**	72 = **1Z**	...	360 = **9Z**	396 = **AZ**	...	1260 = **YZ**	1296 = **ZZ**

An example of the use of the Geo Data Subset files structure is depicted below:

NOAMER01.SOU

This example defines a SOURCE_FILE which is part of a dataset uniquely identified with NOAMER. If the dataset contains more than one source file, the file name will be the same except that at least one of the characters , "0" or "1", must be changed.

"**ZZZZZZDD**" will uniquely identify the layer to which the file belongs.

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A. ISO 8211 ENCAPSULATION SPECIFICATIONS

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A.0 INTRODUCTION

This annex contains specifications for the encapsulation of DIGEST as ISO 8211 interchange files. The specifications include the data structures and data descriptions for the following:

- the files of the DIGEST transmittal file set;
- the records and fields of each file; and
- the subfields of each field.

The first two items are specified as ordered, rooted fields with an explicit statement of the required or permitted subtrees (see A.2 and A.3.n File content by Record and field). The third item is specified as the field descriptions of the component files (see A.3.n Field Data description). The details of the specification format are given in the next section.

A.1 SPECIFICATION OF ISO 8211 EXCHANGE FILE SETS

An ISO 8211 exchange set is usually a large data structure which must be specified in great detail. The following style of presentation is intended to define the specification in a concise yet detailed manner.

A.1.1 SPECIFICATION OF THE EXCHANGE SET CONTENT

Note: The following notation is in Backus Naur Form (BNF)

The structural model for a ISO 8211 exchange set is an ordered rooted tree. The general notation for the model is:

<tree root>
    <r>-<subtree>

where <tree root> is the root of the tree structure
<r> is the repetition factor of the subtree, <subtree>.

In the usual depiction of trees, each subtree type may comprise the root of further subtrees. The complete specification of an exchange set comprises the following generic subtrees:

<exchange set>
    <r>-<file type>|<exchange subset>
        <r>-<record type>|<file type>
            <r>-<field type>|<record type>
                <r>-<field type>
                    <field description>

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where

<exchange set> is the exchange set name

<exchange subset> is the exchange subset name

<r> is a specified repetition factor for a subtree,
= integer, meaning a specific repetition factor
= null means r = 1
= R, meaning indefinite repetition
= R:O, meaning indefinite repetition, order of the repetition being significant.

<file type>, <record type> and <field type> level may have an instance of the same type as a subtree (i.e. a file can be the subtree of a file, etc.)

<file type> ::= File: external file title
i.e., contents of ISO 8211 DDR; tag = 0...0

<record type> ::= Record: record name

<field type> ::= <tag>(<structure>:<order>)-<field name>

<tag> ::= an ISO 8211 field tag (which associates this field uniquely to its data description).

<structure> ::= a succinct description of the structure {ISO8211 data structure}

where
(1) is an elementary field {elementary}
(n) is an n-tuple (with n = integer) {vector}
(m*n) is a 2-D array of m rows and n columns {array}
(*n) is a repeating 2-D table with n columns {array}
(i*j*k) is a 3-D array with extents i, j and k. {array}

Note: The intent of <field structure> is to provide the user with a clue to the repetition pattern of the subfields within the field. "n,m,i,j,k" represent the maximum values of the contents of the field. These may be less if optional subfields are omitted.

<order> ::= a succinct statement of any intra- or inter-field ordering requirements.

where
O implies the order of the subfields is significant.
O,<tag>, implies the order of the subfields is correlated with the order of the subfields in the field bearing the tag(s), <tag>.

<field name> ::= the ISO 8211 field name corresponding to <tag>.

<field description> is the ISO 8211 data description for a field.
The details of field description are given in the next section.

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The presentation diagram for ordered, rooted trees is:

```
<tree root>
|
|-<r><subtree 1>
*-<r><subtree 2>      <subtree 2> or <sub tree 3> but not both.
*-<r><subtree 3>
```

Note: In these representations, the preorder traversal sequence rule is: top down, right hand branch first. The parent of any subtree is readily apparent and the parent tags for fields must coincide with the field description. The traversal of the tree encounters the repetition factor, perhaps the default of one, of a subtree as the subtree is entered. Further repetition may be indicated in the field descriptions.

Spaces may be introduced into the text for readability and for large exchange sets the description may be compartmentalized into subtrees for reasons of clarity. The root of each subtree identifies its nodal position in its parent tree.

The above tree structures for each file define the order and structure of the data descriptive records (DDRs) and the order and structure of the data records (DRs).

A.1.2 ISO 8211 DATA FIELD DESCRIPTION

The format of the machine- and human-readable field description, contained in A.3.n Field Data Description section, is described below. The description comprises a series of lines, i.e. one-line records easily maintained by an editor. There are six line types: a control line, record title line, tag definition lines, subfield definition lines, subfields group header lines, and interspersed comment lines.

These lines may begin with the requirement codes [req] as described in A.1.3 .. Tabulation ‡ is used as a separator.

Control line:

The control line is the first line of the Field Data Description section.
‡Control‡ == ‡ (see DDR Header in ISO 8211)

Record title line:

[req]‡Record:‡Record name

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Tag definition line (one per field):

[req]-t 0 -t tag -t ptag -t pg field name

where	tag	is an ISO 8211 field tag, A
	ptag	is a parent tag, A
	pg	are the printable graphics, A2, (usually ";&")
	name	is an ISO 8211 field name, A48

Subfield definition line (one per subfield) which may be of two different types:

- Description of the elements of the first Vector label part of a Cartesian label describing a 2-d array field:

  [req]-t nsi -t label -t @ -t subfield comment

- Description of the elements of the last (or only) Vector label part of a Cartesian label describing a 2-d array field, or Description of the Vector label describing a vector field, or Description of an elementary field:

  [req]-t nsi -t label -t d w -t subfield definition

where	nsi	is a sequence number (1 = first , 999 = end of field description)
	label	is an ISO 8211 label component, Akk
	*label	initiates a vector label in a Cartesian label describing a 2-d data structure
	d	is the subfield data type, A1 (d = A | L | I | R | S | C | B) (see Part 3 clause 5 for details on data types)
	w	is a fixed subfield width (0|SPACE = delimited, variable width)
	subfield definition	is a definition string

Subfield group header lines:

These lines are placed only for grouping subfields when describing the requirement codes.

[req] -t- (group name)

Comment lines:

Comment records must start with five SPACEs or a "-" and may be located anywhere.

Withdrawn/Retirée

A.1.3 REQUIREMENT CODES

The DIGEST use code is given in []s immediately prior the file name, record title, tag description, subfield description, subfield group header.

DIGEST use codes:

Applicable data set codes:

C	=	**C**ommon to all data sets
V	=	**V**ector data sets at topological level
Vn	=	**V**ector data sets at topological level **n**
R	=	**R**aster data sets
A	=	m**A**trix data sets

Requirement code:

M	=	presence of data item is **M**andatory
S	=	**S**trongly recommended
O	=	presence of data item is **O**ptional
D^{d}	=	presence of data item is mandatory **D**epending upon the presence or value of another item as described in dependency condition d.

In the following description, each file, record, field and subfield description is preceded by a digit representing the rank in the Mandatory/Optional hierarchy, Level 1 in the hierarchical scheme is the top level. The hierarchical rank is followed by the code for the applicable dataset (C, V, R, A, described above) followed by the Optional/Mandatory/Dependent code. Higher level data items confer their optionality to all items at a lower level until another item of equal or higher rank to the original is encountered. For instance:

3[C,O]	Data Item A
4[C,M]	Data Item B
4[C,O]	Data Item C

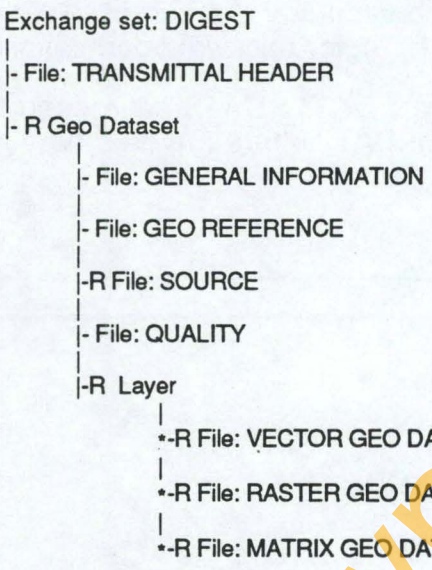
Thus, Item A may be absent, and if it is, then both B and C must be absent. If A is present then B must also be present. Note that if A were mandatory then at least one item of level 4 must be mandatory.

Withdrawn/Retirée

A.2 SPECIFICATION OF DIGEST TRANSMITTAL FILE SET BY FILES

This clause specifies the content of a DIGEST exchange set at the file level by an ordered, rooted tree structure.

Note: See A.1 for format interpretation.



A.3 SPECIFICATION OF DIGEST FILES BY RECORDS AND FIELDS

This clause specifies the content and structure of each DIGEST file at the record and field level. The specification for each file is given as an ordered rooted tree specifying the file contents by record and field followed by the ISO 8211 data description for each field. (See A.1 for format interpretation)

Alternative Date Format:

Note that DIGEST allows two alternative date formats. The tags, DAT, DAT1, DAT2, DAT3, DAT4, and DAT5 have been retained only for backward compatibility with previous versions of the standard. New data sets should not include the use of DAT, DAT1... or DAT5. Occurrences of dates in the A12 format (per DAT, DAT1... DAT5) will be interpreted to be equivalent to CDV (using A8 format), or CDP (I) and CDV (A8)

Withdrawn/Retirée

The A12 format consists of a three character numeric code which designates the type of date, followed by a comma separating the actual date in the form YYYYMMDD, e.g. 007,19881126 . The latter eight characters are equivalent to CDV while the first three are equivalent to CDP, the codes for which are to be found in the DIGEST Part 4 (FACC attributes). Thus the DAT A12 format is a combination of CDP and CDV.

For backward compatibility, wherever CDV alone occurs in the documentation it may be replaced by DAT in A12 format and wherever the pair of CDP and CDV occurs they may be replaced by DATx (x=1...5), for backward compatibility.

In the DIGEST document all occurrences of DAT1...DAT5 have been replaced with the pair CDP, CDV. All occurrences of DAT, where the date type is known by context, have been replaced by CDV.

A.3.1 TRANSMITTAL HEADER FILE

File Content by Record and Field:

```
1[C,M]   File: TRANSMITTAL HEADER
2[C,M]   |- Record: TRANSMITTAL DESCRIPTION
         |  |-  001      (2)    {RTY = THF, RID = 01}
         |  |-  VDR      (8)    Transmittal Header
         |  |-R FDR      (7)    Data Set Description
         |
2[C,M]   |- Record: SECURITY AND UPDATE
         |  |-  001      (2)    {RTY = LCF}
         |  |-  QSR      (4)    Security and Release
         |  |-R QUV      (6)    Up to Dateness
```

Note: The Dataset description field and up-to-dateness field will be repeated once for each dataset present in the transmittal. They will be repeated in the same order, there will be a one to one mapping between them. A single up-to-dateness field will be used when the information apply to all the datasets.

Field Data Descriptions:

```
Control    ==      (see DDR Header in ISO 8211)

    0      000     {=TRANSMITTAL_HEADER_FILE}
    1              File title field, present only in DDR
  999
```

2[C,M] **Record: TRANSMITTAL DESCRIPTION**

```
3[C,M]    0    001                ;& RECORD_ID_FIELD
3[C,M]    1    RTY      A 3       Record type          {RTY = THF}
3[C,M]    2    RID      I         Record id number     {RID = 1}
        999
```

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3[C,M]	0	VDR	001	;& TRANSMITTAL_HEADER
4[C,O]	1	MSD	A	Media Volume and File Structure Standard
4[C,O]				(originator - addressee)
5[C,M]	2	VOO	A	Originator
5[C,M]	3	ADR	A	Addressee
4[C,O]	4	NOV	I	Number of volumes
4[C,M]	5	NOF	I	Number of data sets
4[C,M]	6	URF	A	Transmittal Id
4[C,M]	7	EDN	I	Edition number
4[C,M]	8	CDV07	A 8	Creation date value
		Note: or DAT (see A.3. Alternative Date Format)		
	999			

*3[C,M]	0	FDR	001	;& DATA_SET_DESCRIPTION
4[C,M]	1	NAM	A	Data set Id
4[C,M]	2	STR	I	Data structure code
4[C,M]	3	PRT	A	Data set type
4[C,M]	4	SWO	R	Westernmost longitude
4[C,M]	5	SWA	R	Southernmost latitude
4[C,M]	6	NEO	R	Easternmost longitude
4[C,M]	7	NEA	R	Northernmost latitude
	999			

2[C,M] **Record: SECURITY AND UPDATE**

3[C,M]	0	001		;& RECORD_ID_FIELD
3[C,M]	1	RTY	A 3	Record type {RTY = LCF}
3[C,M]	2	RID	I	Record id number {RID = 1}
	999			

3[C,M]	0	QSR	001	;& SECURITY_AND_RELEASE
3[C,M]	1	QSS	A	Highest security classification
3[C,M]	2	QOD	A	Downgrading instructions
3[C,M]	3	CDV10	A 8	Date of downgrading value
		Note: or DAT (see A.3. Alternative Date Format)		
3[C,M]	4	QLE	A	Releasability
	999			

*3[C,M]	0	QUV	001	;& UP_TO_DATENESS
3[C,M]	1	SRC1	A	DIGEST edition Id
3[C,M]	2	CDV12	A 8	DIGEST edition date value
		Note: or DAT (see A.3. Alternative Date Format)		
3[C,M]	3	SPA1	A	DIGEST amendment number
3[C,D[1]]	4	SRC2	A	Specification Edition Id
3[C,D[2]]	5	CDV22	A 8	Specification edition date value
		Note: or DAT2 (see A.3. Alternative Date Format)		
3[C,D[3]]	6	SPA2	A	Specification amendment number
	999			

Dependency conditions:

1. **Specification edition ID:**
   The specification edition ID will be transmitted unless the Dataset type is UNSPECIFIED.

2. **Specification edition date:**
   The specification edition date will be transmitted whenever the specification edition ID is also transmitted.

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3. **Specification amendment number:**
The specification amendment number will be transmitted whenever the specification edition ID is also transmitted.

A.3.2 GENERAL INFORMATION FILE

File Content by Record and Field:

```
1[C,M]      File:   GENERAL INFORMATION
2[C,M]      |-R  Record: GENERAL INFORMATION
            |   |-  001        (2)       {RTY = GIN}
            |   |-  DSI        (2)       Data Set Id
            |   |-  GEN        (29)      General Information
            |   |-  SPR        (15)      Data Set Parameters
            |   |-  BDF        (*3:O)    Band Id
            |   |-  TIM        (*1)      Tile Index Map
            |
2[C,O]      |- Record: DATASET DESCRIPTION
            |   |-  001        (2)       {RTY = DSS}
            |   |-  DRF        (5)       Dataset Description
```

Field Data Descriptions:

```
            Control     =       (see  DDR Header in ISO 8211)

                0       000     {=GENERAL_INFORMATION_FILE}
                1               File title field, present only in DDR
              999
```

***2[C,M] Record: GENERAL INFORMATION**

```
3[C,M]          0   001
3[C,M]          1   RTY     A 3   Record type           {RTY = GIN}
3[C,M]          2   RID     I     Record id number       {RID =  1,n}
              999

3[C,M]          0   DSI     001   ;& DATA_SET_ID
4[C,M]          1   PRT     A     Data set type
4[C,M]          2   NAM     A     Data set Id
              999

3[C,M]          0   GEN     001   ;& GENERAL_INFORMATION
4[C,M]          1   STR     I 1   Structure of Data
4[R/A,D1]                         (data density)
5[R/A,M]        2   LOD     R     Data Interval E-W direction
5[R/A,M]        3   LAD     R     Data interval N-S direction
5[R/A,M]        4   UNIloa  A     Unit of measurement for LOD/LOA
4[A,M]          5   UNImat  A     Unit of measurement for Matrix Data. Null if not relevant.
4[V,D2]         6   MBU     A     MBR and GRP Units
4[V/A,O]        7   COV     I     Data Cover MBR in Percent
4[V,O]          8   FEC     I     Feature Count Total in Data Set
4[V,O]          9   POC     I     Point Feature Count
4[V,O]         10   LIC     I     Line Feature Count
4[V,O]         11   ALC     I     Area Feature Count
4[V,O]         12   SGC     I     Segment/Edge Record Count
4[V,O]         13   NEC     I     Node Record Count
4[V,O]         14   FCC     I     Face Record Count
```

Withdrawn/Retirée

4[V,O]	15	SFT	I	Simple Feature Count
4[R/A,D[3]]	16	ZNA	I	Zone number
4[C,M]	17	SWO	R	Westernmost longitude
4[C,M]	18	SWA	R	Southernmost latitude
4[C,M]	19	NEO	R	Easternmost longitude
4[C,M]	20	NEA	R	Northernmost latitude
4[R,M] [V/A,O]	21	SCA	I	Source graphic scale reciprocal
4[R,M]	22	PSP	R	Pixel Spacing, Microns
4[R,O]	23	IMR	A	Image Rectified during Scanning
4[R/A,D[4]]				(pixel ground spacing)
5[R/A,M]	24	ARV	I	Number of pixels in 360 degrees (E-W)
5[R/A,M]	25	BRV	I	Number of pixels in 360 degrees (N-S)
4[R/A,M] [V,O]	26	LSO	R	Longitude/Eastings of origin
4[R/A,M] [V,O]	27	PSO	R	Latitude/Northings of origin
4[V,O]	28	CSF	I	Coordinates scale factor
4[C,O]	29	TXT	L	Free Text
	999			

3[R/A,M] [V,D[5]]	0	SPR	001	;& DATA_SET_PARAMETERS
4[R/A,O]				(corners of MBR)
5[R/A,M]	1	NUL	I	Row Number; upper right corner of MBR
5[R/A,M]	2	NUS	I	Column Number; upper right corner of MBR
5[R/A,M]	3	NLL	I	Row Number; lower left corner of MBR
5[R/A,M]	4	NLS	I	Column Number; lower left corner of MBR
4[R/A,M]	5	NFL	I	Number of Sub-blocks, vertically
4[R/A,M]	6	NFC	I	Number of Sub-blocks, horizontally
4[R/A,M]	7	PNC	I	Number of Pixels/Sub-block Line
4[R/A,M]	8	PNL	I	Number of Scan Lines/Sub-block
4[R/A,M]	9	COD	I	Column Sequence
4[R/A,M]	10	ROD	I	Row sequence
4[R/A,M]	11	POR	I	Pixel order
4[R/A,M]	12	PCB	I	Size of Pixel/Element Count in bits
4[R/A,M]	13	PVB	I	Size of Pixel/Element Value in bits
4[C,M]	14	BAD	A	Layer file name
4[R/A,M]	15	TIF	A 1	Tile index map flag ("Y" or "N")
	999			

3[R/A,M]	0	BDF	001	;& BAND_ID
*4[R/A,M]	1	*BID	A	Band identification
4[R,D[6]]				(band description)
5[R,M]	2	WS1	I	Lower limit wavelength
5[R,M]	3	WS2	I	Upper limit wavelength
	999			

3[R/A,D[7]]	0	TIM	001	;& TILE_INDEX_MAP
*4[R/A,M]	1	*TSI	I	Tile index map (N = 1-tuple)
	999			

2[C,O] **Record: DATASET DESCRIPTION**

3[C,M]	0	001		;& RECORD_ID_FIELD	
3[C,M]	1	RTY	A 3	Record type	{RTY = DSS}
3[C,M]	2	RID	I	Record id number	{RID=1}
	999				

Withdrawn / Retirée

3[C,M]	0	DRF	001	;& DATASET_DESCRIPTION
4[C,M]	1	NSH	I 2	Total number of horizontal accuracy sub-regions
4[C,M]	2	NSV	I 2	Total number of vertical accuracy sub-regions
4[C,M]	3	NSP	I 2	Total number of position accuracy sub-regions
4[C,M]	4	NOZ	I 2	Total number of layers
4[C,M]	5	NOS	I 2	Total number of source graphics
	999			

Dependency conditions:

1. **data density: see Pixel ground spacing**
   Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on cartographic coordinates or Cartesian coordinates (USRP), the LOD, LAD and UNIloa subfields must be used. There is no default value for UNIloa.

2. **MBU :**
   Required when not the same as coordinates UNITS defined in the Georeference file.

3. **Zone Number:**
   Must be used when transferring raster or matrix data using either UTM/UPS or ARC projection.

4. **Pixel Ground Spacing: see data density**
   Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on geographic coordinates (ASRP), the ARV and BRV subfields must be used.

5. **Layer file name:**
   The dataset parameters will be transmitted for vector data when the Geodataset comprises more than one layer.

6. **Band description:**
   The Band identification must be present for any raster or matrix data: counting the number of BID subfields is the only way to specify the number of raster or matrix bands. WS1 and WS2 are mandatory in case of multi-banded raster data.

7. **Tile index Map:** Mandatory if TIF = "Y"

Withdrawn/Retired

A.3.3 GEO REFERENCE FILE

File Content by Record and Field:

```
1[C,D1]   File: GEO REFERENCE
2[C,M]    |- Record:  GEO REFERENCE
          |  |-  001     (2)     {RTY = GEO}
          |  |-  GEP     (10)    Geo Parameters
          |  |-  PRR     (9)     Projection
          |  |-  RPR     (*7)    Registration Points
          |  |-  DPR     (*7)    Diagnostic Points
```

Field Data Descriptions:

```
Control     =       (see  DDR Header in ISO 8211)

    0       000     {=GEO_REFERENCE_FILE}
    1               File title field, present only in DDR
  999
```

2[C,M] Record: GEO REFERENCE

```
3[C,M]      0   001                 ;& RECORD_ID_FIELD
3[C,M]      1   RTY     A 3         Record type         {RTY = GEO}
3[C,M]      2   RID     I           Record id number    {RID =  1}
          999

3[C,D2]     0   GEP     001         ;& GEO_PARAMETERS
4[C,M]      1   TYP     A           Data Type
4[C,M]      2   UNI     A           Unit of measurement for coordinates
4[C,M]      3   ELL     A           Ellipsoid Name
4[C,M]      4   ELC     A           Ellipsoid Code
4[C,D3]                             (vertical datum)
5[C,M]      5   DVR     A           Datum Vertical Name
5[C,M]      6   VDCdvr  A4          Vertical Datum Code
4[C,D4]                             (sounding datum)
5[C,M]      7   SDA     A           Sounding Datum Name
5[C,M]      8   VDCsda  A4          Sounding Datum Category
4[C,M]      9   DAG     A           Datum Geodetic Name
4[C,M]     10   DCD     A           Datum Geodetic Code
          999

4[C,D5]     0   PRR     001         ;& PROJECTION
5[C,M]      1   PRN     A           Projection Name
5[C,M]      2   PCO     A           Projection Codes (Part 3—6)
5[C,M]      3   PAA     R           Projection Parameter 1
6[C,D6]     4   PAB     R           Projection Parameter 2
7[C,D7]     5   PAC     R           Projection Parameter 3
8[C,D8]     6   PAE     R           Projection Parameter 4
5[C,D9]                             (projection false origin)
6[C,M]      7   XOR     R           Easting false Origin
6[C,M]      8   YOR     R           Northing false Origin
5[C,D10]    9   ZOR     R           Z-values false Origin
          999
```

Withdrawn/Retirée

3[C,O]	0	RPR	001	;& REGISTRATION_POINT
*4[C,M]	1	*PID	A	Registration Point ID
4[C,M]	2	LON	R	Longitude/Easting of Registration Point
4[C,M]	3	LAT	R	Latitude/Northing of Registration Point
4[C,D[11]]	4	ZVL	R	Elevation of Registration Point
4[C,M]	5	DIX	R	X Table Coord. of Digitized Registration Points
4[C,M]	6	DIY	R	Y Table Coord. of Digitized Registration Points
4[C,D[11]]	7	DIZ	R	Z Table Coord. of Digitized Registration Points
	999			

3[C,O]	0	DPR	001	;& DIAGNOSTIC_POINT
*4[C,M]	1	*DPD	A	Diagnostic Point ID - Repeating Field
4[C,M]	2	LON	R	Longitude/Easting of Diagnostic Point
4[C,M]	3	LAT	R	Latitude/Northing of Diagnostic Point
4[C,D[12]]	4	ZVL	R	Elevation of Diagnostic Point
4[C,M]	5	DIX	R	X Table Coord. of Digitized Diagnostic Point
4[C,M]	6	DIY	R	Y Table Coord. of Digitized Diagnostic Point
4[C,D[12]]	7	DIZ	R	Z Table Coord. of Digitized Diagnostic Point
	999			

Dependency conditions:

1. **Geo reference file:**
   The presence of Geo reference file is mandatory except for raster data when Dataset type is ASRP or USRP.

2. **Geo parameters:**
   Mandatory when Georeference file exists except when Dataset type is SRG.

3. **Vertical Datum:**
   Mandatory if elevation information is present in the dataset (z values).

4. **Sounding Datum:**
   Mandatory if sounding information is present in the dataset (depth values).

5. **Projection field:**
   The projection field is mandatory when the coordinates type is MAP (cartographic coordinates) or DIG and forbidden otherwise.

6. **Parameter 2: see Part 3 clause 6**
7. **Parameter 3: see Part 3 clause 6**
8. **Parameter 4: see Part 3 clause 6**

9. **Projection False Origin: when relevant only**
10. **Z values False Origin: when relevant only**

11. **Elevation Registration Point:**
    Mandatory if z coordinates must be registered. In this case the table coordinates will have a Z value.

12. **Elevation Diagnostic Point:**
    Mandatory if the table coordinates have a Z value.

Withdrawn/Retirée

A.3.4 SOURCE FILE

File Content by Record and Field:

```
1[C,M]      File: SOURCE
2[C,M]      |-  Record: SOURCE
            |   |-   001        (2)      {RTY = SOU}
            |   |-   SGF        (4)      Source Summary
            |   |-   SOR        (29)     Source
            |   |-   MAG        (*10)    Magnetic Rate
            |   |-R  RCI        (*2)     Bounding Polygon Coordinates
            |   |-   PRR        (8)      Projection
            |   |-   QSR        (4)      Security and Release
            |   |-   INS        (*19)    Inset
            |   |-   CPY        (1)      Copyright
            |
2[R,O]      |-R  Record: LEGEND
            |   |- 001 (2) {RTY = LEG}
            |   |- LGI (2) Legend
            |   |- SPR (15) Scanning Parameters
            |   |- TIM (*1) Tile Index Map
            |
2[R/A,D]    |-  Record: METRIC SUPPORT
            |   |-001          (2)      {RTY = MSD}
            |   |-NCD          (8)      Normalization Constants
            |   |-SDC          (14)     Source Datum Coefficients Data
            |   |-MPC          (20)     Map Projections Coefficients Data
            |   |-DCC          (7)      Datum Change Constants
            |   |-SCC          (2)      Source Datum Coefficient Counters
            |   |-SLG          (*3)     Source Datum Longitude Coefficients
            |   |-SLT          (*3)     Source Datum Latitude Coefficients
            |   |-GRC          (3)      Grid Rotation Coefficients
            |
2[C,O]      |-  Record: SUPPLEMENTARY TEXT
            |   |- 001 (2) {RTY = SPT}
            |   |- SUP (*3) Supplementary Text
```

Field Data Descriptions:

```
Control     ==      (see  DDR Header in ISO 8211)

    0       000     {=SOURCE_FILE}
    1               File title field, present only in DDR
  999
```

2[C,M] **Record: SOURCE**

```
3[C,M]      0       001                 ;& RECORD_ID_FIELD
3[C,M]      1       RTY     A 3         Record type         {RTY = SOU}
3[C,M]      2       RID     I           Record id number    {RID = 1}
          999

3[C,M]      0       SGF     001         ;& SOURCE_SUMMARY
4[C,D[1]]   1       BAD     A           Name of derived layer
4[C,O]      2       NST     I 4         Number of supplementary text records
4[R,O]      3       NLI     I           Number of legend images
4[R,O]      4       NIN     I           Number of insets
          999
```

Withdrawn/Retirée

3[C,M]	0	SOR	001	;& SOURCE
4[C,S]	1	PRT	A	Series Designator for the Series
4[C,S]	2	URF	A	Unique Source ID
4[C,S]	3	EDN	A	Source Edition Number
4[C,S]	4	NAM	A	Full Name of Source Document
4[C,S]	5	CDP	I	Type of significant date
4[C,S]	6	CDV	A 8	Significant Date value
		Note: or	DAT1	(see A.3. Alternative Date Format)
4[C,S]	7	COU	A	Country Code (see Part 3—11)
4[C,S]	8	CDV27	A 8	Perishable information date value
		Note: or	DAT2	(see A.3. Alternative Date Format)
4[C,S]	9	SCA	I	Cartographic Scale
4[C,O]	10	GRD	A	Cartographic Grid Code
4[C,O]				(area coverage)
5[C,M]	11	SQU	I	Area Coverage
5[C,M]	12	UNIsqu	A	Unit of Measure for Area Coverage
4[C,O]				(contour interval)
5[C,M]	13	PCI	I	Predominant Contour Interval
5[C,M]	14	UNIpci	A	Unit of Measure for Contour Interval
4[C,O]	15	WPC	I	Percentage Covered by Water
4[C,O]	16	NST	I	Navigational System Type
4[C,D[2]]				(geodetic ellipsoid)
5[C,M]	17	ELL	A	Ellipsoid Name
5[C,M]	18	ELC	A	Ellipsoid Code
4[C,D[3]]				(vertical datum)
5[C,M]	19	DVR	A	Datum Vertical Reference
5[C,M]	20	VDCdvr	A	Code for Datum of Vertical Reference
4[C,D[4]]				(sounding datum)
5[C,M]	21	SDA	A	Sounding Datum Name
5[C,M]	22	VDCsda	A	Code for Sounding Datum
4[C,D[5]]				(geodetic datum)
5[C,M]	23	DAG	A	Geodetic Datum Name
5[C,M]	24	DCD	A	Geodetic Datum Code
4[C,O]	25	SRN	A	Library/Source Reference Number
4[R,O]				(highest elevation)
5[R,M]	26	HKE	I	Highest known elevation of source
5[R,M]	27	UNIhke	A	Units of elevation value
5[R,S]				(highest elevation point)
6[R,M]	28	LON	R	Longitude/Easting of HKE
6[R,M]	29	LAT	R	Latitude/Northing of HKE
	999			
3[R,O]	0	MAG	001	;& MAGNETIC_RATE
*4[R,M]	1	*CDP	I	Type of magnetic date rate
4[R,M]	2	CDV	A 8	Magnetic rate Date value
		Note: or	DAT	(see A.3. Alternative Date Format)
4[R,M]	3	RAT	R	Annual magnetic rate of change
4[R,M]	4	UNIrat	A	Units of annual rate of change
4[R,M]	5	GMA	R	Grid north - magnetic north
4[R,M]	6	UNIgma	A	Units of grid magnetic angle
4[R,S]				(magnetic rate reference point)
5[R,M]	7	LON	R	Longitude/Easting of the G-M angle reference point
5[R,M]	8	LAT	R	Latitude/Northing of the G-M angle reference point
4[R,O]				(grid convergence)
5[R,M]	9	GCA	R	Grid convergence angle
5[R,M]	10	UNIgca	A	Units of grid convergence angle
	999			
*3[C,D[6]]	0	RCI	001	;& BOUNDING_POLYGON_COORDINATES
*4[C,M]	1	*LON	R	Longitude/Easting coordinate
4[C,M]	2	LAT	R	Latitude/Northing coordinate
	999			

Withdrawn/Retirée

3[C,O]	0	PRR	001	;& PROJECTION
4[C,M]	1	PRN	A	Projection Name
4[C,M]	2	PCO	A	Projection Codes (Part 3—6)
4[C,M]	3	PAA	R	Projection Parameter 1
5[C,D[7]]	4	PAB	R	Projection Parameter 2
6[C,D[8]]	5	PAC	R	Projection Parameter 3
7[C,D[9]]	6	PAE	R	Projection Parameter 4
4[C,D[10]]				(projection false origin)
5[C,M]	7	XOR	R	Easting false Origin
5[C,M]	8	YOR	R	Northing false Origin
	999			

3[C,S]	0	QSR	001	;& SECURITY_AND_RELEASE
4[C,M]	1	QSS	A	Highest security classification
4[C,M]	2	QOD	A	Downgrading instructions
4[C,M]	3	CDV10	A 8	Downgrading date value
		Note: or DAT (see A.3. Alternative Date Format)		
4[C,M]	4	QLE	A	Releasability
	999			

3[R,D[11]]	0	INS	001	;& INSET
*4[R,M]	1	*INT	A	Unique ID of an Inset
4[R,M]	2	SCA	I	Cartographic Scale of Inset
4[R,M]	3	NAM	A	Name of Inset
4[R,M]	4	NTL	R	Abs. lon. lower left corner
4[R,M]	5	TTL	R	Abs. lat. lower left corner
4[R,M]	6	NVL	R	Abs. lon. upper left corner
4[R,M]	7	TVL	R	Abs. lat. upper left corner
4[R,M]	8	NTR	R	Abs. lon. upper right corner
4[R,M]	9	TTR	R	Abs. lat. upper right corner
4[R,M]	10	NVR	R	Abs. lon. lower right corner
4[R,M]	11	TVR	R	Abs. lat. lower right corner
4[R,M]	12	NRL	R	Rel. lon. lower left corner
4[R,M]	13	TRL	R	Rel. lat. lower left corner
4[R,M]	14	NSL	R	Rel. lon. upper left corner
4[R,M]	15	TSL	R	Rel. lat. upper left corner
4[R,M]	16	NRR	R	Rel. lon. upper right corner
4[R,M]	17	TRR	R	Rel. lat. upper right corner
4[R,M]	18	NSR	R	Rel. lon. lower right corner
4[R,M]	19	TSR	R	Rel. lat. lower right corner`
	999			

3[C,S]	0	CPY	001	;& COPYRIGHT
4[C,M]	1	CPZ	L	Copyright statement
	999			

*2[R,O] **Record: LEGEND**

3[R,M]	0	001		;& RECORD_ID_FIELD	
3[R,M]	1	RTY	A 3	Record type	{RTY = LEG}
3[R,M]	2	RID	I	Record id number	{RID = 1,n}
	999				

3[R,M]	0	LGI	001	;& LEGEND
4[R,O]	1	NAM	A	Legend name
4[R,M]	2	STR	I	Structure class code
	999			

Withdrawn/Retirée

3[R,M]	0	SPR	001	;& DATA_SET_PARAMETERS
4[R,O]		(corners)		
5[R,M]	1	NUL	I	Row Number; upper right corner of MBR
5[R,M]	2	NUS	I	Column Number; upper right corner of MBR
5[R,M]	3	NLL	I	Row Number; lower left corner of MBR
5[R,M]	4	NLS	I	Column Number; lower left corner of MBR
4[R,M]	5	NFL	I	Number of Sub-blocks, vertically
4[R,M]	6	NFC	I	Number of Sub-blocks, horizontally
4[R,M]	7	PNC	I	Number of Pixels/Sub-block Line
4[R,M]	8	PNL	I	Number of Scan Lines/Sub-block
4[R,M]	9	COD	I	Column Sequence
4[R,M]	10	ROD	I	Row sequence
4[R,M]	11	POR	I	Pixel order
4[R,M]	12	PCB	I	Size of Pixel/Element Count in bits
4[R,M]	13	PVB	I	Size of Pixel/Element Value in bits
4[R,M]	14	BAD	A	Image File name
4[R,M]	15	TIF	A 1	Tile index map flag ("Y" or "N")
	999			
3[R,D[12]]	0	TIM	001	;& TILE_INDEX_MAP
*4[R,M]	1	*TSI	I	Tile index map (N = 1-tuple)
	999			

2[R/A,D[13]] **Record: METRIC SUPPORT**

3[R/A,M]	0	001		;& RECORD_ID_FIELD	
3[R/A,M]	1	RTY	A 3	Record type	{RTY = MSD}
3[R/A,M]	2	RID	I	Record id number	{RID=1}
	999				
3[R/A,D[14]]	(arc system metric support)				
4[R/A,M]	0	NCD	001	;& NORMALIZATION_CONSTANTS	
5[R/A,M]	1	TSF	R	Latitude Scale Factor	
5[R/A,M]	2	GSF	R	Longitude Scale Factor	
5[R/A,M]	3	TTT	R	Latitude Translation Term	
5[R/A,M]	4	GTT	R	Longitude Translation Term	
5[R/A,M]	5	NSF	R	Northing Scale Factor	
5[R/A,M]	6	ESF	R	Easting Scale Factor	
5[R/A,M]	7	NTT	R	Northing Translation Term	
5[R/A,M]	8	ETT	R	Easting Translation Term	
	999				
4[R/A,M]	0	SDC	001	;& SOURCE_DATUM_COEFFICIENTS_DATA	
5[R/A,M]	1	AX1	R	Latitude coefficient 1	
5[R/A,M]	2	AX2	R	Latitude coefficient 2	
5[R/A,M]	3	AX3	R	Latitude coefficient 3	
5[R/A,M]	4	AX4	R	Latitude coefficient 4	
5[R/A,M]	5	AX5	R	Latitude coefficient 5	
5[R/A,M]	6	AX6	R	Latitude coefficient 6	
5[R/A,M]	7	AX7	R	Latitude coefficient 7	
5[R/A,M]	8	BX1	R	Longitude coefficient 1	
5[R/A,M]	9	BX2	R	Longitude coefficient 2	
5[R/A,M]	10	BX3	R	Longitude coefficient 3	
5[R/A,M]	11	BX4	R	Longitude coefficient 4	
5[R/A,M]	12	BX5	R	Longitude coefficient 5	
5[R/A,M]	13	BX6	R	Longitude coefficient 6	
5[R/A,M]	14	BX7	R	Longitude coefficient 7	
	999				

Withdrawn/Retirée

4[R/A,M]	0	MPC	001	;& MAP_PROJECTIONS_COEFFICIENTS_DATA
5[R/A,M]	1	CX1	R	Northing coefficient 1
5[R/A,M]	2	CX2	R	Northing coefficient 2
5[R/A,M]	3	CX3	R	Northing coefficient 3
5[R/A,M]	4	CX4	R	Northing coefficient 4
5[R/A,M]	5	CX5	R	Northing coefficient 5
5[R/A,M]	6	CX6	R	Northing coefficient 6
5[R/A,M]	7	CX7	R	Northing coefficient 7
5[R/A,M]	8	CX8	R	Northing coefficient 8
5[R/A,M]	9	CX9	R	Northing coefficient 9
5[R/A,M]	10	CXA	R	Northing coefficient 10
5[R/A,M]	11	DX1	R	Easting coefficient 1
5[R/A,M]	12	DX2	R	Easting coefficient 2
5[R/A,M]	13	DX3	R	Easting coefficient 3
5[R/A,M]	14	DX4	R	Easting coefficient 4
5[R/A,M]	15	DX5	R	Easting coefficient 5
5[R/A,M]	16	DX6	R	Easting coefficient 6
5[R/A,M]	17	DX7	R	Easting coefficient 7
5[R/A,M]	18	DX8	R	Easting coefficient 8
5[R/A,M]	19	DX9	R	Easting coefficient 9
5[R/A,M]	20	DXA	R	Easting coefficient 10
	999			

3[R/A,D[15]] (UTM/UPS system metric support)

4[R/A,M]	0	DCC	001	;&DATUM_CHANGE_CONSTANTS
		(Note: units for all datum change constants are n degrees and decimal part of a degree.)		
5[R/A,M]	1	TOF	R	Latitude normalizing offset.
5[R/A,M]	2	GOF	R	Longitude normalizing offset.
5[R/A,M]	3	NZT	R	Normalizing factor
5[R/A,M]	4	ELV	R	Eastern limit of validity to use multiple regression equations.
5[R/A,M]	5	WLV	R	Western limit of validity to use multiple regression equations.
5[R/A,M]	6	NLV	R	Northern limit of validity to use multiple regression equations.
5[R/A,M]	7	SLV	R	Southern limit of validity to use multiple regression equations.
	999			
4[R/A,M]	0	SCC	001	;&SOURCE_DATUM_COEFFICIENTS_COUNTER
5[R/A,M]	1	BCT	I	Number of longitude coefficients.
5[R/A,M]	2	ACT	I	Number of latitude coefficients.
	999			
4[R/A,M]	0	SLG	001	;&SOURCE_DATUM_LONGITUDE_COEFFICIENTS
*5[R/A,M]	1	*CBI	I	i index of the coefficient of MRE $b_{i,j}$.
5[R/A,M]	2	CBJ	I	j index of the coefficient of MRE $b_{i,j}$.
5[R/A,M]	3	LGC	R	Coefficient of MRE $b_{i,j}$ ($b_{i,j}$ coefficients are ordered with respect to increasing i then j.
	999			
4[R/A,M]	0	SLT	001	;&SOURCE_DATUM_LATITUDE_COEFFICIENTS
*5[R/A,M]	1	*CAI	I	i index of the coefficient of MRE $a_{i,j}$.
5[R/A,M]	2	CAJ	I	j index of the coefficient of MRE $a_{i,j}$.
5[R/A,M]	3	LTC	R	Coefficient of MRE $a_{i,j}$ ($a_{i,j}$ coefficients are ordered with respect to increasing i then j.
	999			

Withdrawn/Retirée

4[R/A,O]	0	GRC	001	;&GRID_ROTATION_COEFFICIENTS
5[R/A,M]	1	NES	R	Normalized Eastings Shift
5[R/A,M]	2	NNS	R	Normalized Northings shift
5[R/A,M]	3	AOR	R	Angle of orientation from source datum grid to WGS UTM grid
	999			

2[C,O] **Record: SUPPLEMENTARY TEXT**

3[C,M]	0	001		;& RECORD_ID_FIELD	
3[C,M]	1	RTY	A 3	Record type	{RTY = SPT}
3[C,M]	2	RID	I	Record id number	{RID=1}
	999				

3[C,M]	0	SUP	001	;& SUPPLEMENTARY_TEXT
*4[C,M]	1	*TRY	A	Supplementary text record type
4[C,O]	2	TRI	A	Supplementary text field reference identifier
4[C,M]	3	TXT	L	Supplementary text
	999			

Dependency conditions:

1. **Name of derived layer:**
   Name of the derived layer will be transmitted whenever the source described in the source record does not apply to all layers in the dataset.

2. **Ellipsoid:**
   Mandatory if the projection field is transmitted.

3. **Vertical Datum:**
   Mandatory if elevation information is present on the source (e.g. contour lines on a raster map). Forbidden if no elevation information is present on the source.

4. **Sounding Datum:**
   Mandatory if sounding information is present in the source (depth values or sounding information on a raster map). Forbidden if no sounding information is present on the source .

5. **Geodetic Datum:**
   Mandatory if the projection field is transmitted.

6. **Bounding polygon:**
   Mandatory when the source information is not valid for the whole dataset extension.

7. **Parameter 2: see Part 3 clause 6**
8. **Parameter 3: see Part 3 clause 6**
9. **Parameter 4: see Part 3 clause 6**

10. **Projection False Origin: when relevant only**

11. **Inset: mandatory when relevant only**

12. **Tile index Map:**
    Mandatory if TIF = "Y"

13. **Metric support:**
    Mandatory when the dataset type is ASRP or USRP
    Strongly recommended for use of ARC or UTM/UPS systems.

Withdrawn/Retirée

14. Arc system:
used with Arc system only

15. UTM/UPS system:
used with UTM/UPS system only

A.3.5 QUALITY FILE

File Content by Record and Field:

1 [C,M]	File: QUALITY			
2 [C,M]	|- Record: QUALITY			
	| |- 001	(2)	{RTY = QAL}	
	| |- QSR	(4)	Security and Release	
	| |- QCC	(*4)	Completeness and Consistency	
	| |- QUV	(10)	Up_to_Dateness	
	| |- QAA	(*4)	Attribute Accuracy	
	| |- CPT	(1)	Colour Patch Type	
	| |- CPI	(*4)	Colour Patch Id	
	| |- SPR	(15)	Scanning Parameters	
	| |- COL	(*9)	Colour Code Id	
	| |- NOM	(*3)	Nominal Code Id	
	| |- QOI	(1)	Other Quality Information	
	|			
2 [C,D]	|-R Record: ACCURACY †			
	| |- 001	(2)	{RTY = QAI}	
	| |- QAP	(9)	Accuracy	
	| |- RCI	(*2)	Bounding Polygon Coordinates	
	|			
2 [C,D]	|-R Record: HORIZONTAL ACCURACY ††			
	| |- 001	(2)	{RTY = HOR}	
	| |- ASH	(5)	Horizontal Accuracy	
	| |- RCI	(*2)	Bounding Polygon Coordinates	
	|			
2 [C,D]	|-R Record: VERTICAL ACCURACY ††			
	|- 001	(2)	{RTY = VER}	
	|- ASV	(5)	Vertical Accuracy	
	|- RCI	(*2)	Bounding Polygon Coordinates	

† Accuracy alternative 1--used when accuracy values for both horizontal and vertical accuracies are constant within the same bounding polygon.

†† Accuracy alternative 2--used when accuracy values are different and require separate bounding polygons.

Field Data Descriptions:

Control	==	(see DDR Header in ISO 8211)
0	000	{=QUALITY_FILE}
1		File title field, present only in DDR
999		

Withdrawn/Retirée

2[C,M]		**Record:**		**QUALITY**	
3[C,M]	0	001		;& RECORD_ID_FIELD	
3[C,M]	1	RTY	A 3	Record type	{RTY = QAL}
3[C,M]	2	RID	I	Record id number	{RID = 1}
	999				
3[C,M]	0	QSR	001	;& SECURITY_AND_RELEASE	
4[C,M]	1	QSS	A	Highest classification within the data set	
4[C,M]	2	QOD	A	Downgrading instructions	
4[C,M]	3	CDV10	A 8	Downgrading date value	
		Note: or DAT (see A.3. Alternative Date Format)			
4[C,M]	4	QLE	A	Releasability Statement	
	999				
3[V,O]	0	QCC	001	;& COMPLETENESS_AND_CONSISTENCY	
*4[V,D[1]]	1	*BAD	A	Layer name	
4[V,O]	2	QFC	I	Feature Completeness percent	
4[V,O]	3	QAC	I	Attribute Completeness percent	
4[V,O]	4	QLC	A	Logical Consistency	
	999				
3[C,S]	0	QUV	001	;& UP_TO_DATENESS	
4[C,M]	1	EDN	I	Edition Number of Data Set	
4[C,M]	2	CDV07	A 8	Creation of dataset date value	
		Note: or DAT1 (see A.3. Alternative Date Format)			
4[C,M]	3	CDV24	A 8	Revision or Update date value	
		Note: or DAT2 (see A.3. Alternative Date Format)			
4[C,O]	4	REC	I	Recompilation Count	
4[C,O]	5	REV	I	Revision Count	
4[C,M]	6	SRC	A	Specification ID	
4[C,D[2]]	7	CDV22	A 8	Specification date value (null when unspecified)	
		Note: or DAT3 (see A.3. Alternative Date Format)			
4[C,D[3]]	8	SPA	A	Specification amendment	
4[C,O]	9	CDV20	A 8	Earliest source date value	
		Note: or DAT4 (see A.3. Alternative Date Format)			
4[C,O]	10	CDV21	A 8	Latest source date value	
		Note: or DAT5 (see A.3. Alternative Date Format)			
	999				
3[V,O]	0	QAA	001	;& ATTRIBUTE_ACCURACY	
*4[V,D[4]]	1	*BAD	A	Layer name	
4[V,O]	2	QUT	I	Standard Deviation of Quantitative Attributes	
4[V,O]	3	QUL	I	Percent Reliability of Qualitative Attributes	
4[V,O]	4	CCR	A	Collection Criteria	
	999				
3[R,O]		(color patch description)			
4[R,M]	0	CPT	001	;& COLOUR_PATCH_TYPE	
4[R,M]	1	SCR	A	Standard colour patch reference	
	999				
4[R,O]	0	CPI	001	;& COLOUR_PATCH_ID	
*5[R,M]	1	*PNM	A	Colour Patch Name (e.g. Red)	
5[R,M]	2	PIR	I	Patch Intensity Value - Red	
5[R,M]	3	PIG	I	Patch Intensity Value - Green	
5[R,M]	4	PIB	I	Patch Intensity Value - Blue	
	999				

Withdrawn/Retirée

4[R,D[5]]	0	SPR	001	;& DATA_SET_PARAMETERS
5[R,O]	(corners)			
6[R,M]	1	NUL	I	Row Number; upper right corner of MBR
6[R,M]	2	NUS	I	Column Number; upper right corner of MBR
6[R,M]	3	NLL	I	Row Number; lower left corner of MBR
6[R,M]	4	NLS	I	Column Number; lower left corner of MBR
5[R,M]	5	NFL	I	Number of Sub-blocks, vertically
5[R,M]	6	NFR	I	Number of Sub-blocks, horizontally
5[R,M]	7	PNR	I	Number of Pixels/Sub-block Line
5[R,M]	8	PNL	I	Number of Scan Lines/Sub-block
5[R,M]	9	ROD	I	Column Sequence
5[R,M]	10	ROD	I	Row sequence
5[R,M]	11	POR	I	Pixel order
5[R,M]	12	PRB	I	Size of Pixel/Element Count in bits
5[R,M]	13	PVB	I	Size of Pixel/Element Value in bits
5[R,M]	14	BAD	A	Image File name
5[R,M]	15	TIF	A 1	Tile index map flag ("Y" or "N")
	999			
3[R,D[6]]	0	COL	001	;& COLOUR_CODE_ID
*4[R,M]	1	*CBD	A	Name and/or Description of Colour Code
4[R,M]	2	CCD	I3	Colour Code Assigned in Data Set (0-255)
4[R,O]	(CIE color description)			
5[R,M]	3	CR1	I	CIEx
5[R,M]	4	CR2	I	CIEy
5[R,M]	5	CR3	I	CIE Reflectivity (y)
4[R,O]	6	FRM	A	Mathematical Relation to other colour-codes (free text). See 10.4
4[R,S]	(RGB color description)			
5[R,M]	7	NSR	I3	Colour Intensity - Red actual (0-255)
5[R,M]	8	NSG	I3	Colour Intensity - Green actual (0-255)
5[R,M]	9	NSB	I3	Colour Intensity - Blue actual (0-255)
	999			
3[A,M]	0	NOM	001	;& NOMINAL_CODE_ID
*4[A,M]	*1	NCI	A	Code Identifier
4[A,M]	2	NDB	A	Description/meaning of code
4[A,M]	3	NCD	I	Nominal code assigned in data set
	999			
3[C,O]	0	QOI	001	;& OTHER_QUALITY_INFORMATION
4[C,M]	1	OQI	L	Free text
	999			

*2[C,D[7]] **Record: ACCURACY**

3[C,M]	0	001		;& RECORD_ID_FIELD	
3[C,M]	1	RTY	A 3	Record type	{RTY = QAI}
3[C,M]	2	RID	I	Record id number	{RID = 1,n}
	999				

Withdrawn/Retirée

3[C,M]	0	QAP	001	;& POSITIONAL_ACCURACY
3[C,M]	1	AAH	I	Accuracy Absolute Horizontal
3[C,M]	2	UNIaah	A	Unit of measure
3[C,M]	3	AAV	I	Accuracy Absolute Vertical
3[C,M]	4	UNIaav	A	Unit of measure
3[C,M]	5	APH	I	Accuracy Point to Point Horizontal
3[C,M]	6	UNIaph	A	Unit of measure
3[C,M]	7	APV	I	Accuracy Point to Point Vertical
3[C,M]	8	UNIapv	A	Unit of measure
3[C,D[8]]	9	BAD	A	Layer name
	999			

3[C,D[9]]	0	RCI	001	;& BOUNDING_POLYGON_COORDINATES
*4[C,M]	1	*LON	R	Longitude/Easting coordinate
4[C,M]	2	LAT	R	Latitude/Northing coordinate
	999			

*2[C,D[7]] Record: HORIZONTAL ACCURACY

3[C,M]	0	001		;& RECORD_ID_FIELD
3[C,M]	1	RTY	A 3	Record type {RTY = HOR}
3[C,M]	2	RID	I	Record id number {RID = 1,n}
	999			

3[C,M]	0	ASH	001	;& HORIZONTAL_ACCURACY
3[C,M]	1	AAH	I	Absolute Horizontal Accuracy
3[C,M]	2	UNIaah	A	Unit of measure
3[C,M]	3	APH	I	Relative Horizontal Accuracy
3[C,M]	4	UNIaph	A	Unit of measure
3[C,D[10]]	5	BAD	A	Layer name
	999			

3[C,D[11]]	0	RCI	001	;& BOUNDING_POLYGON_COORDINATES
*4[C,M]	1	*LON	R	Longitude/Easting coordinate
4[C,M]	2	LAT	R	Latitude/Northing coordinate
	999			

*2[C,D[7]] Record: VERTICAL ACCURACY

3[C,M]	0	001		;& RECORD_ID_FIELD
3[C,M]	1	RTY	A 3	Record type {RTY = VER}
3[C,M]	2	RID	I	Record id number {RID = 1,n}
	999			

3[C,M]	0	ASV	001	;& VERTICAL_ACCURACY
3[C,M]	1	AAV	I	Absolute Vertical Accuracy
3[C,M]	2	UNIaav	A	Unit of measure
3[C,M]	3	APV	I	Relative Vertical Accuracy
3[C,M]	4	UNIapv	A	Unit of measure
3[C,D[12]]	5	BAD	A	Layer name
	999			

3[C,D[13]]	0	RCI	001	;& BOUNDING_POLYGON_COORDINATES
*4[C,M]	1	*LON	R	Longitude/Easting coordinate
4[C,M]	2	LAT	R	Latitude/Northing coordinate
	999			

Withdrawn/Retiree

Dependency conditions:

1. **Name of layer:**
The name of the layer will be transmitted whenever the completness and consistency information does not apply to all layers in the dataset.

2. **Specification edition date:**
The specification edition date will be transmitted with the specification edition ID.

3. **Specification amendment number:**
The specification amendment number will be transmitted with specification edition ID.

4. **Name of layer:**
The name of the layer will be transmitted whenever the attribute accuracy information does not apply to all layers in the dataset.

5. **Color patch dataset parameters:**
The color patch dataset parameters will be transmitted if the color patch image file exists.

6. **Color coded:**
Must be defined when raster color coded data is transmitted (STR=4). Forbidden otherwise.

7. **Accuracy record:**
Must be used when both horizontal and vertical accuracy are known and homogeneous on the same area. If it is absent then both horizontal and vertical accuracy records must be present.

8. **Name of layer:**
The name of the layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset

9. **Bounding polygon:**
Mandatory when the source information is not valid for the whole dataset extent.

10. **Name of layer:**
The name of the layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset.

11. **Bounding polygon:**
Mandatory when the source information is not valid for the whole dataset extent.

12. **Name of layer:**
Name of layer will be transmitted whenever the accuracy information does not apply to all layers in the dataset.

13. **Bounding polygon:**
Mandatory when the source information is not valid for the whole dataset extension

Withdrawn/Retirée

A.3.6 VECTOR GEO DATA FILE

File Content by Record and Field:

```
1[V,M]      File: VECTOR GEO DATA
2[V,D]      |-R  Record:   EDGE
            |   |-  001       (2)      {RTY = ED}
            |   |-  CNT       (3)      Counter
            |   |-  IRE       (6*3)    Edge Implicit Relation Pointers
            |   |-  IRS       (*3)     Implicit Relations Pointer
            |   |-  IAT       (2*3)    Implicit Attributes
            |   |-  ATT       (*3)     Explicit Attribute Labels and Values
            |   |-  COR       (*3)     Coordinates
            |
2[V,D]      |-R  Record:   NODE
            |   |-  001       (2)      {RTY = NO}
            |   |-  CNT       (3)      Counter
            |   |-  IRN       (3)      Node implicit Relation Pointer
            |   |-  IRS       (*3)     Implicit Relations Pointer
            |   |-  ATT       (*3)     Explicit Attribute Labels and Values
            |   |-  COR       (3)      Coordinates
            |
2[V3,D]     |-R  Record:   FACE
            |   |-  001       (2)      {RTY = FE}
            |   |-  CNT       (3)      Counter
            |   |-  IRS       (*3)     Implicit Relations Pointer
            |   |-  IAT       (2*3)    Implicit Attributes
            |   |-  ATT       (*3)     Explicit Attribute Labels and Values
            |
2[V0,D]     |-R  Record:   SPATIAL DATA
            |   |- 001       (2)      {RTY = SP}
            |   |- CNT       (3)      Counter
            |   |- IRS       (*3)     Implicit Relations Pointer
            |   |- IAT       (2*3)    Implicit Attributes
            |   |- ATT       (*3)     Explicit Attribute Labels and Values
            |   |- COR       (*3)     Coordinates/elevation
            |
2[V,M]      |-R  Record:   FEATURE
            |   |-  001       (2)      {RTY = FL | FP | FA | FC}
            |   |-  CNS       (3)      Counter - Explicit Relations
            |   |-  IRS       (*3)     Implicit Relation Pointer
            |   |-  IAS       (9)      Implicit Attributes
            |   |-  ATT       (*5)     Explicit Attribute Labels and Values
            |   |-R |-  R1L    (1)      Explicit Relation Pointer  (ALT | CPO | STK | STU) for Simple
            |   |   |                   Features,
            |   |   |                                              (ALT | CPO) for Complex Features.
            |   |   |-  R1V    (*3)     Explicit Relation Value
            |
2[V,O]      |-R  Record:   TEXT PLACEMENT
            |   |-  001       (2)      {RTY = TP}
            |   |-  CNT       (3)      Counter
            |   |-  IRS       (*3)     Implicit Relations Pointers
            |   |-  ATT       (*3)     Explicit Attribute Labels and Values
            |   |-  TXT       (2)      Text
            |   |-  COR       (*2)     Coordinates
            |
2[V,D]      |-R  Record: FEATURE/ATTRIBUTE ENTRY
            |   |-  001       (2)      {RTY = DD}
            |   |-  DFA       (6)      Feature Attribute Entry
            |
```

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```
2[V,O]      |-R  Record: FEATURE/ATTRIBUTE ASSOCIATION
            |  |-  001      (2)     {RTY = DF}
            |  |-  DAA      (1)     Feature Association
            |  |-  AAD      (*1)    Attribute Association
            |
2[V,D]      |-R  Record: ATTRIBUTE/VALUE ASSOCIATION
            |  |-  001      (2)     {RTY = DA}
            |  |-  DAV      (4)     Attribute Format Description
            |  |-  VAD      (*2)    Attribute Value Description
```

Field Data Descriptions:

```
            Control     ==      (see  DDR Header in ISO 8211)

                0       000     {=VECTOR_GEO_DATA_FILE}
                1               File title field, present only in DDR
              999
```

***2[V,D1] Record: EDGE**

```
3[V,M]          0   001             ;& RECORD_ID_FIELD
3[V,M]          1   RTY     A3      Record type         {RTY = ED}
3[V,M]          2   RID     I       Record id number    {RID = 1,n}
              999

3[V,O]          0   CNT     001     ;& COUNTER
4[V,M]          1   EXT     I       Number of explicit attributes
4[V,M]          2   EXC     I       Number of coordinate sets
4[V,D2]         3   NLF     I       Number of Features "composed of" this edge
              999

3[V3,M][V1-2,O] 0   IRE     001     ;& EDGE_IMPLICIT_RELATION_POINTERS
4[V3,M]             (face topology)
5[V3,M]         1   FAL     @       Left Face Pointer
5[V3,M]         2   FAR     @       Right Face Pointer
4[V3,M][V1-2,O]     (edge-node topology)
5[V1-3,M]       3   NOS     @       Start Node Pointer
5[V1-3,M]       4   NOE     @       End Node Pointer
4[V1-3,O]           (winged-edge topology)
5[V1-3,M]       5   NER     @       Pointer to Next Right Edge
5[V1-3,M]       6   NEL     @       Pointer to Previous Left  Edge
              @
6[V1-3,M]       1   *RTY    A       Record type
6[V1-3,M]       2   RID     I       Record ID
6[V1-3,O]       3   SEC     A       Security
              999

3[V,O]          0   IRS     001     IMPLICIT_RELATIONS_POINTER
*4[V,M]         1   *RTY    A       Level 3 {RTY= CFL }
                                    Level 2 &1 & 0 {RTY= CFL | CFA }
4[V,M]          2   RID     I       Record ID
4[V,O]          3   SEC     A       Security
              999
```

Withdrawn/Retirée

3[V,O]	0	IAT	001	;& IMPLICIT_ATTRIBUTES
4[V,M]	1	MIN	@	Minimum
4[V,M]	2	MAX	@	Maximum
	@			
5[V,M]	1	*EAS	R	Easting/Latitude
5[V,M]	2	NOR	R	Northing/Longitude
5[V,D3]	3	ELE	R	Elevation
	999			

3[V,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V,M]	1	*ATC	A	Attribute Label
4[V,M]	2	FOR	A	Value Format
4[V,M]	3	VAL	A | I | R | L	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field		
	999			

3[V,M]	0	COR	001	;& COORDINATES
*4[V,M]	1	*LON	R	Longitude/Easting
4[V,M]	2	LAT	R	Latitude/Northing
4[V,D4]	3	ELE	R	Elevation
	999			

Dependency conditions

1. **Edge record:**
Vector geodata files containing only nodes and no edges or faces may exist. Edge record is mandatory if Vector geodata file contains Line or Area feature records. At level0, it may be replaced by Spatial data record.

2. **NLF counter subfield:**
The NLF counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

3. **Elevation MBR subfield :**
Minimum and maximum elevation must be transmitted if the transmitted coordinates (COR) contain elevation value(s).

4. **Elevation Coordinates subfield :**
Elevation must be absent or present for all transmitted coordinates.

*2[V,D1] Record: NODE

3[V,M]	0	001		;& RECORD_ID_FIELD	
3[V,M]	1	RTY	A3	Record type	{RTY = NO}
3[V,M]	2	RID	I	Record id number	{RID = 1,n}
	999				

3[V,O]	0	CNT	001	;& COUNTER
4[V,M]	1	EXT	I	Number of explicit attributes
4[V,M]	2	EXC	I	Number of coordinate sets {EXC = 1}
4[V,D2]	3	NLF	I	Number of Features "composed of" this node
	999			

3[V3,M]	0	IRN	001	;& NODE_IMPLICIT_RELATION_POINTER
4[V3,M]	1	RTY	A	={FE if isolated node; null if connected node}
4[V3,D3]	2	RID	I	Record ID
4[V3,O]	3	SEC	A	Security
	999			

Withdrawn/Retirée

3[V,O]	0	IRS	001	IMPLICIT_RELATIONS_POINTER
*4[V,M]	1	*RTY	A	{RTY= CFP }
4[V,M]	2	RID	I	Record ID
4[V,O]	3	SEC	A	Security
	999			
3[V,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V,M]	1	*ATC	A	Attribute Label
4[V,M]	2	FOR	A	Value Format
4[V,M]	3	VAL	A | I | L | R	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field		
	999			
3[V,M]	0	COR	001	;& COORDINATES
4[V,M]	1	LON	R	Longitude/Easting
4[V,M]	2	LAT	R	Latitude/Northing
4[V,O]	3	ELE	R	Elevation
	999			

Dependency conditions

1. **Node record:**
Vector geodata files without any node record may exist. Node record is mandatory if Vector geodata file contains Point feature records or if Edge record contains edge-node topology description. At level 0, it may be replaced by Spatial data record.

2. **NLF counter subfield:**
The NLF counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

3. **Connected node IRN:**
RID is null when RTY is null

*2[V3,M] **Record: FACE**

3[V3,M]	0	001		;& RECORD_ID_FIELD	
3[V3,M]	1	RTY	A3	Record type	{RTY = FE}
3[V3,M]	2	RID	I	Record id number	{RID = 1,n}
	999				
3[V3,O]	0	CNT	001	;& COUNTER	
4[V3,M]	1	EXT	I	Number of explicit attributes	
4[V3,M]	2	EXC	I	Number of coordinate sets {EXC = Null}	
4[V3,D[1]]	3	NLF	I	Number of Features "composed of" this face	
	999				
3[V3,O]	0	IRS	001	IMPLICIT_RELATIONS_POINTER	
*4[V3,M]	1	*RTY	A	{RTY= CFA }	
4[V3,M]	2	RID	I	Record ID	
4[V3,O]	3	SEC	A	Security	
	999				

Withdrawn/Retirée

3[V3,O]	0	IAT	001	;& IMPLICIT_ATTRIBUTES
4[V3,M]	1	MIN	@	Minimum
4[V3,M]	2	MAX	@	Maximum
	@			
5[V3,M]	1	*EAS	R	Easting/Latitude
5[V3,M]	2	NOR	R	Northing/Longitude
5[V3,D^2]	3	ELE	R	Elevation
	999			

3[V3,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V3,M]	1	*ATC	A	Attribute Label
4[V3,M]	2	FOR	A	Value Format
4[V3,M]	3	VAL	A | I | L | R	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field		
	999			

Dependency conditions

1. **NLF counter subfield:**
The NLF counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

2. **Elevation MBR subfield :**
Minimum and maximum elevation must be transmitted if the bordering edges are transmitted with elevation value(s) in their coordinates field(COR).

*2[V0,D^1] Record: SPATIAL DATA

3[V0,M]	0	001		;& RECORD_ID_FIELD
3[V0,M]	1	RTY	A3	Record type {RTY = SP}
3[V0,M]	2	RID	I	Record id number {RID = 1,n}
	999			

3[V0,O]	0	CNT	001	;& COUNTER
4[V0,M]	1	EXT	I	Number of explicit attributes
4[V0,M]	2	EXC	I	Number of coordinate sets {EXC = 1 for IRS!RTY=CFP}
4[V0,D^2]	3	NLF	I	Number of Features "composed of" this spatial data
	999			

3[V0,O]	0	IRS	001	IMPLICIT_RELATIONS_POINTER
*4[V0,M]	1	*RTY	A	{ RTY=CFL | CFP | CFA }
4[V0,M]	2	RID	I	Record ID
4[V0,O]	3	SEC	A	Security
	999			

3[V0,O]	0	IAT	001	;& IMPLICIT_ATTRIBUTES
4[V0,M]	1	MIN	@	Minimum
4[V0,M]	2	MAX	@	Maximum
	@			
5[V0,M]	1	*EAS	R	Easting/Latitude
5[V0,M]	2	NOR	R	Northing/Longitude
5[V0,D^3]	3	ELE	R	Elevation
	999			

Withdrawn/Retirée

3[V0,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V0,M]	1	*ATC	A	Attribute Label
4[V0,M]	2	FOR	A	Value Format
4[V0,M]	3	VAL	A | I | L | R	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field		
	999			

3[V0,M]	0	COR	001	;& COORDINATES (without repetition for IRS!RTY=CFP)
*4[V0,M]	1	*LON	R	Longitude/Easting
4[V0,M]	2	LAT	R	Latitude/Northing
4[V0,D[4]]	3	ELE	R	Elevation
	999			

Dependency conditions

1. **Spatial data record:**
Spatial data record will be present at level 0 if neither node record nor edge record are present.

2. **NLF counter subfield:**
The NLF counter sub-field is mandatory (and must be consistent with) when the IMPLICIT RELATIONS POINTER is present.

3. **Elevation MBR subfield :**
Minimum and maximum elevation must be transmitted if the transmitted coordinates (COR) contain elevation value(s).

4. **Elevation Coordinates subfield :**
Elevation must be absent or present for all transmitted coordinates.

*2[V,M] **Record: FEATURE**

3[V,M]	0	001		;& RECORD_ID_FIELD
3[V,M]	1	RTY	A3	Record type {RTY = FL | FP | FA | FC}
3[V,M]	2	RID	I	Record id number {RID = 1,n}
	999			

3[V,O]	0	CNS	001	;& COUNTER_FIELD
4[V,M]	1	EXT	I	Number of spatial explicit attributes
4[V,M]	2	EXR	I	Number of explicit relations
4[V,M]	3	EXE	I	Total number of "composed of" relations
	999			

3[V,M]	0	IRS	001	IMPLICIT_RELATIONS_POINTER
*4[V,M]	1	*RTY	A	FL {RTY= ±ED **level 0-3** } {RTY= ±SP (level 0) }
				FP {RTY= NO **level 0-3** } {RTY= SP (level 0) }
				FA {RTY= FE **level 3** } { RTY = ± ED | IED | JED **level 0-2** }
				FA { RTY = ± SP | ISP | JSP level 0 }
				FC { RTY = FL | FP | FA | FC **level 0-3** }
4[V,M]	2	RID	I	Record ID
4[V,O]	3	SEC	A	Security
	999			

Withdrawn/Retirée

3[V,M]	0	IAS	001	;& IMPLICIT_ATTRIBUTES
4[V,M]	1	FAC	A5	FACC identifier code
4[V,O]	(MBR)			
5[V,M]	2	MIE	R	Minimum longitude/easting value
5[V,M]	3	MIN	R	Minimum latitude/northing value
5[V,D[1]]	4	ZV1	R	Minimum elevation value
5[V,M]	5	MAE	R	Maximum longitude/easting value
5[V,M]	6	MAI	R	Maximum latitude/northing value
5[V,D[1]]	7	ZV2	R	Maximum elevation value
4[V,O]		(control point)		
5[V,M]	8	GLO	R	Longitude/Easting of geographic reference point
5[V,M]	9	GLA	R	Latitude/Northing of geographic reference point
	999			
3[V,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V,D[2]]		(ordered rooted tree links)		
5[V,M]	1	*LLK	I	Left Link
5[V,M]	2	RLK	I	Right Link
4[V,M]		(attribute description)		
5[V,M]	3	ATC	A	Attribute Label
5[V,M]	4	FOR	A	Value Format
5[V,M]	5	VAL	A | I | R | L	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field.		
	999			
*3[V,O]	(explicit relation)			
4[V,M]	0	R1L	001	;& EXPLICIT_RELATION_POINTERS
5[V,M]	1	ERT	A	Relation type
	999			
5[V,M]	0	R1V	R1L	;& EXPLICIT_RELATION_VALUE
*6[V,M]	1	*RTY	A	{RTY= FL | FP| FA | FC}
		Note: FC is not appropriate for stacked on/stacked under (STK/STU)relation type		
6[V,M]	2	RID	I	Record id number
6[V,O]	3	SEC	A	Security
	999			

Dependency conditions

1. **Elevation MBR subfields:**
If any of the topological entities, composing or bordering the simple feature or any of the simple feature composing the complex feature, contains elevation values in its coordinates field, maximum and minimum elevation values will be transmitted.

2. **Left/Right Link:**
Left and right link subfield will exist for all attributes, if there is at least one multi-level attribute.

2[V,O] **Record: TEXT PLACEMENT**

3[V,M]	0	001		;& RECORD_ID_FIELD	
3[V,M]	1	RTY	A3	Record type	{RTY = TP}
3[V,M]	2	RID	I	Record id number	
	999				

Withdrawn/Retirée

3[V,O]	0	CNT	001	;& COUNTER
4[V,M]	1	EXT	I	Number of explicit attributes
4[V,M]	2	EXC	I	Number of coordinate sets
4[V,M]	3	NLF	I	Number of features pointed to by this text
	999			

3[V,O]	0	IRS	001	;& IMPLICIT_RELATION_POINTER
*4[V,M]	1	*RTY	A	Record type {RTY= FL | FP | FA | FC | CF}
4[V,M]	2	RID	I	Record ID
4[V,O]	3	SEC	A	Security
	999			

3[V,O]	0	ATT	001	;& EXPLICIT_ ATTRIBUTE_LABELS_AND_VALUES
*4[V,M]	1	*ATC	A	Attribute Label
4[V,M]	2	FOR	A	Value Format
4[V,M]	3	VAL	A | I | I3 | R	Attribute Value
		Note: The data type of VAL sub-field will be consistent with the value of FOR sub-field		
	999			

3[V,M]	0	TXT	001	;& TEXT
4[V,M]	1	FTX	L	Text
	999			

3[V,M]	0	COR	001	;& COORDINATES
*4[V,M]	1	*LON	R	Longitude/Easting
4[V,M]	2	LAT	R	Latitude/Northing
	999			

*2[V,D[1]] Record: FEATURE/ATTRIBUTE ENTRY

3[V,M]	0	001		;& RECORD_ID_FIELD
3[V,M]	1	RTY	A3	Record type {RTY = DD}
3[V,M]	2	RID	I	Record id number {RID = 1,n}
	999			

3[V,M]	0	DFA	001	;& FEATURE_ATTRIBUTE_ENTRY
4[V,M]	1	FAQ	I	Feature or attribute {1=Feature; 2=Attribute}
4[V,M]	2	LAB	A	Feature code/name or Attribute label
4[V,O]	3	SOG	A	Source for the feature or attribute
4[V,O]	4	DES	A	Description of originator and/or source
4[V,O]	5	FAN	A	Short name for the feature or attribute
4[V,M]	6	DEF	L	Attribute or feature definition
	999			

Dependency condition

1. **Feature/attribute entry record:**
Feature (or attribute) entry record will be present if any Feature (or attribute) transmitted in the Vector Geodata file is not described in FACC (DIGEST Part4)

*2[V,O] Record: FEATURE/ATTRIBUTE ASSOCIATION

3[V,M]	0	001		;& RECORD_ID_FIELD
3[V,M]	1	RTY	A3	Record type {RTY = DF}
3[V,M]	2	RID	I	Record id number {RID = 1,n}
	999			

Withdrawn/Retiree

```
3[V,M]          0     DAA      001     ;& FEATURE_ASSOCIATION
3[V,M]          1     LAB      A5       Feature label
              999

3[V,M]          0     AAD      001     ;& ATTRIBUTE_ASSOCIATION
*3[V,M]         1     *ALB     A3       Attribute label
              999
```

*2[V,D[1]] **Record: ATTRIBUTE/VALUE ASSOCIATION**

```
3[V,M]          0     001              ;& RECORD_ID_FIELD
3[V,M]          1     RTY      A3      Record type          {RTY = DA}
3[V,M]          2     RID      I       Record id number     {RID = 1,n}
              999

3[V,M]          0     DAV      001     ;& ATTRIBUTE_FORMAT_DESCRIPTION
4[V,M]          1     LAB      A3       Attribute label
4[V,M]          2     AVT      A2      enumerated "EN" or actual value "AV"
4[V,D]          3     AVF      A       Attribute value format
4[V,D]          4     AVU      A       Attribute measurement unit
              999

3[V,D]          0     VAD      001     ;& ATTRIBUTE_VALUE_DESCRIPTION
*4[V,M]         1     *ALB     I       Attribute values
                      note: enumerated values I only
4[V,M]          2     AVD      L       Attribute value definition
              999
```

Dependency condition

1. **Attribute/value association record:**
   Attribute/value association record will be present for each attribute transmitted in the Vector Geodata file and not present in FACC .

A.3.7 RASTER GEO DATA FILE

File Content by Record and Field:

```
1[R,M]      File:   RASTER GEO DATA
2[R,M]      |-R  Record:   IMAGE
            |   |-  001      (2)      {RTY = IMG}
            |   |-  PAD      (1)      Padding
            |   |-  SCN      (*1)     Pixel Field
```

Field Data Descriptions:

```
            Control     ==          (see  DDR Header in ISO 8211)

                0       000         {=RASTER_GEO_DATA_FILE}
                1                   File title field, present only in DDR
              999
```

*2[R,M] **Record: IMAGE**

```
3[R,M]          0     001              ;& RECORD_ID_FIELD
3[R,M]          1     RTY      A3      Record type          {RTY = IMG}
3[R,M]          2     RID      I       Record id number
              999
```

Withdrawn/Retirée

```
3[R,O]          0     PAD      001     ;& PADDING FIELD
4[R,M]          1     PAD      A       Padding Characters to Fill Block
              999

3[R,M]          0     SCN      001      ;& PIXEL_FIELD
*3[R,M]         1     *PIX     B 8     Pixel Values - edit to B(8)
              999
```

A.3.8 MATRIX GEO DATA FILE

File Content by Record and Field:

```
1[R,M]      File:   MATRIX GEO DATA
2[R,M]      |-R  Record:   MATRIX
            |   |-  001       (2)     {RTY = VAR}
            |   |-  PAD       (1)     Padding
            |   |-  SCN       (*1)    Element  Field
```

Field Data Descriptions:

```
            Control     ==          (see  DDR Header in ISO 8211)

                0       000         {=MATRIX_GEO_DATA_FILE}
                1                   File title field, present only in DDR
              999
```

***2[A,M] Record: MATRIX**

```
3[A,M]          0     001                      ;& RECORD_ID_FIELD
3[A,M]          1     RTY      A3      Record type          {RTY = VAR}
3[A,M]          2     RID      I       Record id number
              999

3[A,O]          0     PAD      001     ;& PADDING FIELD
4[A,M]          1     PAD      A       Padding Characters to Fill Block
              999

3[A,M]          0     SCN      001      ;& ELEMENT_FIELD
*3[A,M]         1     *PIX     B 8     Element Values - edit to B(8)
              999
```

A.4 GENERAL REQUIREMENTS

This section contains general requirements for DIGEST interchange files.

- **Explicit Relation Coding**

  Explicit relations should be coded using the ISO 8211 structures depicted below:

  DDR

  ```
  R1L   bbbbbbRELATION;
  R1V   2600;&RELATION VALUE&*RTY!RID!SEC&(A(3),I,A(1));
  ```

Withdrawn/Retirée

In the above DDR representation, the elementary field R1L refers to the type of relation ("STK" for stacked on), RTY refers to the code used to designate the type of object referenced by the relation (e.g. a line feature — see 12.3.2 for a complete list of codes), RID refers to a numeric identifier, which when combined with RTY uniquely identifies the object referenced by the relation, and SEC refers to the classification of the object being pointed to. It should be noted that R1V is a repeating three-tuple so that a given relation type may reference more than one object.

Example: the feature being represented is stacked on a line feature:

```
DDR   R1L   bbbbbbRELATION;
      R1V   2600;&RELATION VALUE&*RTY!RID!SEC&(A(3),I,A(1));
DR    R1L   STK;
      R1V   FL&2&S;
```

- **Decimal Mark Specification**

The decimal mark in all numeric representation shall be the FULL STOP, i.e., ISO 646 (2/14).

- **DIGEST Specific Data Syntax**

Data items having DIGEST specific syntax, e.g., dates, shall be encoded according to the applicable section or annex.

- **Rules Governing Empty or Inapplicable Fields/Subfields**

For inapplicable or otherwise empty field/subfields, three mechanisms are allowed.

— For fixed format subfields, ASCII spaces will be the value of the subfield.

— For delimited subfields, the values will be null.

— For a transfer, if the field tag or subfield label is consistently not used in the file, the field or subfield may be omitted from the DDR.

A.5 CONFORMANCE REQUIREMENTS

A DIGEST interchange file conforming to ISO 8211 shall also conform to the requirements of this annex and to all applicable requirements of the body, other annexes and conventions of this standard.

Withdrawn/Retiree

A.6 EXAMPLES OF ISO 8211 STRUCTURES

A.6.1 EXAMPLE OF TRANSMITTAL HEADER FILE

DATA_DESCRIPTIVE_RECORD

```
  Tag  Descriptive Data
  000  bbbbbbTRANSMITTAL_HEADER_FILE;
  001  1000;&RECORD_ID_FIELD&RTY!RID&(A(3),I);
  VDR  1600;&TRANSMITTAL_HEADER_FIELD&
       MSD!VOO!ADR!NOV!NOF!URF!EDN!CDV07&(3A,2I,A,I,A(8));
  FDR  1600;&DATA_SET_DESCRIPTION_FIELD&NAM!STR!PRT!SWO! SWA !NEO!NEA&
       (A,I,A,4R);
  QSR  1000;&SECURITY_AND_RELEASE_FIELD&QSS!QOD!CDV10!QLE&(2A(1),A(8),A );
  QUV  1600;&UP_TO_DATENESS_FIELD&SRC1!CDV12!SPA1!SRC2!CDV22!SPA2&
       (A,A(8),2A,A(8),A);
```

TRANSMITTAL_DESCRIPTION_RECORD

```
  Tag  User Data
  001  THF&1;
  VDR  CD-ROM&;Defense Mapping Agency\Washington, DC&AMT FUR
MILGEO\EUSKIRCHEN
  \GERMANY&1&2&North American Data set&1& 19940129;

        FDR    NORTHA00.XXX&3&NULL&-329010.00&+127200.00&-324000.00&+130200.00;
        FDR    NORTHB00.XXX&8&BDD&-365070.00&+145530.30& 342000.00&+162000.00;
```

SECURITY_AND_UPDATE_RECORD

```
  Tag  User Data
  001  LCF&1;
  QSR  R&N&     &;

        QUV    DIGEST Edition 1.2&19940131&0&&       &;
        QUV    DIGEST Edition 1.2&19940131&0&BDD Level 1 Edition 1.0&19940731&0;
```

A.6.2 EXAMPLE OF RECORD IMPLEMENTATIONS

Edge Record Implementations:

The EDGE_IMPLICIT_RELATION_POINTERS_FIELD , the IMPLICIT_ATTRIBUTES_FIELD and the COORDINATES_FIELD shall be implemented as shown below:

```
IRE     2600;&IMPLICIT_RELATION_POINTERS_FIELD&
              FAL!FAR!NOS!NOE!NER!NEL!*RTY!RID!SEC&(6(A(3),I,A(1)));

IAT     2200;&IMPLICIT_ATTRIBUTES_FIELD&MIN!MAX!*EAS!NOR!ELE;

ATT:    See A.6.4

COR     2200;&COORDINATE_FIELD&*LON!LAT!ELE;
```

Withdrawn/Retirée

Node Record Implementations:

The NODE_IMPLICIT_RELATION_POINTER_FIELD and the COORDINATES_FIELD shall be implemented as shown below:

IRN 2600;&NODE_IMPLICIT_RELATION_POINTER_FIELD&RTY!RID!SEC&(A(3),I,A(1));

ATT: See A.6.4

COR 2200;&COORDINATE_FIELD&*LON!LAT!ELE;

Note: "COR" is shown only for explanation. It is the same structure as used with the edge record, and in the DDR would appear only once

Face Record Implementations:

The IMPLICIT_ATTRIBUTES_FIELD shall be implemented as shown below:

IAT 2200;&IMPLICIT_ATTRIBUTES_FIELD&MIN!MAX!*EAS!NOR!ELE;

ATT: See A.6.4

Note: "IAT" is shown only for explanation. It is the same structure as used with the edge record, and in the DDR would appear only once

Line Feature Implementations:

The IMPLICIT_RELATION_POINTERS_FIELD and the EXPLICIT_RELATIONS_POINTER_FIELD shall be implemented as shown below:

IRS 2600;&IMPLICIT_RELATION_POINTERS_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

(RTY must be "+/- ED")

R1L 0000;&RELATION;

R1V 2600;&RELATION_VALUE_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

ATT: See Section A.6.4

Withdrawn/Retiree

Point Feature Implementations:

The IMPLICIT_RELATION_POINTERS_FIELD and the EXPLICIT_RELATIONS_POINTER_FIELD shall be implemented as shown below:

IRS 2600;&IMPLICIT_RELATION_POINTERS_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

(RTY must be "NO")

R1L 0000;&RELATION;

R1V 2600;&RELATION_VALUE_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

ATT: See A.6.4

Note: The above definitions are shown only for explanation. They would be stated only once in the DDR for all records requiring their use

Area Feature Implementations:

The IMPLICIT_RELATION_POINTERS_FIELD and the EXPLICIT_RELATIONS_POINTER_FIELD shall be implemented as shown below:

IRS 2600;&IMPLICIT_RELATION_POINTERS_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

(RTY must be "FE" at level 3 , "+ED"|"-ED"|"IED"|"JED" at level 1 to 0)

R1L 0000;&RELATION;

R1V 2600;&RELATION_VALUE_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

ATT: See A.6.4

Note: The above definitions are shown only for explanation. They would be stated only once in the DDR for all records requiring their use

Withdrawn/Retirée

Complex Feature Implementations:

The IMPLICIT_RELATION_POINTERS_FIELD and the EXPLICIT_RELATIONS_POINTER_FIELD shall be implemented as shown below:

IRS 2600;&IMPLICIT_RELATION_POINTERS_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

(RTY must be "FC" or "FA" or "FP" or "FL")

R1L 0000;&RELATION;

R1V 2600;&RELATION_VALUE_FIELD&*RTY!RID!SEC&(A(3),I,A(1));

ATT: See A.6.4

Note: The above definitions are shown only for explanation. They would be stated only once in the DDR for all records requiring their use.

A.6.3 EXAMPLES OF RECORDS SUPPORTING CHAIN-NODE OR PLANAR-GRAPH VECTOR DATA

Edge Record Implementations:

The EDGE_IMPLICIT_RELATION_POINTERS_FIELD shall be implemented as shown below:

IRE 2600;&IMPLICIT_RELATION_POINTERS_FIELD&
NOS!NOE!NER!NEL!*RTY!RID!SEC&(4(A(3),I,A(1)));

Node Record Implementations:

There will be no NODE_IMPLICIT_RELATION_POINTER_FIELD.

A.6.4 EXAMPLES OF EXPLICIT SINGLE AND MULTILEVEL ATTRIBUTION

The most common type of attribution is the single level of attribution. When none of the features described in the file requires a multi-level attribution, the EXPLICIT_ATTRIBUTES_LABELS_AND_VALUES_FIELD will be described as follows:

Record	Tag	Descriptive Data
DDR	ATT 2600;&EXPLICIT_ATTRIBUTE_LABELS_AND_VALUES &*ATC!FOR!VAL&(3A);	
DR	ATT	LTN & I & 4 & MED & I & 1 & NAM & L & L' Aquitaine&

Withdrawn/Retirée

The attribution data located at the tree nodes can be represented by a 3-tuple, supplemented by the left- and right-handed linkages, as shown below in Table A-1 with the data used in the example from 12.2.2 (compare with Table 12-1):

Table A-1 Example of Multilevel Attribution Data

L	R	Att. Label	Att. Value Format	Attribute Value
0	2	PAT	I	4
0	3	CCC	I	1
0	4	CCC	I	19
5	6	ORC	R	2.5
0	0	TXT	L	"Varie selon les conditionsatmosphériques"
7	0	TMC	I	3
0	8	CCC	I	1
9	0	WID	R	0.33
0	0	TXT	L	"à la base"

The data descriptive record in ISO 8211 syntax is as follows:

Record	**Tag**	**Descriptive Data**
DDR	ATT	2600;&EXPLICIT_ATTRIBUTE_LABELS_AND_ VALUES&*LLK!RLK!ATC!FOR!VAL&(2I,3A);

where

- FOR (FORMAT) may have the values; A, I, R, L, S, C or other special values specified by DIGEST,
- VAL (VALUE) is always "character" to be decoded as necessary by the application according to the value of the subfield FORMAT,

Note: where multilevel attribution is not required the LLK (Left Link) and RLK (Right Link) subfields may be null or omitted (See A.6.5).

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The same data from Table A-1 is shown in ISO 8211 syntax as follows:

Record	Tag	Descriptive Data
DR	ATT	0 & 2 & PAT & I & 4& 0 & 3 & CCC & I & 1& 0 & 4 & CCC & I & 19& 5 & 6 & ORC & R & 2.5& 0 & 0 & TXT & L & Varie selon les conditions atmosphériques& 7 & 0 & TMC & I & 3& 0 & 8 & CCC & I & 1& 9 & 0 & WID & R & 0.33& 0 & 0 & TXT & L & à la base;

Notes:

1. The "root" is not indicated and is by convention the record; its links, always 1 and 0, are not needed.
2. The data is shown by row with inserted spaces for readability.

The same data as described above in the single attribution description will then be as follows:

Record	Tag	Descriptive Data
DR	ATT	&&LTN & I & 4 &&& MED & I & 1 & &&NAM & L & L 'Aquitaine&

A.6.5 EXAMPLE OF IMPLICIT RELATION CODING

Record FC015 - Implicit relation: COMPOSED OF - No. of relation pointers 3 - Component Features FA06, FP01, FL35 - Security code: Restricted

```
DDR  IRS 2000;&IMPLICIT_RELATION_POINTER_FIELD&*RTY!RID!SEC&(A,I,A);
DR   IRS FA&6&R&FP&1&R&FL&35&R;
```

Withdrawn/Retirée

B. ISO 8824 ENCAPSULATION SPECIFICATIONS

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B.1 Introduction

This annex presents an alternative encoding based on the ISO 8824 telecommunications standard with a view to efficient telecommunications.
The same information content is retained but the hierarchical style of presentation inherent with the Abstract Syntax Notation (ASN) is used.

The basic information elements of the interchange format are information fields composed of specific data elements. The fields used in this ISO 8824 description of the DIGEST data format are equivalent to the data fields used in the ISO 8211 formulation of the same data format. For instance:

ISO 8824

```
Security-and-Release-Field                    --QSR
        ::= SEQUENCE   {
qss             Basic-Text-String,            --Highest security classification
qod             Basic-Text-String,            --Downgrading instructions
cdv10           Date,                         --Date of downgrading value
qle             Basic-Text-String             --Releasability
        }
```

means that "QSR" is the field tag, "qss", "qod", "cdv10", and "qle" are subfield labels, as defined in the DIGEST specifications, however, these four items, together with the other comments preceded by "--" may be omitted with no change in the meaning. They are included merely to provide a reference back to the fields described in ISO 8211 DIGEST. The equivalent ISO 8211 encapsulation for the above example is:

ISO 8211

```
3[C,M]          0       QSR     001     ;& SECURITY_AND_RELEASE
4[C,M]          1       QSS     A       Highest security classification
4[C,M]          2       QOD     A       Downgrading instructions
4[C,M]          3       CDV10   A 8     Date of downgrading value
4[C,M]          4       QLE     A       Releasability
        999
```

The USE (i.e. Vector, Matrix, or Raster) classifications in the ISO 8211 notation have been handled by separating out those sub-fields in the Header Data Subset which are a mixture of applications. These are identified appropriately. However, within the Geo Dataset, it is to be understood that the Topological Vector Subset will contain only vector data and similarly, the Raster and Matrix Geo Data Subsets will contain only their corresponding data.

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B.2 Normalized Coordinates

In order to efficiently communicate geographic data over telecommunications media, the ISO 8824/5 encoding is used which permits the handling of optional data fields and of geographic coordinates in a compact and efficient manner. Telecommunications applications are particularly sensitive to the volume of data that must be handled in any particular communication data transfer.

ISO 8824/5 (ASN.1) makes use of a tag length encoding scheme for the identification of data elements as components of a communication stream. Each piece of information is identified with preceding tag and a number defining the length of the element. Such tag length combinations may be nested to any level. The sending and receiving communications entities follow identical syntactic trees in composing and parsing the data stream. The syntactic tree is a property of the standard and is not communicated. The tag codes permit the communicating entities to skip through the syntactic description. Therefore only actual data elements need be transferred. There is no overhead involved in the self description of the syntactic tree or the identification of optional but missing elements. This makes the ISO 8824/5 encoding of DIGEST particularly useful in the communications of map segments or updates to previously communicated maps.

A second aspect of the communication efficiency built into the ISO 8824/5 encapsulation of DIGEST is the use of normalized coordinates for the handling of coordinate data and other numbers of fixed range. In some encoding schemes, which are not tuned for a high level of communications efficiency, numbers such as coordinates are handled as real numbers. If only a small range of numbers is valid, this is a potential waste of "code space" and therefore efficiency. For example, if a number could validly range from 0° to 5° then values such as 25° or 2.94×10^{43} ° would be illegal. However, the real number coding system would assign potential bit combinations to handle these potential values. Since these values would never be encountered in an actual communication, the encoding of the real numbers would be larger than required to handle the actual data. If a number has a fixed range, such as the 0° to 5° in our example, then it can always be normalized to a corresponding 0 to 1 range. All values in the range would be fractions of 0 to 1. This can be efficiently encoded as a binary fraction.

A number in the range 0 (inclusive) to 1 (exclusive) is equivalent to the mantissa part of a real number, and can be termed a fraction number. In an actual implementation there is always a fixed number of bits of precision assigned. A fraction number can therefore easily be implemented by scaling the number up by the number of bits of precision assigned. That is the decimal point (or more correctly binary point) can be shifted by multiplying by 2^n where n is the number of bits of precision available in the number field. The number therefore can be represented as an integer number in a fixed length binary field.

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Since integer numbers are normally encoded using half the number of bits, for equivalent precision, this provides a significant improvement in efficiency. Also, since the number range is a better fit to the value range of the data, it is sometimes possible to use short integers rather than long integers and therefore achieve a four fold increase in the efficiency of encoding a particular real number.

Coordinate data are normally handled as a Cartesian pair (or triple) of real numbers. Latitude and Longitude are normally represented as degrees, however in other projections, northings and eastings in terms of meters from the equator are at times communicated. Great efficiencies can be achieved by normalizing the coordinate data to the possible number range and carrying that as a pair of normalized binary fractions. For example, if we were interested in a map area with a minimum bounding rectangle of -63° to -62° longitude and 44° to 45° latitude, then we could represent that as a unit square from -1 to 0 and from 0 to 1. Note that both positive and negative normalized number values are permitted.

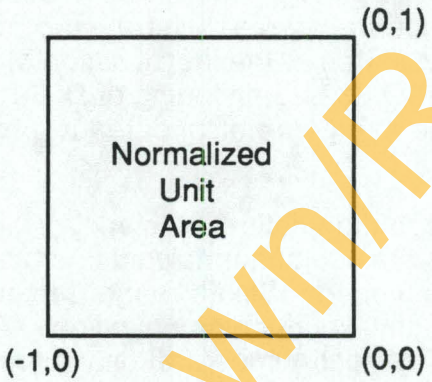


Figure B-1 Normalized Coordinate Space.

Normalized unit areas are always square to maintain the aspect ratio of the projected data. Therefore if the map area of interest is not square, it is circumscribed within the minimum bounding square area.

In the DIGEST ISO 8824/5 encapsulation normalized coordinates are used to handle most of the spatial information in the body of the data exchange. This covers the vast majority of the spatial data elements in a data set. Certain data elements in the header are excluded to make the data set easier to interpret. In addition, the specification of the Minimum Bounding Rectangle (see Map-Boundary-Coordinates-Subfield in General-Information-Record) for the whole map in the header is specified using real numbers for the coordinate values, because these numbers are used to calculate the dimensions of the Normalized Unit Area. In effect, all there coordinate information in this encapsulation is defined as fractions of the minimum bounding rectangle. For most coordinate oriented data, such as "Node" positions, the dimensions of the Minimum Bounding Rectangles (MBRs) around "Features", etc., Fraction numbers in a normalized coordinate space are adequate. However the "Edge" topological primitive is a special case. An edge carries a string of vertices as a spatial

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attribute defining the shape of the edge. Due to the nature of geographical data each vertex tends to be "near" its neighbor in a mathematical sense. Therefore, an additional efficiency can be achieved for strings of vertices. Three special types of coordinate encoding are defined for edges. These are absolute, relative and differential coordinate strings.

Absolute-coordinate-string(s) are merely sets of X,Y coordinates represented as pairs of numbers in normalized coordinate space. The number of bits of precision used to specify an absolute coordinate is defined in the tag length structure of the OCTETSTRING used to encode the coordinate. Absolute coordinates may be either X,Y coordinate pairs or X,Y,Z coordinate triples.

Relative-Coordinate-String(s) are a set of X,Y relative displacements requiring fewer bits of encoding, and thereby provide an additional efficiency for edge data that tends to be well behaved, that is, data in which the displacement from vertex to vertex is never greater than a small maximum value. An initial absolute coordinate specifies the beginning of the string of coordinates. A sub-string length indicator specifies the number of bits of each coordinate element. This is followed by an OCTETSTRING containing the bit packed coordinate information. All of these values are of course in terms of the normalized coordinate space. For example, an edge might consist of 300 X,Y vertices. This edge might be well behaved and have a difference from vertex to vertex that can be represented in 14 bits (7-bits for X and 7-bits for Y). The relative coordinate string would consist of an absolute coordinate (Abs-Coord) position, followed by an integer number indicating that the following relative coordinate sub-strings are each 14 bits long. This is followed by a string of 4186 bits, packed into an OCTETSTRING of 524 bytes, representing the 299 remaining vertices. Note that there are 6 remaining leftover bits in the octet string that are padded with 0 and ignored.

Differential-Coordinate-String(s) provide an even higher level of compaction for that class of edge in which there is both a maximum and minimum vectorial displacement between vertices. Actually, due to the manner in which geographic data is often gathered, this is a very common situation. A differential coordinate string is very much like a relative coordinate string, except that a differential factor common to all relative displacements is divided out. For example, if each relative coordinate displacement is a minimum of 4 bit increments, for the numerical precision used in the Normalized Unit Coordinate system, then the differential factor of 4 can be divided out of each of the coordinate positions. This would mean in the example used above, that each coordinate could be represented as 10 bits (5-bits for X and 5-bits for Y). Therefore the string would consist of an absolute coordinate (Abs-Coord) position, followed by an integer number specifying a differential factor of 2, followed by an integer number indicating that the following differential coordinate sub-strings are each 10 bits long. This is followed by a string of 2990 bits, packed into an OCTETSTRING of 374 bytes, representing the 299 remaining vertices. Note that there are 2 remaining leftover bits in the octet string that are padded with 0 and ignored.

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B.3 Overall Structure

The DIGEST geographical data interchange standard specification allows the definition of entire maps or charts to be exchanged. The interchange unit corresponding to an entire map or chart is called an "Exchange Set." Such an entity can be broken down into several components for the purpose of defining the various elements which compose a map or chart specified according to the DIGEST format.

The Exchange set is represented schematically below in a form similar to that used in Section A.2. The following notation is used:

```
|-R              represents indefinite repetition

|
*-R Item-1
|
*-R Item-2
|
*-R Item-3       represents a choice of either Item-1, Item-2, or Item-3 (each
                 of which is repeating), but not any combination of the three,
                 nor all three.
```

The following is a general description of the Exchange set:

```
Exchange set
|
|-Transmittal-Header-File
|-R Geo-Dataset-File
    |
    |-  General-Information-File
    |-  Geo-Reference-File
    |-R Source-File
    |-  Quality-File
    |-R Layer-Section
      |
      *-R    Vector-Geo-Data-File
      |
      *-R    Raster-Geo-Data-File
      |
      *-R    Matrix-Geo-Data-File
```

This is encapsulated in ISO 8824 in the following sections and subsections.
Note: The term "File" in this exchange encapsulation is a logical grouping of data, not a physical file on an exchange media. The term is retained to make the correspondence between encapsulations clearer.

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B.3.1 Exchange Set Structure

Exchange-set

```
::= SEQUENCE   {
    Transmittal-Header-File,
    SEQUENCE OF
        Geo-Dataset-File
}
```

B.3.2 Geo Dataset Structure

Geo-Dataset-File

```
::= SEQUENCE   {
[0]  General-Information-File,
[1]  Geo-Reference-File                 OPTIONAL,
                                        --see Dependency condition 0-1
[2]  SEQUENCE OF
         Source-File,
[3]  Quality-File,
[4]  SEQUENCE OF
         Layer-Section
}
```

Layer-Section

```
::= CHOICE   {
    [0] Vector-Geo-Data-File,
    [1] Raster-Geo-Data-File,
    [2] Matrix-Geo-Data-File
}
```

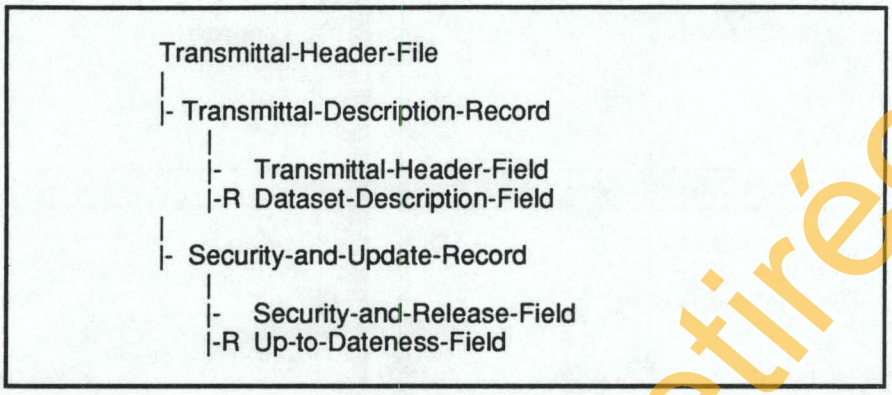
Dependency condition (list 0):

0-1 Geo-Reference-File:
The presence of the Geo-Reference-File is mandatory except for raster data when: PRT = ASRP, or PRT = USRP

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B.4 Transmittal Header File

The Transmittal-Header describes general information encompassing the entire transmittal dataset.




```
Transmittal-Header-File
        ::= SEQUENCE   {
thf             Transmittal-Description-Record,
lcf             Security-and-Update-Record
        }
```

B.4.1 Transmittal-Description-Record

```
Transmittal-Description-Record                  --THF
        ::= SEQUENCE   {
vdr             Transmittal-Header-Field,
fdr             SEQUENCE OF
                    Dataset-Description-Field
        }

Transmittal-Header-Field                        --VDR
        ::= SEQUENCE   {
voo             Basic-Text-String,              --Originator
adr             Basic-Text-String,              --Addressee
nof             Integer-Number,                 --Number of data sets
urf             Basic-Text-String,              --Transmittal ID
edn             Integer-Number,                 --Edition number
cdv07           Date                            --Creation date
        }
```

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```
Dataset-Description-Field                    --FDR
        ::=SEQUENCE   {
nam             Basic-Text-String,           --Dataset ID
str             Integer-Number,              --Structure code
                                             {  Matrix-values(1),
                                             Matrix-coded(2),
                                             Raster -RGB(3),
                                             Raster-color-coded(4),
                                             Cartographic-Spaghetti(5),   --Vector: Level 0 Topology
                                             Non-Planar-Graph(6),         --Vector: Level 1 Topology
                                             Chain-node(7),               --Vector: Level 2 Topology
                                             Full-Topology(8)             --Vector: Level 3 Topology
                                             }
prt             Basic-Text-String,           --Dataset type
swo             Real-Number,                 --Westernmost longitude
swa             Real-Number,                 --Southernmost latitude
neo             Real-Number,                 --Easternmost longitude
nea             Real-Number                  --Northernmost latitude
                }
```

B.4.2 Security-and-Update-Record

```
Security-and-Update-Record                   --LCF
        ::= SEQUENCE   {
qsr             Security-and-Release-Field,
                SEQUENCE OF
quv                 Up-to-Dateness-Field
        }

Security-and-Release-Field                   --QSR
        ::= SEQUENCE   {
qss             Security-Level,              --Highest security classification
qod             Basic-Text-String,           --Downgrading instructions
cdv10           Date,                        --Date of Downgrading
qle             Basic-Text-String            --Releasability
        }

Up-to-Dateness-Field                         --QUV
        ::= SEQUENCE   {
src1            [0] Basic-Text-String,       --DIGEST Edition ID
cdv12           [1] Date,                    --DIGEST Edition Date
spa1            [2] Basic-Text-String,       --DIGEST Amendment Number
src2            [3] Basic-Text-String        OPTIONAL,
                                             --Specification Edition ID; see Dependency
                                               --condition 1-1
cdv22           [4] Date                     OPTIONAL,
                                             --Specification edition date; see Dependency
                                               --condition 1-2
spa2            [5] Basic-Text-String        OPTIONAL
                                             --Specification Amendment number; see
                                               --Dependency condition 1-3
        }

Security-Level                               --QSS
        ::= Basic-Text-String                { top-secret("T"),  secret("S"),  confidential("C"),
                                             restricted("R"),  unclassified("U")
                                             }
                                             --Highest security classification
```

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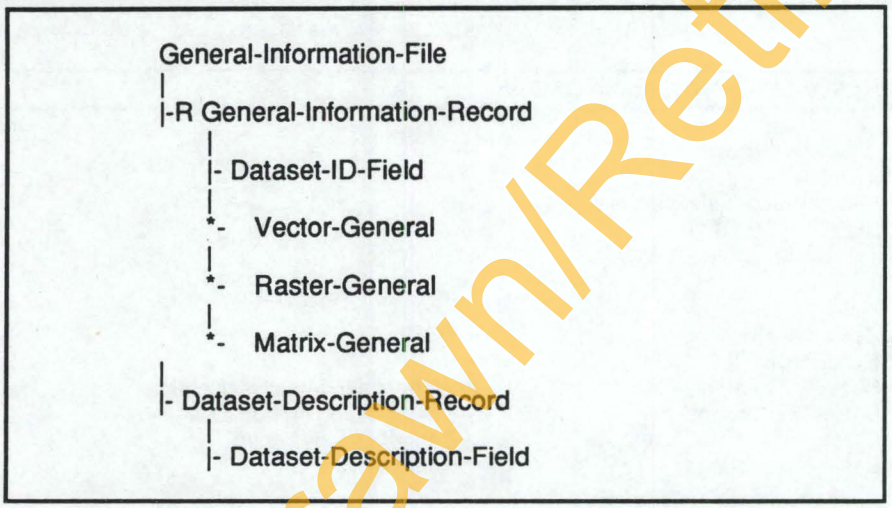
Dependency conditions (list 1):

1-1 Specification edition ID:
The specification edition ID will be transmitted unless the Dataset type is UNSPECIFIED.

1-2 Specification edition date:
The specification edition date will be transmitted when the specification edition ID is also transmitted.

1-3 Specification amendment number:
The specification amendment number will be transmitted when the specification edition ID is also transmitted.

B.5 General-Information-File




```
General-Information-File
        ::= [A 1]* SEQUENCE   {
                [0] SEQUENCE OF
gin                 General-Information-Record,
dss             [1] Dataset-Description-Record   OPTIONAL
        }
```

--* Note: **[A n]** represents the application-wide tag [APPLICATION n], where n is an integer.

B.5.1 General-Information-Record

```
General-Information-Record                  --GIN
        ::= SEQUENCE   {
dsi             Dataset-ID-Field,           --Dataset name
gen             CHOICE   {                  --General-Information-Field
gen-v               [0] Vector-General,
gen-r               [1] Raster-General,
gen-m               [2] Matrix-General
                }
        }
```

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```
Dataset-ID-Field                                    --DSI
        ::= SEQUENCE    {
prt-d       Basic-Text-String,                      --Dataset type
nam-d       Basic-Text-String                       --Dataset ID
        }

Vector-General                                      --GEN-V
                                                    --General-Information-Field for Vector type data
        ::= SEQUENCE    {
str-v       [0] IMPLICIT-INTEGER,                   --Structure of the data
mbu-v       [1] Basic-Text-String                   OPTIONAL,
                                                    --Units of GRP and MBR, see Dependency
                                                      --condition 2-2
cov-v       [2] Integer-Number                      OPTIONAL,
                                                    --Data cover MBR in percent
fec-v       [3] Integer-Number                      OPTIONAL,
                                                    --Feature count total in dataset
poc-v       [4] Integer-Number                      OPTIONAL,
                                                    --Point feature count
lic-v       [5] Integer-Number                      OPTIONAL,
                                                    --Linear feature count
alc-v       [6] Integer-Number                      OPTIONAL,
                                                    --Areal feature count
sgc-v       [7] Integer-Number                      OPTIONAL,
                                                    --Segment/Edge Record Count
nec         [8] Integer-Number                      OPTIONAL,
                                                    --Node record count
fcc         [9] Integer-Number                      OPTIONAL,
                                                    --Face record count
sft         [10] Integer-Number                     OPTIONAL,
                                                    --Simple feature count
            [11] Map-Boundary-Coordinates-Subfield,
sca-v       [12] Integer-Number                     OPTIONAL,
                                                    --Source graphic scale reciprocal
lso-v       [13] Fraction-Number                    OPTIONAL,
                                                    --Longitude/Eastings of Origin
pso-v       [14] Fraction-Number                    OPTIONAL,
                                                    --Latitude/Northings of Origin
csf-v       [15] Integer-Number                     OPTIONAL,
                                                    --Coordinates scale factor
txt-v       [16] Basic-Text-String                  OPTIONAL,
                                                    --Free text
bad-v       [17] Basic-Text-String                  OPTIONAL,
                                                    --layer file name; see Dependency condition 2-5
        }

        --Note:  Latitude and Longitude are coded as a fraction of 360 degrees with the usual
        --directional conventions.

Raster-General                                      --GEN-R
                                                    --General-Information-Field for Raster type data
        ::= SEQUENCE    {
str-r       [0] IMPLICIT-INTEGER,                   --Structure of the data
            [1] Data-Density-Subfield               OPTIONAL,
                                                    --see Dependency condition 2-1
zna-r       [2] Integer-Number                      OPTIONAL,
                                                    --Zone number; see Dependency condition 2-3
```

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```
                [3] Map-Boundary-Coordinates-Subfield,
sca-r           [4] Integer-Number,                 --Source graphic scale reciprocal
psp-r           [5] Real-Number,                    --Sample Pixel Spacing in microns
imr-r           [6] Basic-Text-String               OPTIONAL,
                                                    { rectified("Y"), unrectified("N") }
                                                    --Image Rectified during Scanning Indicator
                [7] Pixel-Ground-Spacing-Subfield   OPTIONAL,
                                                    --see Dependency condition 2-4
lso-r           [8] Fraction-Number,                --Longitude /Eastings of Origin
pso-r           [9] Fraction-Number,                --Latitude/Northings of Origin
txt-r           [10] Basic-Text-String              OPTIONAL,
                                                    --Free text
spr-r           [11] Dataset-Parameters-Subfield,
bdf-r           [12] Band-ID-Subfield,
tim-r           [13] Tile-Index-Map-Subfield        OPTIONAL
                                                    --see Dependency condition 2-7
        }
```

--Note: Latitude and Longitude are coded as a fraction of 360 degrees with the usual directional conventions.

```
Matrix-General                                      --GEN-M
                                                    --General-Information-Record for Matrix type data
        ::= SEQUENCE    {
str-a           [0] IMPLICIT-INTEGER,               { matrix(5),matrix(coded)(7) }
                                                    --Structure of the data
                [1] Data-Density-Subfield           OPTIONAL,
                                                    --see Dependency condition 2-1
unilmat-a       [2] Integer-Number,                 --Unit of measure for Matrix data
cov-a           [3] Integer-Number                  OPTIONAL,
                                                    --Data cover MBR in percent
zna-a           [4] Integer-Number                  OPTIONAL,
                                                    --Zone number; see Dependency condition 2-3
                [5] Map-Boundary-Coordinates-Subfield,
sca-a           [6] Integer-Number                  OPTIONAL,
                                                    --Source graphic scale reciprocal
                [7] Pixel-Ground-Spacing-Subfield   OPTIONAL,
                                                    --see Dependency condition 2-4
lso-a           [8] Fraction-Number ,               --Longitude /Eastings of Origin
pso-a           [9] Fraction-Number,                --Latitude/Northings of Origin
txt-a           [10] Basic-Text-String              OPTIONAL,
spr-a           [11] Dataset-Parameters-Subfield,
bdf-a           [12] Band-ID-Subfield,
tim-a           [13] Tile-Index-Map-Subfield        OPTIONAL
                                                    --see Dependency condition 2-7
        }
```

--Note: Latitude and Longitude are coded as a fraction of 360 degrees with the usual --directional convention.

```
Data-Density-Subfield
        ::= SEQUENCE    {
lod-r           [0] Real-Number,                    --Data interval in E/W direction
lad-r           [1] Real-Number,                    --Data interval in N/S direction
uniloa-r        [2] Basic-Text-String               --Unit of measure for LOD and LAD
        }
```

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```
Pixel-Ground-Spacing-Subfield
        ::= SEQUENCE   {
arv             Integer-Number,          --Number of pixels in 360 degrees (E-W)
brv             Integer-Number           --Number of pixels in 360 degrees (N-S)
        }

Map-Boundary-Coordinates-Subfield
        ::= SEQUENCE   {
swo-mb          Fraction-Number,         --Westernmost Longitude
swa-mb          Fraction-Number,         --Southernmost Latitude
neo-mb          Fraction-Number,         --Easternmost Longitude
nea-mb          Fraction-Number          --Northernmost Latitude
        }

--Note: The minimum bounding rectangle for the whole map uses real numbers for the
 --coordinate values because these numbers are used to calculate the dimensions of
--the Normalized Unit Area. All other coordinate information in this encapsulation except in
--the Transmittal-Header-File or the General-Information-File of a Geo-Dataset or
--projection related parameters are defined as fractions of this minimum bounding
 --rectangle.

Dataset-Parameters-Subfield              --SPR
                                         --for Raster and Matrix Applications
        ::= SEQUENCE   {
            [0] Corners-of-MBR-Subfield  OPTIONAL,
nfl         [1] Integer-Number,          --Number of Sub-blocks vertically
nfc         [2] Integer-Number,          --Number of Sub-blocks horizontally
pnc         [3] Integer-Number,          --Number of Pixels/Sub-block line (Q)
pnl         [4] Integer-Number,          --Number of Scan lines/Sub-block
cod         [5] Integer-Number,          --Column sequence
rod         [6] Integer-Number,          --Row sequence
por         [7] Integer-Number,          --Pixel order
pcb         [8] Integer-Number,          --Size of Pixel/Element count in bits
pvb         [9] Integer-Number,          --Size of Pixel/Element value in bits
bad-d       [10] Basic-Text-String,      --Layer file name
tif         [11] Basic-Text-String       --Tile index map image ("Y" or "N")
        }

Corners-of-MBR-Subfield
        ::= SEQUENCE   {
nul             Integer-Number,          --Row #, Upper Right Corner of the MBR
nus             Integer-Number,          --Column #, Upper Right Corner of the MBR
nll             Integer-Number,          --Row #, Lower left Corner of the MBR
nls             Integer-Number           --Column #, Lower left Corner of the MBR
        }

Band-ID-Subfield                         --BDF
        ::= SEQUENCE OF
        SEQUENCE   {
bid         [0] Basic-Text-String        OPTIONAL,
                                         --Band identification
            [1] SEQUENCE   {             --Band Description; see Dependency condition 2-6
ws1             Integer-Number,          --Lower limit wavelength
ws2             Integer-Number           --Upper limit wavelength
            }                            OPTIONAL
        }
```

Withdrawn/Retirée

```
Tile-Index-Map-Subfield                    --TIM
                                           --Raster and Matrix Applications
        ::= SEQUENCE OF
tsi             Integer                    --Tile Index Map (N = 1-tuple)
```

Dependency conditions (list 2):

2-1 Data-Density-Subfield:
see Pixel-Ground-Spacing Subfield Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on cartographic coordinates or Cartesian coordinates (USRP), the LOD, LAD and UNIloa subfields must be used. There is no default value for UNIloa.

2-2 MBU:
Required when not the same as coordinates UNITS defined in Geo-Reference-File.

2-3 Zone number:
Must be used when transferring raster or matrix data using either UTM/UPS or ARC projection.

2-4 Pixel-Ground-Spacing-Field:
see Data-Density-Field; Raster and matrix data consist of arrays of information pertaining to pixels or points at regularly identified intervals. The dimension of these pixels or intervals must be transmitted. If the dimension of these intervals is based on geographic coordinates (ASRP), the ARV and BRV subfields must be used.

2-5 Layer filename:
The layer filename will be transmitted for vector data when the Geodataset comprises more than one layer.

2-6 Band-Description-Field:
The Band identification must be present for any raster or matrix data: counting the number of BID subfields is the only way to know the number of raster or matrix bands. WS1 and WS2 are mandatory in case of multi-banded raster data.

2-7 Tile-Index-Map-Field:
Mandatory if TIF = "Y".

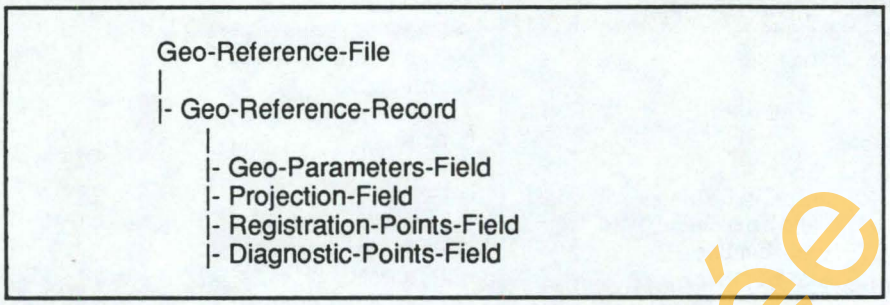
B.5.2 Dataset-Description-Record

```
Dataset-Description-Record                 --DSS
        ::= Dataset-Description

Dataset-Description                        --DRF
        ::= SEQUENCE   {
nsh             Integer-Number,            --number of horizontal accuracy sub-regions
nsv             Integer-Number,            --number of vertical accuracy sub-regions
nsp             Integer-Number,            --number of position accuracy sub-regions
noz             Integer-Number,            --number of layers
nos             Integer-Number,            --number of source graphics
        }
```

Withdrawn/Retired

B.6 Geo-Reference-File



Geo-Reference-File
::= **[A 2]** Geo-Reference-Record

B.6.1 Geo-Reference-Record

```
Geo-Reference-Record                    --GEO
        ::= SEQUENCE   {
gep             [0] Geo-Parameters-Field        OPTIONAL,
                                        --geographic reference info; see Dependency
                                          --condition 3-1
prr             [1] Projection-Field            OPTIONAL,
                                        --projection information; see Dependency condition 3-4
rpr             [2] Registration-Points-Field   OPTIONAL,
dpr             [3] Diagnostic-Points-Field     OPTIONAL
        }

Geo-Parameters-Field                    --GEP
        ::= SEQUENCE   {
typ             [0] Basic-Text-String,          --Data Type
uni             [1] Basic-Text-String,          --Unit of measure for coordinates
                [2] Geodetic-Ellipsoid-Subfield,
                [3] Vertical-Datum-Subfield     OPTIONAL,
                                        --see Dependency condition 3-2
                [4] Sounding-Datum-Subfield     OPTIONAL,
                                        --see Dependency condition 3-3
                [5] Geodetic-Datum-Subfield
                }
Geodetic-Ellipsoid-Subfield
        ::= SEQUENCE   {
ell             Basic-Text-String,              --Ellipsoid name
elc             Basic-Text-String               --Ellipsoid code
        }

Vertical-Datum-Subfield
        ::= SEQUENCE   {
dvr             Basic-Text-String,              --Datum Vertical Name
vdcdvr          Integer-Number                  --Vertical Datum Code
        }

Sounding-Datum-Subfield
        ::= SEQUENCE   {
sda             Basic-Text-String,              --Sounding Datum Name
vdcsda          Integer-Number                  --Sounding Datum Category
        }
```

Withdrawn/Retirée

```
Geodetic-Datum-Subfield
        ::= SEQUENCE   {
dag     Basic-Text-String,                  --Geodetic Datum Name
dcd     Basic-Text-String                   --Geodetic Datum Code
        }

Projection-Field                            --PRR
        ::= SEQUENCE   {
prn             [0] Basic-Text-String,      --Projection name
pco             [1] Basic-Text-String,      --Projection Codes(Part 3-6); Null if Geo
paa             [2] Real-Number,            --Projection Parameter 1
pab             [3] Real-Number,            OPTIONAL
                                            --Projection Parameter 2; see Dependency condition 3-5
pac             [4] Real-Number,            OPTIONAL
                                            --Projection Parameter 3; see Dependency condition 3-6
pae             [5] Real-Number,            OPTIONAL
                                            --Projection Parameter 4; see Dependency condition 3-7
                [6] Projection-False-Origin-Subfield  OPTIONAL,
                                            --see Dependency condition 3-8
zor             [7] Real-Number             OPTIONAL,
                                            --Z-values false Origin; see Dependency condition 3-9
        }

Projection-False-Origin-Subfield
        ::= SEQUENCE   {
xor             Real-Number,                --Easting false Origin
yor             Real-Number                 --Northing false Origin
        }

Registration-Points-Field                   --RPR
        ::= SEQUENCE OF
        SEQUENCE   {
pid-r           [0] Basic-Text-String,      --Registration Point ID
lon-r           [1] Fraction-Number ,       --Longitude/Easting of Registration Point
lat-r           [2] Fraction-Number ,       --Latitude/Northing of Registration Point
zvl-r           [3] Real-Number             OPTIONAL,
                                            --Elevation of Registration Point; see Dependency
                                              --condition 3-10
dix-r           [4] Real-Number,            --X Table Coord. of Digitized Registration Points
diy-r           [5] Real-Number,            --Y Table Coord. of Digitized Registration Points
diz-r           [6] Real-Number             OPTIONAL
                                            --Z Table Coord. of Digitized Registration Points;
                                              --see Dependency condition 3-10
        }

Diagnostic-Points-Field                     --DPR
        ::= SEQUENCE OF
        SEQUENCE   {
dpd-d           [0] Basic-Text-String,      --Diagnostic Point ID
lon-d           [1] Fraction-Number ,       --Longitude/Easting of Diagnostic Point
lat-d           [2] Fraction-Number ,       --Latitude/Northing of Diagnostic Point
zvl-d           [3] Real-Number             OPTIONAL,
                                            --Elevation of Diagnostic Point; see Dependency
                                              --condition 3-11
dix-d           [4] Real-Number,            --X Table Coord. of Digitized Diagnostic Point
diy-d           [5] Real-Number,            --Y Table Coord. of Digitized Diagnostic Point
diz-d           [6] Real-Number             OPTIONAL
                                            --Z Table Coord. of Digitized Diagnostic Point;
                                              --see Dependency condition 3-11
        }
```

Withdrawn/Retirée

Dependency conditions (list 3):

3-1 Geo-Parameters-Field:
Mandatory when the Geo-Reference-File exists, except when PRT = SRG.

3-2 Vertical-Datum-Subfield:
Mandatory if elevation information is present in the dataset (z values).

3-3 Sounding-Datum-Subfield:
Mandatory is sounding information is present in the dataset (depth values).

3-4 Projection-Field:
The Projection-Field is mandatory when the coordinates type is MAP (cartographic coordinates) and forbidden otherwise.

3-5 Parameter 2:
see Part 3, Clause 6.

3-6 Parameter 3:
see Part 3, Clause 6.

3-7 Parameter 4:
see Part 3, Clause 6.

3-8 Projection-False-Origin-Subfield:
when relevant only

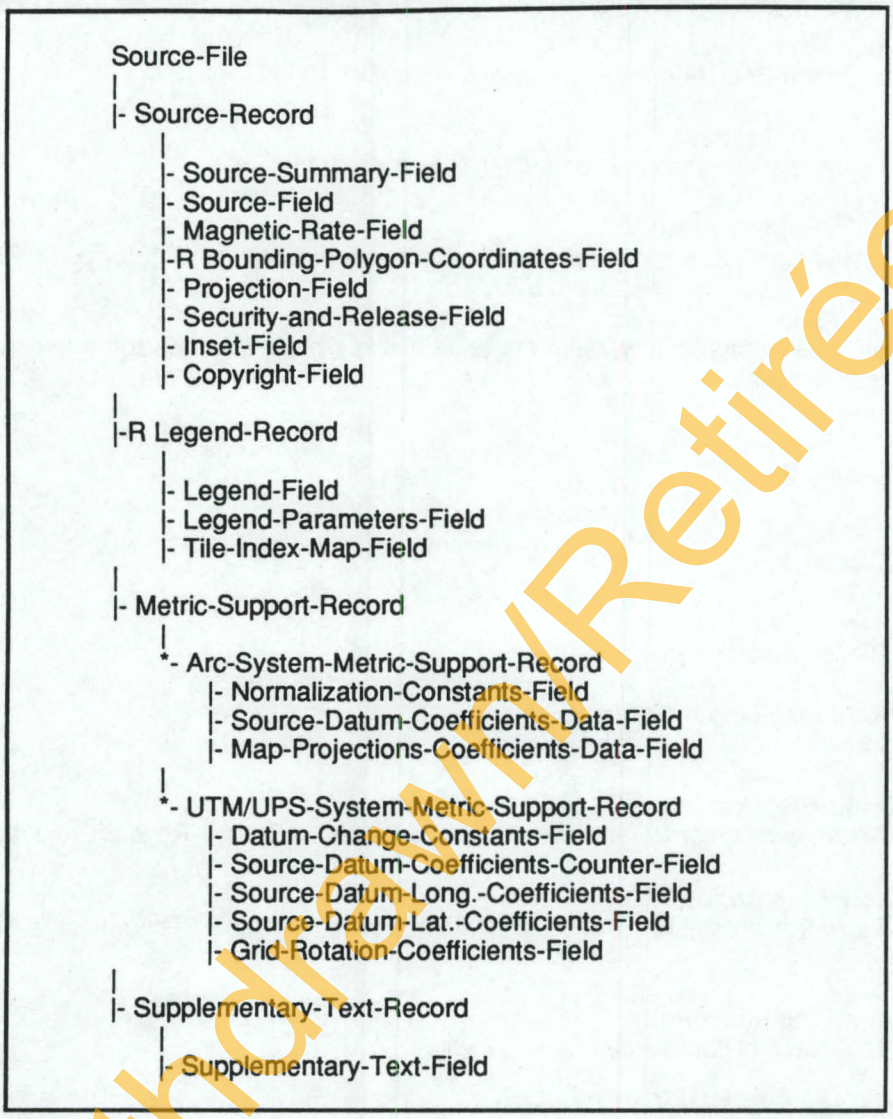
3-9 False-Origin-Subfield:
used in Geo-Reference record when relevant only; not used in Source-Record Projection-Field.

3-10 Elevation Registration Point:
Mandatory if z coordinates must be registered. In this case, the table of coordinates will have a Z value.

3-11 Elevation Diagnostic Point:
Mandatory if the table of coordinates have a Z value.

Withdrawn/Retirée

B.7 Source-File



Source-File
::= SEQUENCE {

sou	**[A 3]** Source-Record,	
	[A 4] SEQUENCE OF	
leg	Legend-Record	OPTIONAL,
msd	**[A 5]** Metric-Support-Record	OPTIONAL,
		--see Dependency condition 4-9
spt	**[A 6]** Supplementary-Text-Record	OPTIONAL

}

Withdrawn/Retirée

B.7.1 Source-Record

```
Source-Record                                   --SOU
        ::= SEQUENCE   {
sgf             [0] Source-Summary-Field,
sor             [1] Source-Field,
mag             [2] Magnetic-Rate-Field         OPTIONAL,
rci             [3] SEQUENCE OF
                    Bounding-Polygon-Coordinates-Field
                                                OPTIONAL
                                                --Coordinates of the Source Polygon; see
                                                  --Dependency condition 4-6
prr-s           [4] Projection-Field            OPTIONAL,
qsr-s           [5] Security-and-Release-Field  OPTIONAL,
                                                --Info on security and releasability of the source;
                                                  --strongly recommended
ins             [6] Inset-Field                 OPTIONAL,
                                                --see Dependency condition 4-7
cpy             [7] Copyright-Field             OPTIONAL
                                                --information on copyrights; strongly recommended
        }

Source-Summary-Field                            --SGF
        ::= SEQUENCE   {
bad-s           [0] Basic-Text-String           OPTIONAL,
                                                --Name of derived layer; see Dependency condition 4-1
nst             [1] Integer-Number              OPTIONAL,
                                                --Number of supplementary text records
nli             [2] Integer-Number              OPTIONAL,
                                                --Number of legend images; Raster applications only
nin             [3] Integer-Number              OPTIONAL
                                                --Number of insets; Raster applications only
        }

Source-Field                                    --SOR
        ::= SEQUENCE   {
prt-s           [0] Basic-Text-String           OPTIONAL,
                                                --Series Designator for the Series; strongly
                                                  --recommended
urf-s           [1] Basic-Text-String           OPTIONAL,
                                                --Unique Source ID; strongly recommended
edn-s           [2] Basic-Text-String           OPTIONAL,
                                                --Source Edition Number; strongly recommended
nam-s           [3] Basic-Text-String           OPTIONAL
                                                --Full name of source document; strongly recommended
cdt-s           [4] Integer-Number              OPTIONAL,
                                                --Type of significant date; strongly recommended
cdv-s           [5] Date                        OPTIONAL,
                                                --Significant date value; strongly recommended
cou-s           [6] Basic-Text-String           OPTIONAL,
                                                --Country Code (see Part 3-11); strongly recommended
cdv27           [7] Basic-Text-String           OPTIONAL,
                                                --Perishable information date value; strongly
                                                  --recommended
sca-s           [8] Integer-Number              OPTIONAL,
                                                --Cartographic Scale; strongly recommended
grd             [9] Basic-Text-String           OPTIONAL,
                                                --Cartographic Grid Code
```

Withdrawn/Retirée

```
                [10] Area-Coverage-Subfield          OPTIONAL,
                [11] Contour-Interval-Subfield       OPTIONAL,
wpc             [12] Integer-Number                  OPTIONAL,
                                                     --Percentage covered by water
nst-s           [13] Integer-Number                  OPTIONAL,
                                                     --Navigational System Type
                [14] Geodetic-Ellipsoid-Subfield     OPTIONAL,
                                                     --see Dependency condition 4-2
                [15] Vertical-Datum-Subfield         OPTIONAL,
                                                     --see Dependency condition 4-3
                [16] Sounding-Datum-Subfield         OPTIONAL,
                                                     --see Dependency condition 4-4
                [17] Geodetic-Datum-Subfield         OPTIONAL,
                                                     --see Dependency condition 4-5
srn-s           [18] Basic-Text-String               OPTIONAL,
                                                     --Library/Source Reference Number
                [19] Highest-Elevation-Subfield      OPTIONAL
                                                     --Raster applications only
        }

Area-Coverage-Subfield
        ::= SEQUENCE    {
squ             Integer-Number,                      --Area Coverage
unisqu          Basic-Text-String                    --Unit of Measure for Area Coverage
        }

Contour-Interval-Subfield
        ::= SEQUENCE    {
pci             Integer-Number,                      --Predominant Contour Interval
unipci          Basic-Text-String                    --Unit of Measure for Contour Interval
        }

--Geodetic-Ellipsoid-Subfield                        see Geo-Reference-Record

--Vertical-Datum-Subfield                            see Geo-Reference-Record

--Sounding-Datum-Subfield                            see Geo-Reference-Record

--Geodetic-Datum-Subfield                            see Geo-Reference-Record

Highest-Elevation-Subfield
        ::= SEQUENCE    {
hke             [0] Integer-Number,                  --Highest known elevation of source
unihke          [1] Basic-Text-String,               --Units of elevation value
                [2] Highest-Elevation-Point          OPTIONAL
                                                     --strongly recommended
        }

Highest-Elevation-Point
        ::= SEQUENCE    {
lon-h           Fraction-Number,                     --Longitude/Easting of HKE
lat-h           Fraction-Number                      --Latitude/Northing of HKE
        }
```

Withdrawn/Retirée

```
Magnetic-Rate-Field                                  --MAG
        ::= SEQUENCE OF
        SEQUENCE   {
cdp         [0] Integer-Number,                      --Type of magnetic date rate
cdv         [1] Date,                                --Magnetic rate Date value
rat         [2] Real-Number,                         --Magnetic rate of change
unirat      [3] Basic-Text-String,                   --Units of rate of change
gma         [4] Real-Number,                         --Grid north-magnetic north
unigma      [5] Basic-Text-String,                   --Units of grid magnetic angle
            [6] Magnetic-Rate-Reference-Point-Subfield
                                                     OPTIONAL,
                                                     --strongly recommended
            [7] Grid-Convergence-Subfield            OPTIONAL
        }

Magnetic-Rate-Reference-Point-Subfield
        ::= SEQUENCE   {
lon-m       Fraction-Number,                         --Longitude/Easting of the G-M angle reference point
lat-m       Fraction-Number                          --Latitude/Northing of the G-M angle reference point
        }

Grid-Convergence-Subfield
        ::= SEQUENCE   {
gca         Real-Number,                             --Grid convergence angle
unigca      Basic-Text-String                        --Units of grid convergence angle
        }

Bounding-Polygon-Coordinates-Field                   --RCI
        ::= SEQUENCE OF
        SEQUENCE   {
lon         Fraction-Number,                         --Longitude/Easting coordinate
lat         Fraction-Number                          --Latitude/Northing coordinate
        }

--Projection-Field                                   PRR
                                                     --see Geo-Reference-Record

--Security-and-Release-Field                         QSR
                                                     --see Security-and-Update-Record

Inset-Field                                          --INS
        ::= SEQUENCE OF
        SEQUENCE   {
int         Basic-Text-String,                       --Unique ID of an Inset
sca         Integer-Number,                          --Cartographic Scale of Inset
nam-i       Basic-Text-String,                       --Name of Inset
ntl         Fraction-Number,                         --Abs. lon. lower left corner
ttl         Fraction-Number,                         --Abs. lat. lower left corner
nvl         Fraction-Number,                         --Abs. lon. upper left corner
tvl         Fraction-Number,                         --Abs. lat. upper left corner
ntr         Fraction-Number,                         --Abs. lon. upper right corner
ttr         Fraction-Number,                         --Abs. lat. upper right corner
nvr         Fraction-Number,                         --Abs. lon. lower right corner
tvr         Fraction-Number,                         --Abs. lat. lower right corner
nrl         Fraction-Number,                         --Rel. lon. lower left corner
trl         Fraction-Number,                         --Rel. lat. lower left corner
nsl         Fraction-Number,                         --Rel. lon. upper left corner
tsl         Fraction-Number,                         --Rel. lat. upper left corner
```

Withdrawn/Retirée

```
nrr         Fraction-Number,        --Rel. lon. upper right corner
trr         Fraction-Number,        --Rel. lat. upper right corner
nsr-i       Fraction-Number,        --Rel. lon. lower right corner
tsr         Fraction-Number         --Rel. lat.  lower right corner
        }

Copyright-Field                     --CPY
cpz     ::= General-Text-String     --Copyright statement
```

B.7.2 Legend Record

```
Legend-Record                       --LEG
                                    --Raster applications only
        ::= SEQUENCE    {
lgi         [0] Legend-Field,       --Legend info captured  for easier
                                      --interpretation of source to which it relates
spr-l       [1] Legend-Parameters-Field,  --Parameters to interpret Legend Image Data
tim-l       [2] Tile-Index-Map-Subfield  OPTIONAL
                                    --Info regarding empty subblocks; see Dependency
                                      --condition 4-8
        }

Legend-Field                          --LGI
        ::= SEQUENCE    {
nam-l       [0] Basic-Text-String   OPTIONAL,
                                    --Legend name
str-l       [1] Integer-Number      --Structure class code
        }

Legend-Parameters-Field             --SPR-L
spr-p   ::= Dataset-Parameters-Subfield

--Dataset-Parameters-Subfield       SPR
                                    --see General-Information-Record

--Tile-Index-Map-Subfield          TIM
                                    --see General-Information-Record
```

B.7.3 Metric-Support-Data-Record

```
Metric-Support-Data-Record          --MSD
        ::= CHOICE    {
            [0] Arc-System-Metric-Support-Record,
                                    --see Dependency condition 4-10
            [1] UTM/UPS-System-Metric-Support-Record
                                    --see Dependency condition 4-11
        }
```

Withdrawn/Retirée

B.7.3.1 Arc-System-Metric-Support-Record

```
Arc-System-Metric-Support-Record
        ::= SEQUENCE   {
ncd             Normalization-Constants-Field,
sdc             Source-Datum-Coefficients-Data-Field,
mpc             Map-Projection-Coefficients-Field
        }

Normalization-Constants-Field                   --NCD
        ::= SEQUENCE   {
tsf             [0] Real-Number,                --Latitude Scale Factor
gsf             [1] Real-Number,                --Longitude Scale Factor
ttt             [2] Real-Number,                --Latitude Translation Term
gtt             [3] Real-Number,                --Longitude Translation Term
nsf             [4] Real-Number,                --Northing Scale Factor
esf             [5] Real-Number,                --Easting Scale Factor
ntt             [6] Real-Number                 --Northing Translation Term
ett             [7] Real-Number,                --Easting Translation Term
        }

Source-Datum-Coefficients-Field                 --SDC
        ::=SEQUENCE   {
ax1             [0] Real-Number,                --Latitude coefficient 1
ax2             [1] Real-Number,                --Latitude coefficient 2
ax3             [2] Real-Number,                --Latitude coefficient 3
ax4             [3] Real-Number,                --Latitude coefficient 4
ax5             [4] Real-Number,                --Latitude coefficient 5
ax6             [5] Real-Number,                --Latitude coefficient 6
ax7             [6] Real-Number,                --Latitude coefficient 7
bx1             [7] Real-Number,                --Longitude coefficient 1
bx2             [8] Real-Number,                --Longitude coefficient 2
bx3             [9] Real-Number,                --Longitude coefficient 3
bx4             [10] Real-Number,               --Longitude coefficient 4
bx5             [11] Real-Number,               --Longitude coefficient 5
bx6             [12] Real-Number,               --Longitude coefficient 6
bx7             [13] Real-Number                --Longitude coefficient 7
        }

Map-Projection-Coefficients-Field               --MPC
        ::= SEQUENCE   {
cx1             [0] Real-Number,                --Northing coefficient 1
cx2             [1] Real-Number,                --Northing coefficient 2
cx3             [2] Real-Number,                --Northing coefficient 3
cx4             [3] Real-Number,                --Northing coefficient 4
cx5             [4] Real-Number,                --Northing coefficient 5
cx6             [5] Real-Number,                --Northing coefficient 6
cx7             [6] Real-Number,                --Northing coefficient 7
cx8             [7] Real-Number,                --Northing coefficient 8
cx9             [8] Real-Number,                --Northing coefficient 9
cx10            [9] Real-Number,                --Northing coefficient 10
dx1             [10] Real-Number,               --Easting coefficient 1
dx2             [11] Real-Number,               --Easting coefficint 2
dx3             [12] Real-Number,               --Easting coefficient 3
dx4             [13] Real-Number,               --Easting coefficient 4
dx5             [14] Real-Number,               --Easting coefficient 5
dx6             [15] Real-Number,               --Easting coefficient 6
dx7             [16] Real-Number,               --Easting coefficient 7
```

Withdrawn Retirée

```
dx8         [17] Real-Number,          --Easting coefficient 8
dx9         [18] Real-Number,          --Easting coefficient 9
dx10        [19] Real-Number           --Easting coefficient 10
        }
```

B.7.3.2 UTM/UPS-System-Metric-Support-Record

```
UTM/UPS-System-Metric-Support-Record
        ::= SEQUENCE   {
dcc         [0] Datum-Change-Constants-Field,
scc         [1] Source-Datum-Coefficients-Counter-Field,
slg         [2] Source-Datum-Longitude-Coefficients-Field,
slt         [3] Source-Datum-Latitude-Coefficients-Field,
grc         [4] Grid-Rotation-Coefficients-Field    OPTIONAL
        }

Datum-Change-Constants-Field            --DCC
                                        --(Note:  Units for all datum change constants
                                          --are n degrees and decimal part of a degree.)
        ::= SEQUENCE   {
tof         Real-Number,                --Latitude normalizing offset
gof         Real-Number,                --Longitude normalizing offset
nzt         Real-Number,                --Normalizing factor
elv         Real-Number,                --Eastern limit of validity to use multiple
                                          --regression equations
wlv         Real-Number,                --Western limit of validity to use multiple
                                          --regression equations
nlv         Real-Number,                --Northern limit of validity to use multiple
                                          --regression equations
slv         Real-Number                 --Southern limit of validity to use multiple
                                          --regression equations
        }

Source-Datum-Coefficients-Counter-Field --SCC
        ::= SEQUENCE   {
bct         Integer-Number,             --Number of longitude coefficients
act         Integer-Number              --Number of latitude coefficients
        }

Source-Datum-Longitude-Coefficients-Field --SLG
        ::= SEQUENCE OF   {
        SEQUENCE   {
cbi         Integer-Number,             --i index of the coefficient of MRE bi,j
cbj         Integer-Number,             --j index of the coefficient of MRE b i,j
lgc         Real-Number                 --Coefficient of MRE b i,j ( b i,j coefficients are ordered
                                          --with respect to increasing i then j )
        }}

Source-Datum-Latitude-Coefficients-Field --SLT
        ::= SEQUENCE OF
        SEQUENCE   {
cae         Integer-Number,             --I index of the coefficient of MRE a i,j
caj         Integer-Number,             --j index of the coefficient of MRE a i,j
ltc         Real-Number                 --Coefficient of MRE  a i,j (a i,j coefficients are ordered
                                          --with respect to increasing i then j)
        }
```

Withdrawn/Retirée

```
Grid-Rotation-Coefficients-Field                --GRC
        ::= SEQUENCE   {
nes             Real-Number,                    --Normalized Eastings Shift
nns             Real-Number,                    --Normalized Northings Shift
aor             Real-Number                     --Angle of orientation from source datum grid to
                                                  --WGS UTM grid

        }
```

B.7.4 Supplementary-Text-Record

```
Supplementary-Text-Record                       --SPT
sup             ::= Supplementary-Text-Field

Supplementary-Text-Field                        --SUP
        ::= SEQUENCE OF
        SEQUENCE   {
try             [0] Basic-Text-String,          --Supplementary text record type
tri             [1] Basic-Text-String           OPTIONAL,
                                                --Supplementary text field reference identifier
txt             [2] General-Text-String         --Supplementary text
        }
```

Dependency conditions (list 4):

4-1 Name of derived layer:
Name of the derived layer will be transmitted whenever the source described in the source record does not apply to all layers in the dataset.

4-2 Geodetic-Ellipsoid-Subfield:
Mandatory if the Projection-Field is transmitted.

4-3 Vertical-Datum-Subfield:
Mandatory if elevation information is present on the source (e.g. contour lines on a raster map). Forbidden if no elevation information is present on the source.

4-4 Sounding-Datum-Subfield:
Mandatory if sounding information is present in the source (depth values or sounding information on a raster map). Forbidden if no sounding information is present on the source.

4-5 Geodetic-Datum-Subfield:
Mandatory if the Projection-Field is transmitted.

4-6 Bounding-Polygon-Coordinates-Field:
Mandatory when the source information is not valid for the whole dataset extension.

4-7 Inset-Field:
mandatory when relevant only.

4-8 Tile-Index-Map-Subfield:
mandatory if TIF = "Y".

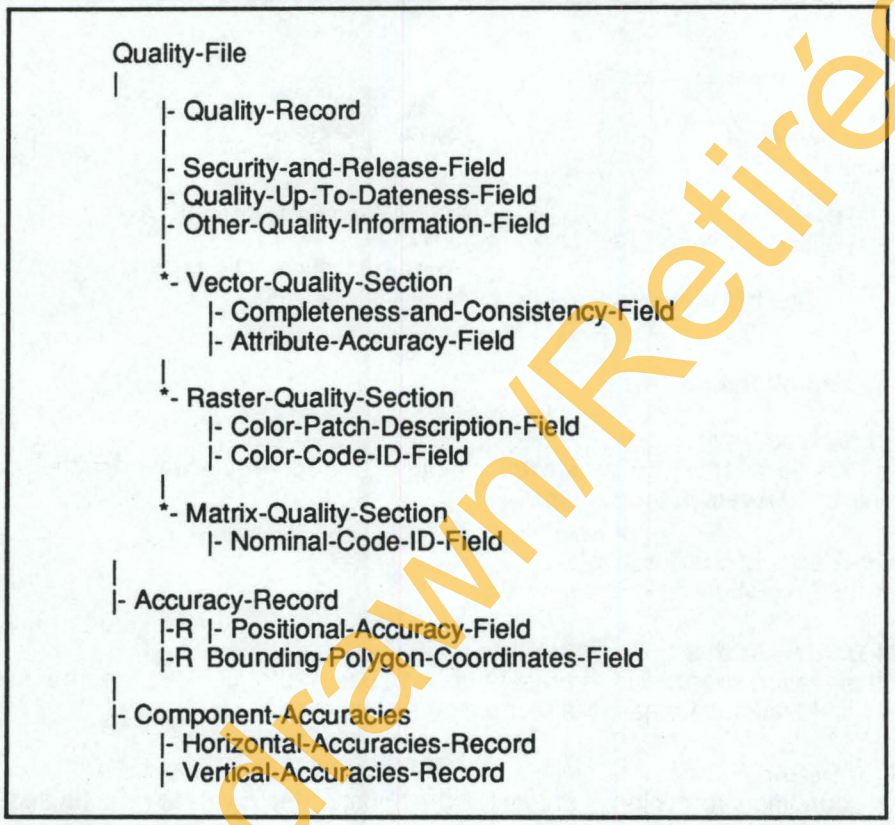
4-9 Metric-Support-Record:
Mandatory if two conditions are satisfied: PRT = ASRP or PRT = USRP, and for Matrix or Raster data.

Withdrawn/Retirée

4-10 Arc system:
used with the Arc system only.

4-11 UTM/UPS system:
used with the UTM/UPS system only.

B.8 Quality-File



Quality-File
::= SEQUENCE {
qal **[A 7]** Quality-Record,
[A 8] SET { --see Dependency condition 5-6
qai [0] Accuracy-Record OPTIONAL,
car [1] Component-Accuracies-Record
OPTIONAL
}
}

Withdrawn/Retirée

B.8.1 Quality-Record

```
Quality-Record                                  --QAL
        ::= SEQUENCE   {
qsr-q       [0] Security-and-Release-Field,     --Security classification, handling, and release info.
quq         [1] Quality-Up-To-Dateness-Field    OPTIONAL,
                                                --strongly recommended
                                                --describes currency of Geo Data Subset
qoi         [2] Other-Quality-Information-Field OPTIONAL,
                                                --Free text
            [3] CHOICE   {
                [0] Vector-Quality-Section,
                [1] Raster-Quality-Section,
                [2] Matrix-Quality-Section
            }
        }

Vector-Quality-Section
        ::= SEQUENCE   {
qcc-v       [0] Completeness-and-Consistency-Field
                                                OPTIONAL,
qaa-v       [1] Attribute-Accuracy-Field        OPTIONAL
        }

Raster-Quality-Section
        ::= SEQUENCE   {
            [0] Color-Patch-Description-Field   OPTIONAL,
                                                --see Dependency condition 5-4
col         [1] Color-Code-ID-Field             OPTIONAL,
                                                --see Dependency condition 5-5
        }

Matrix-Quality-Section                          --NOM-M
        ::= Nominal-Code-ID-Field

--Security-and-Release-Field                    QSR
                                                --see Security-and-Update-Record

Completeness-and-Consistency-Field              --QCC
        ::= SEQUENCE OF
        SEQUENCE   {
bad-c       [0] Basic-Text-String               OPTIONAL,
                                                --Layer name; see Dependency condition 5-1
qfc         [1] Integer-Number                  OPTIONAL,
                                                --Feature Completeness percent
qac         [2] Integer-Number                  OPTIONAL,
                                                --Attribute Completeness percent
qlc         [3] Basic-Text-String               OPTIONAL
                                                --Logical Consistency
        }

Quality-Up-to-Dateness-Field                    --QUQ
        ::= SEQUENCE   {
edn-u       [0] Integer-Number,                 --Edition Number of Data Set
cdv07-u     [1] Date,                           --Creation of dataset date value
cdv24       [2] Date,                           --Revision or Update date value
rec-u       [3] Integer-Number                  OPTIONAL,
                                                --Recompilation count
```

Withdrawn/Retirée

```
rev-u       [4] Integer-Number                  OPTIONAL,
                                                --Revision count
src-u       [5] Basic-Text-String,              --Specification ID
cdv22-u     [6] Date                            OPTIONAL,
                                                --Specification date value; see Dependency
                                                  --condition 5-2
spa-u       [7] Basic-Text-String               OPTIONAL,
                                                --Specification amendment; see Dependency
                                                  --condition 5-3
cdv20       [8] Date                            OPTIONAL,
                                                --Earliest source date value
cdv21       [9] Date                            OPTIONAL
                                                --Latest source date value
        }

Attribute-Accuracy-Field                        --QAA
        ::= SEQUENCE OF
        SEQUENCE   {
bad-a       [0] Basic-Text-String               OPTIONAL,
                                                --Layer name; see Dependency condition 5-1
qut         [1] Integer-Number                  OPTIONAL,
                                                --Standard Deviation of Quantitative Attributes
qul         [2] Integer-Number                  OPTIONAL,
                                                --Percent Reliability of Qualitative Attributes
ccr         [3] Basic-Text-String               OPTIONAL,
                                                --Collection Criteria
        }

Color-Patch-Description-Field
        ::= SEQUENCE   {
cpt     [0] Color-Patch-Type-Subfield,
cpi     [1] Color-Patch-ID-Subfield             OPTIONAL,
spr-c   [2] Dataset-Parameters-Subfield         OPTIONAL
                                                --see Dependency condition 5-4
        }

Color-Patch-Type-Subfield                       --CPT
scr     ::= Basic-Text-String                   --Standard color patch reference

Color-Patch-ID-Subfield                         --CPI
        ::= SEQUENCE OF
        SEQUENCE   {
pnm     Basic-Text-String,                      --Color Patch Name (e.g. Red)
pir     Integer-Number,                         --Patch Intensity Value - Red
pig     Integer-Number,                         --Patch Intensity Value - Green
pib     Integer-Number                          --Patch Intensity Value - Blue
        }

--Dataset-Parameters-Subfield                   SPR
                                                --see General-Information-Record

Color-Code-ID-Field                             --COL
        ::= SEQUENCE OF
        SEQUENCE   {
cbd         [0] Basic-Text-String,              --Name and/or Description of Color Code
ccd         [1] Integer-Number,                 --Color Code Assigned in Data Set (0-255)
            [2] CIE-Color-Description-Subfield  OPTIONAL,
            [3] RGB-Color-Description-Subfield  OPTIONAL,
        }
```

Withdrawn/Retirée

CIE-Color-Description-Subfield
::= SEQUENCE {

cr1	Integer-Number,	--CIEx
cr2	Integer-Number,	--CIEy
cr3	Integer-Number	--CIE Reflectivity (y)

}

RGB-Color-Description-Subfield
::= SEQUENCE {

nsr	Integer-Number,	--Color Intensity - Red actual (0 - 255)
nsg	Integer-Number,	--Color Intensity - Green actual (0 - 255)
nsb	Integer-Number	--Color Intensity - Blue actual (0 - 255)

}

Nominal-Code-ID **--NOM**
::= SEQUENCE OF
SEQUENCE {

nci	Basic-Text-String,	--Code Identifier
nbd	Basic-Text-String,	--Description/meaning of code
ncd-n	Integer-Number	--Nominal code assigned in data set

}

Other-Quality-Information-Field **--QOI**
oqi ::= General-Text-String --Free Text

B.8.2 Accuracy-Record

Accuracy-Record **--QAI**
::= SEQUENCE OF
SEQUENCE {

qap	[0] Positional-Accuracy-Field,	--Positional accuracy of the dataset file
rci-a	[1] SEQUENCE OF Bounding-Polygon-Coordinates-Field	OPTIONAL --Coordinates of the polygon delineating the accuracy --region; see Dependency condition 5-7

}

Positional-Accuracy-Field **--QAP**
::= SEQUENCE {

aah-p	[0] Integer-Number,	--Accuracy Absolute Horizontal
uniaah	[1] Integer-Number,	--Unit of measure
aav	[2] Integer-Number,	--Accuracy Absolute Vertical
uniaav	[3] Integer-Number,	--Unit of measure
aph	[4] Integer-Number,	--Accuracy Point to Point Horizontal
uniaph	[5] Integer-Number,	--Unit of measure
apv	[6] Integer-Number,	--Accuracy Point to Point Vertical
uniapv	[7] Integer-Number,	--Unit of measure
bad-p	[8] Basic-Text-String	OPTIONAL --Layer name; see Dependency condition 5-1

}

--Bounding-Polygon-Coordinates-Field **RCI**
--see Source-Record

Withdrawn/Retirée

B.8.3 Component-Accuracies-Record

```
Component-Accuracies-Record                    --CAR
        ::= SEQUENCE   {
            Horizontal-Accuracies-Record,
            Vertical-Accuracies-Record
        }
```

B.8.3.1 Horizontal-Accuracies-Record

```
Horizontal-Accuracies-Record
        := SEQUENCE OF
        SEQUENCE   {
aah         [0] Horizontal-Accuracies-Field,
rci-h       [1] SEQUENCE OF
                Bounding-Polygon-Coordinates-Field
                                           OPTIONAL
                                           --see Dependency condition 5-7
        }

Horizontal-Accuracies-Field                --ASH
        ::= SEQUENCE   {
aah-h       [0] Integer-Number,            --Absolute Horizontal Accuracy
uniaah-h    [1] Integer-Number,            --Unit of measure
aph-h       [2] Integer-Number,            --Relative Horizontal Accuracy
uniaph-h    [3] Integer-Number,            --Unit of measure
bad-h       [4] Basic-Text-String          OPTIONAL
                                           --Layer name; see Dependency condition 5-1
        }

--Bounding-Polygon-Coordinates-Field       RCI
                                           --see Source-Record
```

B.8.3.2 Vertical-Accuracies-Record

```
Vertical-Accuracies-Record
        ::= SEQUENCE OF
        SEQUENCE   {
asv         [0] Vertical-Accuracies-Field,
rci-v       [1] SEQUENCE OF
                Bounding-Polygon-Coordinates-Field
                                           OPTIONAL
                                           --see Dependency condition 5-7
        }

Vertical-Accuracies-Field                  --ASV
        ::= SEQUENCE   {
aav-v       [0] Integer-Number,            --Absolute Vertical Accuracy
uniaav-v    [1] Integer-Number,            --Unit of measure
apv-v       [2] Integer-Number,            --Relative Vertical Accuracy
uniapv-v    [3] Integer-Number,            --Unit of measure
bad-f       [4] Basic-Text-String          OPTIONAL
                                           --Layer name; see Dependency condition 5-1
        }
```

Withdrawn/Retirée

--Bounding-Polygon-Coordinates-Field	**RCI** **--see Source-Record**

Dependency conditions (list 5):

5-1 Name of layer:
The name of the layer will be transmitted whenever the completeness and consistency information does not apply to all layers in the dataset.

5-2 Specification edition date:
The specification edition date will be transmitted with the specification edition ID.

5-3 Specification amendment number:
The specification amendment number wil be transmitted with the specification edition ID.

5-4 Color patch dataset parameters:
The color patch dataset parameters will be transmitted if the color patch image file exits.

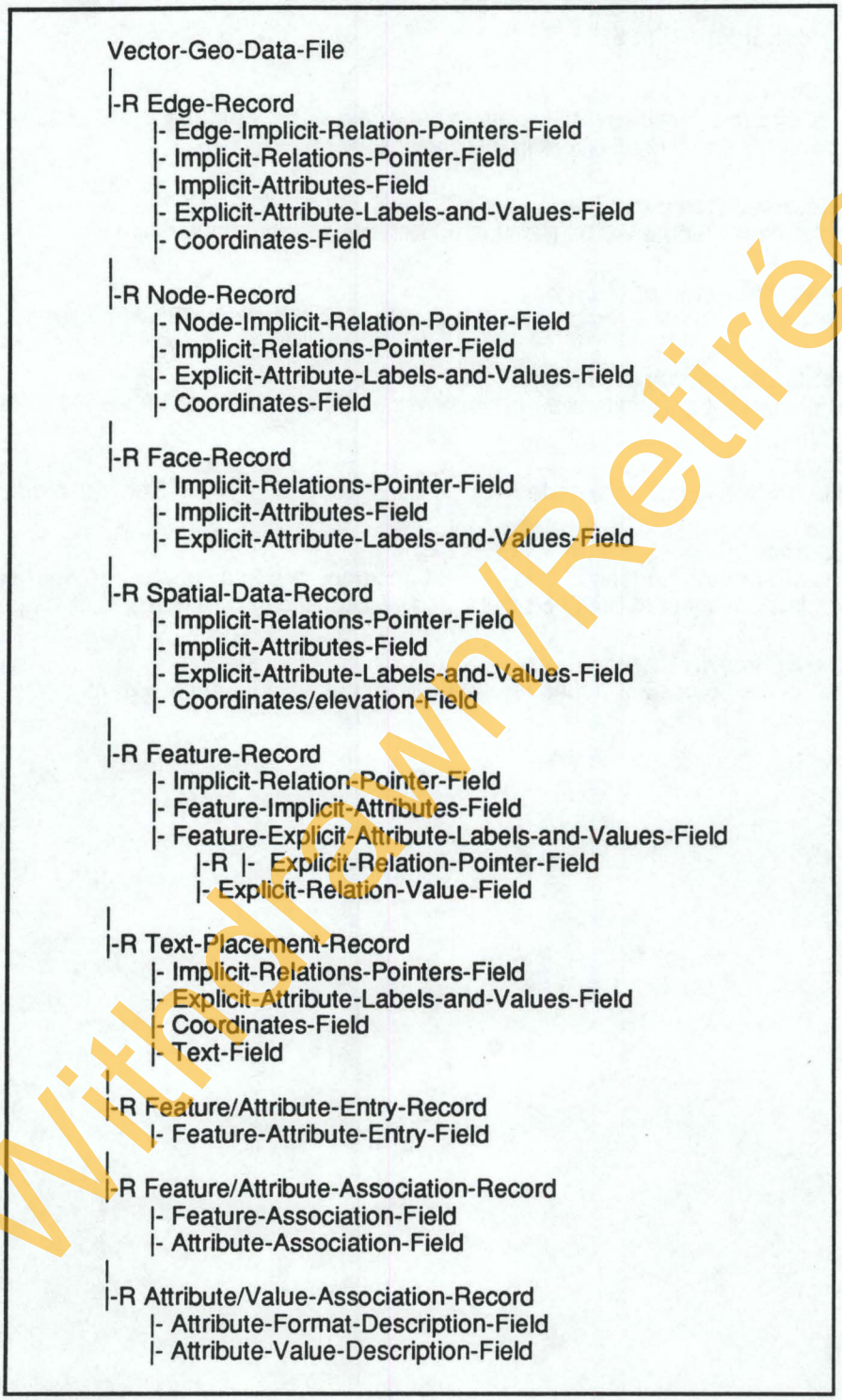
5-5 Color coded:
Must be defined when raster color coded data is transmitted (STR = 2). Forbidden otherwise.

5-6 Accuracy record:
Must be used when both horizontal and vertical accuracy are known and homogeneous on the same area. If it is absent then both horizontal and vertical accuracy records must be present.

5-7 Bounding polygon:
Mandatory when the source information is not valid for the whole dataset extent

Withdrawn/Retirée

B.9 Vector-Geo-Data-File



Withdrawn/Retirée

```
Vector-Geo-Data-File
        := SEQUENCE   {
            [0] SEQUENCE OF
ed              Edge-Record                 OPTIONAL,
                                            --see Dependency condition 6-1
            [1] SEQUENCE OF
no              Node-Record                 OPTIONAL,
                                            --see Dependency condition 6-2
            [2] SEQUENCE OF
fe              Face-Record                 OPTIONAL,
                                            --for Level 3 topology only;
                                            --Levels 0-2: not included
            [3] SEQUENCE OF
                Spatial-Data-Record         OPTIONAL,
                                            --Optional for Level 0 topology; see Dependency
                                              --condition 6-3;
                                              --Levels 1-3: not included
            [4] SEQUENCE OF
                Feature-Record,
            [5] SEQUENCE OF
tp              Text-Placement-Record       OPTIONAL,
            [6] SEQUENCE OF
dd              Feature/Attribute-Entry-Record  OPTIONAL,
                                            --see Dependency condition 6-4
            [7] SEQUENCE OF
df              Feature/Attribute-Association-Record
                                            OPTIONAL,
            [8] SEQUENCE OF
da              Attribute/Value-Association-Record
                                            OPTIONAL
                                            --see Dependency condition 6-5
        }
```

Dependency conditions (list 6):

6-1 Edge-Record:
Vector geodata files containing only nodes and no edges or faces may exist. Edge record is mandatory if Vector geodata file contains Line or Area feature records. At Level 0, it may be replaced by Spatial data record.

6-2 Node-Record:
Vector geodata files without any node record may exist. Node record is mandatory if Vector geodata file contains Point feature records or if Edge record contains edge-node topology description. At Level 0, it may be replaced by Spatial data record.

6-3 Spatial-Data-Record:
Will be present at Level 0 if neither node record nor edge record are present.

6-4 Feature/Attribute-Entry-Record:
Will be present is any Feature (or attribute) transmitted in the Vector Geodata file is not described in FACC (DIGEST Part 4)

6-5 Attribute/Value-Association-Record:
Will be present for each attribute transmitted in the Vector Geodata file and not present in the FACC.

Withdrawn/Retirée

B.9.1 Edge-Record

```
Edge-Record                                          --ED
        ::= [A 9] SEQUENCE   {
            [0] Record-ID-Number,
ire-e       [1] Edge-Implicit-Relation-Pointers-Field
                                                     OPTIONAL,
                                                     --Mandatory for Level 3 topology,
                                                       --Levels 1 and 2:  Optional
                                                       --Level 0: not included
irs-e       [2] Implicit-Relations-Pointer-Field     OPTIONAL,
                                                     --Optional for all levels of topology
iat-e       [3] Implicit-Attributes-Field            OPTIONAL,
                                                     --Optional for all levels of topology
att-e       [4] Explicit-Attribute-Labels-and-Values-Field
                                                     OPTIONAL,
                                                     --Optional for all levels of topology
cor-e       [5] Edge-Coordinates-Field               --Mandatory for all levels of topology
        }

Record-ID-Number
        ::= Integer-Number                           --Unique ID number of the record

Edge-Implicit-Relation-Pointers-Field
        ::= SEQUENCE   {
            [0] Face-Topology-Field                  OPTIONAL,
                                                     --Level 3 topology : Mandatory;
                                                       --Levels 0-2: not included
            [1] Edge-Node-Topology-Field             OPTIONAL,
                                                     --Level 3 topology: Mandatory ;
                                                       --Levels 1 and 2: Optional;
                                                       --Level 0: Not included
            [2] Winged-Edge-Topology-Field           OPTIONAL
                                                     --Levels 1, 2, and 3 topology: Optional,
                                                       --Level 0: Not included
        }

Face-Topology-Field                                  --Mandatory for Level 3 topology only;
                                                       --not included for all other levels of topology
        ::= SEQUENCE   {
fal         Left-Face-Pointer,
far         Right-Face-Pointer
        }

Edge-Node-Topology-Field                             --Mandatory for Level 3 topology only;
                                                       --Optional for Levels 1 and 2 topology;
                                                       --Not included for Level 0 topology
        ::= SEQUENCE   {
nos-e       Start-Node-Pointer,
noe-e       End-Node-Pointer
        }
Winged-Edge-Topology-Field                           --Optional for Levels 1, 2, and 3 topology;
                                                       --Not included for Level 0 topology
        ::= SEQUENCE   {
ner         Pointer-to-Next-Right-Directed-Edge,
nel         Pointer-to-Next-Left-Directed-Edge
        }
```

Withdrawn/Retirée

```
Left-Face-Pointer
        ::= SEQUENCE   {
rid-FAL     [0] Integer-Number,          --Record ID
sec-FAL     [1] Basic-Text-String        DEFAULT ("U")
                                         --Record security
        }

Right-Face-Pointer
        ::= SEQUENCE   {
rid-FAR     [0] Integer-Number,          --Record ID
sec-FAR     [1] Basic-Text-String        DEFAULT ("U")
                                         --Record security
        }

Start-Node-Pointer
        ::= SEQUENCE   {
rid-NOS     [0] Integer-Number,          --Record ID
sec-NOS     [1] Basic-Text-String        DEFAULT ("U")
                                         --Record security
        }

End-Node-Pointer
        ::= SEQUENCE   {
rid-NOE     [0] Integer-Number,          --Record ID
sec-NOE     [1] Basic-Text-String        DEFAULT ("U")
                                         --Record security
        }

Pointer-to-Next-Right-Directed-Edge
        ::= SEQUENCE   {
rid-NER     [0] Integer-Number,          --Record ID
sec-NER     [1] Basic-Text-String        DEFAULT ("U")
                                         --Record security
        }

Pointer-to-Next-Left-Directed-Edge
        ::= SEQUENCE   {
rid-NEL     [0] Integer-Number,          --Record ID
sec-NEL     [1] Basic-Text-String        DEFAULT ("U")
        }

Implicit-Relations-Pointer-Field         --IRS
                                         --Optional reverse pointer back to Line feature or
                                           --Area feature (Level 2, 1 or 0) for Edges, and back
                                           --to Point feature for Nodes
        ::= SEQUENCE OF
        SEQUENCE   {
rid-COS     [0] Integer-Number,          --Record ID; Mandatory for all levels of topology
sec-COS     [1] Basic-Text-String        DEFAULT("U")
                                         --Security; OPTIONAL for all levels of topology
        }
```

Withdrawn/Retirée

```
Implicit-Attributes-Field                    --IAT
        ::= SEQUENCE   {
mie     [0] Fraction-Number,                 --Minimum Easting/Longitude Value of the MBR;
                                               --mandatory for all levels of topology
min     [1] Fraction-Number,                 --Minimum Northing/Latitude Value of the MBR;
                                               --mandatory for all levels of topology
zwi     [1] Fraction-Number                  OPTIONAL,
                                             --Minimum Elevation Value of the MBR;
                                               --see Dependency condition 7-1 for Edge data
                                               --see Dependency condition 9-1 for Face data
                                               --see Dependency condition 10-1 for Spatial Data
                                               --see Dependency condition 11-1 for Feature data
mae     [2] Fraction-Number,                 --Maximum Easting/Longitude Value of the MBR;
                                               --mandatory for all levels of topology
man     [3] Fraction-Number,                 --Maximum Northing/Latitude Value of the MBR;
                                               --mandatory for all levels of topology
zv2     [4] Fraction-Number                  OPTIONAL
                                             --Maximum Elevation Value of the MBR;
                                               --see Dependency condition 7-1 for Edge data
                                               --see Dependency condition 9-1 for Face data
                                               --see Dependency condition 10-1 for Spatial Data
                                               --see Dependency condition 11-1 for Feature data
        }

Explicit-Attribute-Labels-and-Values-Field   --ATT
        ::= SEQUENCE   {
atc             Basic-Text-String,           --Attribute label; Mandatory for all levels of topology
for             Basic-Text-String,           --Value Format; Mandatory for all levels of topology
val             CHOICE   {                   --Attribute Value; consistent with value of for sub-field;
                                               --Mandatory for all levels of topology
                    [0] Basic-Text-String,
                    [1] Integer-Number,
                    [2] Real-Number
                }
        }

Edge-Coordinates-Field                       --COR-E
        ::= CHOICE   {
                    [0] Abs-Coordinate-String,
                    [1] Rel-Coordinate-String,
                    [2] Dif-Coordinate-String
        }
```

Dependency conditions (list 7):

7-1 Elevation MBR subfield:
Minimum and maximum elevation must be transmitted if the transmitted coordinates (COR) contain elevation value(s).

7-2 Elevation Coordinates subfield:
Elevation must be absent or present for all transmitted coordinates; that is, either elevation is present for all transmitted coordinates, or for none, but not for some.

Withdrawn/Retired

B.9.2 Node-Record

```
Node-Record                                          --NO
        ::= [A 10] SEQUENCE   {
            [0] Record-ID-Number,
irn         [1] Node-Implicit-Relation-Pointer-Field
                                                     OPTIONAL,
                                                     --Level 3 topology: Mandatory ;
                                                       --Levels 0-2: Not included
irs-n       [2] Implicit-Relations-Pointer-Field     OPTIONAL,
                                                     --Optional for all levels of topology
att-n       [3] Explicit-Attribute-Labels-and-Values-Field
                                                     OPTIONAL,
                                                     --Optional for all levels of topology
cor-n       [4] Coordinate-Field                     --Mandatory for all levels of topology
        }

--Record-ID-Number                                   see Edge-Record

Node-Implicit-Relation-Pointer-Field                 --IRN
        ::= SEQUENCE   {
rid-COP     [0] Integer-Number                       OPTIONAL,
                                                     --Record ID; see Dependency condition 8-1
sec-COP     [1] Basic-Text-String                    OPTIONAL
                                                     --Security
        }

--Implicit-Relations-Pointer-Field                   IRS
                                                     --Optional reverse pointer back to point feature;
                                                       --see Edge-Record

--Explicit-Attribute-Labels-and-Values-Field         ATT
                                                     --see Edge-Record

Coordinate-Field                                     --COR
        ::= SEQUENCE OF
            SEQUENCE   {
lon-f       [0] Fraction-Number,                     --Longitude/Easting
lat-f       [1] Fraction-Number,                     --Latitude/Northing
ele-f       [2] Real-Number                          OPTIONAL
                                                     --Elevation
        }
```

Dependency conditions (list 8):

8-1 Connected node IRN:
RID is null when RTY is null

Withdrawn/Retirée

B.9.3 Face-Record

Face-Record **--FE**
--for Level 3 topology only

```
        ::= [A 11] SEQUENCE   {
              [0] Record-ID-Number,
irs-r         [1] Implicit-Relations-Pointer-Field     OPTIONAL,
iat-r         [2] Implicit-Attributes-Field           OPTIONAL,
att-r         [3] Explicit-Attribute-Labels-and-Values-Field
                                                      OPTIONAL
        }
```

--Record-ID-Number **see Edge-Record**

--Implicit-Relations-Pointer-Field **IRS**
--see Edge-Record

--Explicit-Attributes-Labels-and-Values-Field **ATT**
--see Edge-Record

--Implicit-Attributes-Field **IAT**
--see Edge-Record

Dependency condition (list 9):

9-1 Elevation MBR subfield:
Minimum and maximum elevation must be transmitted if the bordering edges are transmitted with elevation value(s) in their coordinates field(COR).

B.9.4 Spatial-Data-Record

Spatial-Data-Record **--SP**
--for Level 0 topology only

```
        ::= [A 12] SEQUENCE   {
              [0] Record-ID-Number,
irs-s         [1] Implicit-Relations-Pointer-Field     OPTIONAL,
iat-s         [2] Implicit-Attributes-Field           OPTIONAL,
att-s         [3] Explicit-Attribute-Labels-and-Values-Field
                                                      OPTIONAL,
cor-s         [4] Coordinate-Field
        }
```

--Record-ID-Number **see Edge-Record**

--Implicit-Relations-Pointer-Field **IRS**
--see Edge-Record

--Implicit-Attributes-Field **IAT**
--see Edge-Record

--Explicit-Attribute-Labels-and-Values-Field **ATT**
--see Edge-Record

--Coordinate-Field **COR**
--see Edge-Record

Withdrawn/Retirée

Dependency condition (list 10):

10-1 Elevation MBR subfield:
Minimum and maximum elevation must be transmitted if the transmitted coordinates (COR) contain elevation value(s).

B.9.5 Feature-Record

```
Feature-Record                                  --FL for line feature, FP for point feature,
                                                  --FA for area feature, FC for complex feature;
                                                  --for all levels of topology
        ::= [A 13] SEQUENCE   {
            [0] Record-ID-Number,
irs-f       [1] Implicit-Relations-Pointer-Field,
iat-f       [2]  Feature-Implicit-Attributes-Field,
att-fe      [3] Feature-Explicit-Attribute-Labels-and-Values-Field
                                                OPTIONAL,
            [4] SEQUENCE OF
r1l             Explicit-Relation-Pointers-Field    OPTIONAL
        }

--Record-ID-Number                              see Edge-Record

Feature-Implicit-Attributes-Field               --IAT-F
        ::= SEQUENCE   {
fac         [0] Basic-Text-String,              --FACC identifier code
iat-i       [1] Implicit-Attributes-Field       OPTIONAL,
            [2] Control-Point-Subfield          OPTIONAL
        }

--Implicit-Attributes-Field                     IAT
                                                --see Edge-Record

Control-Point-Subfield
        ::= SEQUENCE   {
glo         Real-Number,                        --Longitude/Easting of geographic reference point
gla         Real-Number                         --Latitude/Northing of geographic reference point
        }

Feature-Explicit-Attribute-Labels-and-Values-Field      --ATT-F
        ::= SEQUENCE OF
        SEQUENCE   {
            [0] Ordered-Rooted-Tree-Links       OPTIONAL,
                                                --see Dependency condition 11-2
att-f       [1] Explicit-Attribute-Labels-and-Values-Field
        }

Ordered-Rooted-Tree-Links
        ::= SEQUENCE OF
        SEQUENCE   {
llk         Integer-Number,                     --Left link
rlk         Integer-Number                      --Right link
        }

--Explicit-Attribute-Labels-and-Values-Field    ATT
                                                --see Edge-Record
```

Withdrawn/Retirée

```
Explicit-Relation-Pointers-Field                --R1L
        ::= SEQUENCE   {
ert             Basic-Text-String               --Relation type
r1v             Explicit-Relation-Value-Field
        }

Explicit-Relation-Value-Field                   --R1V
        ::=SEQUENCE OF
        SEQUENCE   {
rid-e           Integer-Number,                 --Record ID Number
sec-e           Basic-Text-String               OPTIONAL
                                                --Security
        }
```

Dependency conditions (list 11):

11-1 Elevation MBR subfields:
If any of the topological entities, composing or bordering the simple feature or any of the simple feature composing the complex feature, contains the elevation values in its coordinates field, maximum and minimum elevation values will be transmitted.

11-2 Left/Right Link:
Left and right link subfield will exist for all attributes, if there is at least one multi-level attribute.

B.9.6 Text-Placement-Record

```
Text-Placement-Record                           --TP
                                                --for all levels of topology
        ::= [A 14] SEQUENCE   {
            [0] Record-ID-Number,
irs-t       [1] Implicit-Relations-Pointer-Field    OPTIONAL,
att-t       [2] Explicit-Attribute-Labels-and-Values-Field
                                                OPTIONAL,
txt-t       [3] Text-Field,                     --Text
cor-t       [4] Coordinate-Field
        }

--Record-ID-Number                              see Edge-Record

--Implicit-Relation-Pointer-Field               IRS
                                                --see Edge-Record

--Explicit-Attribute-Labels-and-Values-Field    IRS
                                                --see Edge-Record

Text-Field                                      --TXT
ftx     ::= General-Text-String                 --Text

--Coordinate-Field                              COR
        --see Node-Record
```

Withdrawn/Retirée

B.9.7 Feature/Attribute-Entry-Record

```
Feature/Attribute-Entry-Record                --DD
        ::= [A 15] SEQUENCE   {
            Record-ID-Number,
dfa         Feature/Attribute-Entry-Field
        }

--Record-ID-Number                            see Edge-Record

Feature/Attribute-Entry-Field                 --DFA
        ::= SEQUENCE   {
faq         [0] Integer-Number,               --Feature or attribute ( 1 = Feature; 2 = Attribute )
lab         [1] Basic-Text-String,            --Feature code/name or Attribute label
sog         [2] Basic-Text-String             OPTIONAL,
                                              --Source for the feature or attribute
des         [3] Basic-Text-String             OPTIONAL,
                                              --Description of originator and/or source
fan         [4] Basic-Text-String             OPTIONAL,
                                              --Short name for the feature or attribute
def         [5] General-Text-String           --Attribute or feature definition
        }
```

B.9.8 Feature/Attribute-Association-Record

```
Feature/Attribute-Association-Record          --DF
        ::= [A 16] SEQUENCE   {
            Record-ID-Number,
daa         Feature-Association-Field,
aad         Attribute-Association-Field
        }

--Record-ID-Number                            see Edge-Record

Feature-Association-Field                     --DAA
lab-f   ::= Basic-Text-String                 --Feature label

Attribute-Association-Field                   --AAD
        ::= SEQUENCE OF
alb-f       Basic-Text-String                 --Attribute label
```

B.9.9 Attribute/Value-Association-Record

```
Attribute/Value-Association-Record            --DA
        ::= [A 17] SEQUENCE   {
            [0] Record-ID-Number,
dav         [1] Attribute-Format-Description-Field,
vad         [2] Attribute-Value-Description-Field   OPTIONAL
                                              --see Dependency condition 12-1
        }

--Record-ID-Number                            see Edge-Record
```

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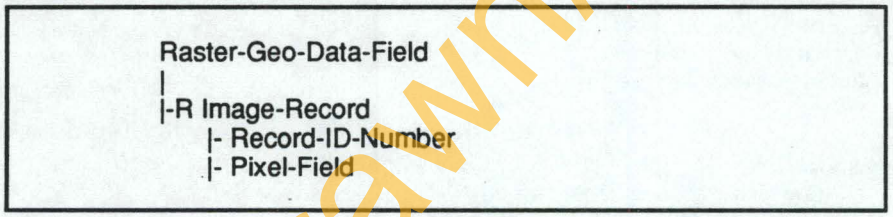
```
Attribute-Format-Description-Field          --DAV
        ::= SEQUENCE   {
lab-a       [0] Basic-Text-String,          --Attribute label
avt         [1] Basic-Text-String,          --enumerated "EN" or actual value "AV"
avf         [2] Basic-Text-String           OPTIONAL
                                              --Attribute value format
                                              --see Dependency condition 12-1
avu         [3] Basic-Text-String           OPTIONAL
                                              --Attribute measurement unit
                                              --see Dependency condition 12-1
        }

Attribute-Value-Description-Field           --VAD
        ::= SEQUENCE OF
        SEQUENCE   {
alb-v       Integer-Number,                 --Attribute values; enumerated values of Integer only
avd-v       General-Text-String             --Attribute value definition
        }
```

Dependency condition (list 12):

12-1 Attribute value format / Attribute measurement unit:
Depends on type of attribute.

B.10 Raster-Geo-Data-File




```
Raster-Geo-Data-File
        ::= [A 18] SEQUENCE OF
img         Image-Record
```

B.10.1 Image-Record

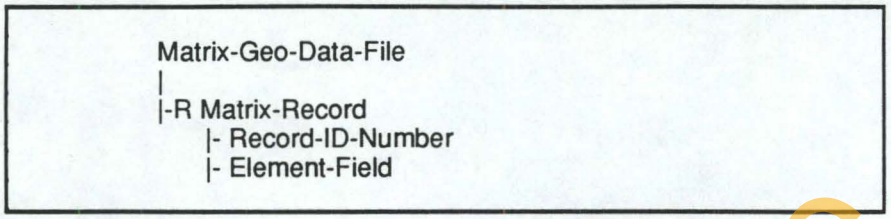
```
Image-Record                                --IMG
        ::= SEQUENCE   {
            Record-ID-Number,
scn         Pixel-Field
        }

--Record-ID-Number                          see Edge-Record

Pixel-Field                                 --SCN
        ::= OCTETSTRING                     --Pixel values
```

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B.11 Matrix-Geo-Data-File




```
Matrix-Geo-Data-File
        ::= [A 19] SEQUENCE OF
var             Matrix-Record
```

B.11.1 Matrix-Record

```
Matrix-Record                                   --VAR
        ::= SEQUENCE    :
                Record-ID-Number,
scn-m           Element-Field
        }

--Record-ID-Number                              --see Edge-Record

Element-Field                                   --SCN-M
        ::= OCTETSTRING                         --Element values
```

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C.1 ENCAPSULATION

The following paragraphs describe the encapsulation requirements of the VRF data structures. Discussion covers the primitive, feature class, coverage, library, and database levels. A description of a data quality table and the narrative table is also provided.

In order to fully understand the content of each data structure it is necessary to explain each table with a text description, definition table, and an example. These specifications pertain to each component description in this annex only.

C.1.1 TABLE DEFINITIONS

These column descriptions define the contents of each relational table. Each description example will contain five entries: column name, description, field type, key type, and whether the column is optional or mandatory (Op/Man). The asterisk (*) found in the column name item is a substitute for an associated feature or primitive table name which is provided by the product specification. "Null" in example tables refers to a valid VRF null for that field type as defined in Table C-XX. Example tables may not reflect the VRF requirement for consecutive row ids. Table C-1 is an example of the table definition style.

Table C-1 Table Definition Example

Column Name	Description	Field Type	Key Type	Op/Man
ID	Entity node primary key	I	P	M
*.PFT_ID	Feature id reference	I	N	OF
CONTAINING_FACE	Face containing the keynode (can be used as a key to face primitive table)	I	N	M3
FIRST_EDGE	(Null)	X	N	O
COORDINATE	Entity point coordinates	C	N	M

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Each table definition includes the following columns:

- **Field type.** This column in the definition table expresses the data type that the field must maintain in the VRF table. The encapsulation of these types is discussed in additional detail in Part 3—5 (see also C.10.1.5). For the purposes of this section, Table C-2 identifies field types.

Table C-2 Field Type Table

Field Type	Description
T,n	Fixed-length text
T,*	Variable-length text
L,n or L,*	Level 1 (Latin 1 - ISO 8859)
N,n or N,*	Level 2 (Full Latin - ISO 6937)
M,n or M,*	Level 3 (Multilingual - ISO 10646)
F,1	Short floating point
R,1	Long floating point
S,1	Short integer
I,1	Long integer
C,n	2-coordinate array short floating point
C,*	2-coordinate string
B,n	2-coordinate array long floating point
B,*	2-coordinate string
Z,n	3-coordinate array short floating point
Z,*	3-coordinate string
Y,n	2-coordinate array long floating point
Y,*	3-coordinate string
D,1	Date and time
X,1	Null field
K,1	Triplet id

[**Note**: The asterisk (*) indicates variable-length string. The "n" indicates a fixed-length; "n" is defined by the product specification. Type characters are case sensitive when used in table definitions.]

- **Key type.** VRF provides three key types. They are primary keys, unique keys, and non-unique keys. Columns identified as non-unique in this document may be changed to unique by a product specification. A product specification may also specify a length for any variable-length element, i.e., change any columns of type "*" to type "n." Table C-3 lists the key types. Any primary key may be referred to as a foreign key in another table.

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Table C-3 Key Table

Key	Description
P	Primary key
U	Unique
N	Non-Unique

- **Optional/mandatory**. This column will indicate the requirement or optionality of the column in VRF. For each column, there are several possibilities as shown in Table C-4. The code "OF" is used in a primitive table when direct pointers to the feature table, are desired to improve performance.

Table C-4 Optional/Mandatory Table

Column Name	Description
O	Optional
OF	Optional feature pointer
M	Mandatory
M<n>	Mandatory at level n topology (0–3)
MT	Mandatory if tiles exist

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C.1.2 RESERVED TABLE NAMES AND EXTENSIONS

Each VRF table has reserved name or suffix extension. Table C-5 lists the tables whose names cannot be modified or changed.

Table C-5 Reserved Table Names Table

File Name	Description
CAT	Coverage Attribute Table
CND	Connected Node Primitive
CSI	Connected Node Spatial Index
DHT	Database Header Table
DQT	Data Quality Table
EBR	Edge Bounding Rectangle
EDG	Edge Primitive
END	Entity Node Primitive
ESI	Edge Spatial Index
FAC	Face Primitive
FBR	Face Bounding Rectangle
FCA	Feature Class Attribute
FCS	Feature Class Schema Table
FCZ	FCS Variable-length Index
FSI	Face Spatial Index
GRT	Geographic Reference Table
LAT	Library Attribute Tablev
LHT	Library Header Table
NSI	Entity Node Spatial Index
RNG	Ring Table
TXT	Text Primitive
TSI	Text Spatial Index
CHAR.VDT	Character Value Description Table
INT.VDT	Integer Value Description Table

Table C-6 Reserved Directory Names Table

Directory Name	Description
LIBREF	Library reference coverage
DATAQUAL	Data quality coverage
TILEREF	Tile reference coverage
PRODSPEC	Product-specific directory
GAZETTE	Names placement coverage

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In a coverage directory, there are many feature class tables that have reserved suffixes. The product specification may define any eight-character prefix, following the naming conventions detailed in C.10.1.6. Any table that contains variable-length records must have a variable-length index associated with it. The index file shall have the same file name as the table, except that the last character of the suffix will be replaced by an "X". For example, a variable-length record for a road line table (ROAD.LFT) would have a variable-length index (ROAD.LFX). The one exception to this convention is the FCS, whose variable-length index shall be named "FCZ." Table C-7 lists the table suffixes.

Table C-7 Reserved Table Names Extensions Table

File Name Suffix	Description
.AET	Area to Edge Table
.AFT	Area Feature Table
.AJT	Area Join Table
.ATI	Area Thematic Index
.CFT	Complex Feature Table
.CJT	Complex Join Table
.CTI	Complex Thematic
.DOC	Narrative Table
.FIT	Feature Index Table
.FRT	Feature Relation Table
.LFT	Line Feature Table
.LJT	Line Join Table
.LTI	Line Thematic Index
.PFT	Point Feature Table
.PJT	Point Join Table
.PTI	Point Thematic Index
.TFT	Text Feature Table
.TTI	Text Thematic Index

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C.2 PRIMITIVES (Topological Entities)

There are three types of geometric primitives (topological entities) in VRF: nodes, edges, and faces. There are two classes of nodes, the entity (isolated) node and the connected node. In addition, text is used as a cartographic primitive. These four primitives, with the addition of feature tables, allow the modeling of geographic phenomena requiring vector geometry.

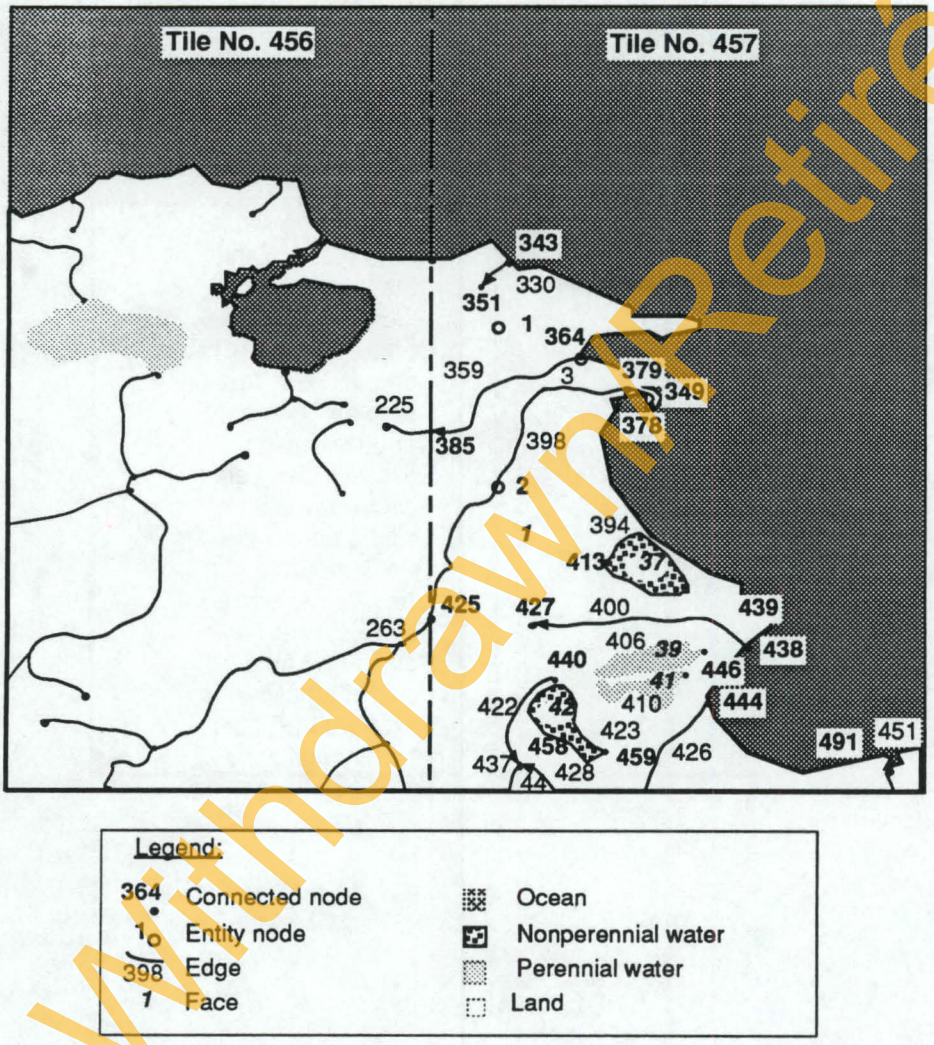


Figure C-1 Node, Edge and Face Primitives

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C.2.1 NODE PRIMITIVES

Two classes of node primitives are implemented: entity (isolated) nodes, which are free floating, and connected nodes, which occur only at edge ends. Both represent zero-dimensional locations.

C.2.1.1 ENTITY (ISOLATED) NODE PRIMITIVE

The entity (isolated) node primitive is composed of three mandatory columns: a primary key, a non-unique (to the face table) key, and the node coordinates. The FIRST_EDGE null column is included to maintain compatibility with the connected node primitive so that the format for a node primitive conceptually remains the same. The non-unique containing face key is only required for level 3 topology to maintain a topological relationship to the face that contains the node. A feature table may be referenced with this primitive table if a one-to-one relationship exists between the primary keys of each table. The optional feature (non-unique) key is used for this purpose. Table C-8 describes the meaning of the entity (isolated) node and indicates the necessary components in its construction. To relate to a feature table a *.PFT_ID column may be added in the entity node table.

Table C-8 Entity (Isolated) Node Definition Table

Column Name	Description	Field Type	Key Type	Op/Man
ID	Entity node primary key	I,1	P	M
*.PFT_ID	Feature id reference	I,1	N	OF
CONTAINING_FACE	Face containing the entity point, key to face primitive table	I,1	N	M3
FIRST_EDGE	Always null (included for compatibility)	X,1	N	O
COORDINATE	Entity point coordinates	C/Z/B/Y	N	M

To help understand the construction of the entity (isolated) node, Table C-9 illustrates the entity (isolated) nodes referenced in Figure C-1.

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.Table C-9 Example Entity (Isolated)Node Definition Table

Column Name	Contents
ID	1
DNPOINT.PFT	345
CONTAINING_FACE	1
FIRST_EDGE	null
COORDINATE	13.563, 37.843
ID	2
DNPOINT.PFT	346
CONTAINING_FACE	1
FIRST_EDGE	null
COORDINATE	12.752, 37.694

C.2.1.2 CONNECTED NODE PRIMITIVE

The connected node primitive is composed of four or five columns: a primary key, an optional feature pointer, a non-unique key (to the edge table), the node coordinates and the CONTAINING_FACE null column which is included to maintain compatibility with the connected node primitive. The non-unique key FIRST_EDGE is required for level 1 and higher topology levels to maintain a topological relationship to the edges which include the node.

The complete set of edges around a connected node may be assembled by following the appropriate edge information until the first edge reappears. A feature table may be referenced with this primitive table if a one-to-one relationship exists between the primary keys of each table. A connected node table is required for any coverage of topology level 1-3 containing an edge table. Table C-10 defines the contents of a connected node primitive.

Table C-10 Connected Node Definition Table

Column Name	Description	Field Type	Key Type	Op/Man
*ID	Node primary key	I,1	P	M
*.PFT_ID	Point feature table id	I,1	N	OF
CONTAINING_FACE	Always null (included for compatibility)	X,1	N	O
FIRST_EDGE	Edge key (key to the edge table)	I,1	N	M1–3
COORDINATE	Node coordinates	C,1	N	M

The connected nodes shown in Figure C-1 are partially described in Table C-11.

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Table C-11 Example Connected Node Table

Column Name	Contents
ID	343
CONTAINING_FACE	null
FIRST_EDGE	330
COORDINATE	10.08, 37.25
ID	351
CONTAINING_FACE	null
FIRST_EDGE	330
COORDINATE	10.05, 37.22
ID	425
CONTAINING_FACE	null
FIRST_EDGE	398
COORDINATE	10.00, 36.88

C.2.2 EDGE PRIMITIVE

The edge primitive represents the location of linear features and the borders of faces. The edge primitive table will include at least six columns for Level 1 and 2 topology and at least eight columns for Level 3 topology: a primary key; start and end nodes (keys to the connected node, if it exists); left and right face (keys to the face table, if it exists); left and right edge (keys within the same edge table); and the edge coordinates. For simplicity in drawing edges, the coordinates include the node coordinates at each end, regardless of the existence of a connected node primitive. Thus, the minimum length of the coordinate string is two pairs. A line feature table may be referenced with the edge primitive (optional feature pointer) if a one-to-one relationship exists between the primary keys. Annex C, Appendix 2 describes winged-edge topology in more detail.

- **Node information.** The keys to the connecting node table (if it exists) are required for level 1 and higher topology levels to maintain a topological relationship to the node connected to the edge. The start node indicates the beginning of the edge, and the coordinates define an edge cycle until the end node is reached.

- **Edge information.** Two keys, right and left edge, are required for level 1, 2, and 3 topology, establishing connectivity between each edge and its neighbouring edges in the coverage network. The right and left edge establish winged-edge topology for both line networks and faces. The right edge is the first edge, counterclockwise around the end node, from the current edge. The left edge is the first edge, counterclockwise around the start node, from the current edge. Isolated/Hanging Edges will always point to themselves at the node

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that does not connect to any other edge. Edges do not cross tile boundaries. If winged edges intersect a tile boundary, the tile id and external edge id will be carried in the triplet id.

- **Face information.** When faces are present, the right and left face columns are added to the edge primitive. Depending on the edge orientation, the face columns are assigned as being on the right or left side. When a face (except for face 1) is split by a tile boundary, the internal tile boundary is used to close the face on each tile. The tile id and external face id are also maintained in the triplet id.

In Table C-12, an edge table definition is described.

Table C-12 Edge Table Definition Table

Column Name	Description	Field Type	Key Type	Op/Man
ID	Edge primary key	I,1	P	M
*.LFT_ID	Line feature table ID	I,1	N	OF
START_NODE	Start node (key to the node primitive)	I,1	N	M1-M3
END_NODE	End node (key to the node primitive)	I,1	N	M1-M3
RIGHT_FACE	Right face (key to the face primitive)	K,1	N	M3
LEFT_FACE	Left face (key to the face primitive)	K,1	N	M3
RIGHT_EDGE	Right edge from end node (key to edge primitive)	K,1	N	M1-M3
LEFT_EDGE	Left edge from start node (key to edge primitive)	K,1	N	M1-M3
COORDINATES	Edge coordinates	C,*	N	M

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Table C-13 partially describes the edges found in Figure C-1.

Table C-13 Example Edge Table Definition Table

ID	LINE	SN	EN	RF	LF	REd	LEd	Coordinates Start Node...End Node
330	24505	343	351	1	1	330	330	10.08, 37.25...10.05, 37.22
349	24524	372	376	1	1	349	398	10.22, 37.11...10.23, 37.10
359	24534	364	385	1	1	359	359	10.13, 37.15...10.00, 37.07
394	24569	413	413	1	37	394	394	10.24, 36.95...10.24, 36.95
398	24573	425	372	1	1	349	398	10.00, 36.88...10.22, 37.11
400	24575	430	427	1	1	400	400	10.33, 36.85...10.12, 36.86
406	24581	438	438	1	39	406	406	10.20, 36.81...10.20, 36.81
410	24585	446	446	1	41	410	410	10.26, 36.77...10.26, 36.77
422	24597	440	458	1	1	437	422	10.15, 36.80...10.11, 36.72
423	24598	459	459	42	1	423	423	10.18, 36.72...10.18, 36.72
426	24601	444	462	1	1	430	426	10.30, 36.78...10.24, 36.69
428	24603	466	458	1	44	422	19	10.14, 36.64...10.11, 36.72
437	24612	458	477	1	44	439	428	10.11, 36.72...10.03, 36.55
451	24626	491	457	1	1	51	451	10.39, 36.50...10.47, 36.72

Note: LINE = *.LFT_ID, SN = START_NODE, EN = END_NODE, RF = RIGHT_FACE, LF = LEFT_FACE, REd = RIGHT_EDGE, LEd = LEFT_EDGE. Only start and end node coordinates are shown, although all coordinates would actually be present in this variable-length column.

C.2.3 FACE PRIMITIVE

Faces are defined as planar graphs. All faces are defined by one or more rings, which are connected chains of edges that compose the face border. Each ring starts with a reference to a particular edge, traveling in a specific direction. Then the left and right edge columns on the edge primitive are traversed until the ring returns to its starting edge. All faces have a unique ring, called the outer ring, which bounds the exterior. Any object with two or more exterior rings must be treated as a complex feature. Some faces require internal rings (inner rings) to remove areas that belong to faces totally enclosed by another face. There is no upper limit on the number of inner rings; therefore a separate structure is required, called the ring table (see below). A ring within a ring contained within a face (e.g., a lake on an island that is contained in a larger lake) has no explicit topologic relation to the outer face (the larger lake). Face primitives consist of the following components.

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C.2.3.1 FACE TABLE

The face table contains at least two columns, where the primary key id identifies the face and the RING_PTR column points to the outer ring in the ring table. The face table contains one face per row id. Face Id 1 is reserved for the universe polygon in the face table; it will never correspond to a feature in the feature table. The outer ring of the universe is unbounded as infinity and can never be drawn. All features within a coverage can thus be thought of as islands or inner rings with respect to Face Id 1. Table C-14 illustrates a face table structure.

Table C-14 Face Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Face primary key	I,1	P	M3
*.AFT_ID	Area feature table ID	I,1	N	OF
RING_PTR	Key to ring table	I,1	N	M3

Note that whenever faces are present in the database, level 3 topology is established by default. Table C-15 depicts an example of the face table.

Table C-15 Face Table Example

Column Name	Contents
ID	1
DNAREA.AFT_ID	null
RING_PTR	1
ID	2
DNAREA.AFT_ID	4571
RING_PTR	37
ID	3
DNAREA.AFT_ID	4572
RING_PTR	38

C.2.3.2 RING TABLE

A ring is a concatenation of edges joined so that they form a closed loop. The direction of digitization need not be consistent with the direction of the sequence of edges in the list, thus the Start Node of one edge may also be the Start Node of its neighbour. Table C-16 defines ring table structure.

A face is defined by an outer ring and zero or more inner rings. The outside ring of a face has a clockwise direction of traversal and is the first ring listed in the ring table for that FACE_ID. Inner rings have a counter-clockwise direction of traversal. An example is provided as Figure C-2. In this example, Face 2 has an outer ring (Ring 1) and one inner ring (Ring 2). The outer ring is

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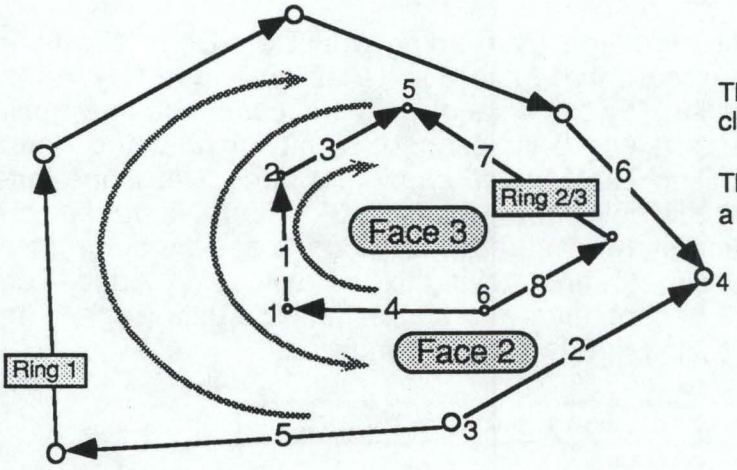
traversed in the clockwise direction by reading the Start Edge (Edge 2), determining from the edge record that Face 2 is its left face, and reading the previous left edge id (Edge 5). The traversal of Ring 1 is continued in a similar fashion until Edge 2 (the start edge) is reached, signifying that the ring is complete. A query of the Ring Table would show that Face 2 has one inner ring, Ring 2 (note that Ring 2 is coincident with Ring 3). Ring 2 is traversed in a counter-clockwise direction by reading the Start Edge (Edge 1), determining that Face 2 is to the left of Edge 1, and moving to its previous left edge, Edge 4. The traversal of Ring 2 is continued in a similar fashion until Edge 1 (the start edge) is reached, signifying that the ring is complete.

Table C-16 Ring Table Structure

Column Name	Description	Field Type	Key Type	Op/Man
ID	Ring primary key	I,1	P	M3
FACE_ID	Face id (row id from face table)	I,1	N	M3
START_EDGE	First edge in the ring key to edge primitive)	I,1	N	M3

NOTE: The START_EDGE for Ring 1, which always corresponds to Face 1, is null.

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The outer ring of a face is traversed in a clockwise direction.

The inner rings of a face are traversed in a counter-clockwise direction

Edge Table (Partial)

ID	Start Node	End Node	Right Face	Left Face	Right Edge	Left Edge
1	1	2	3	2	3	4
2	3	4	1	2	6	5
3	2	5	3	2	7	1
4	6	1	3	2	1	8

Face Table (Partial)

ID	Area ID	Ring Ptr
2	-	1
3	-	3

Ring Table

ID	Face ID	Start Edge
1	2	2
2	2	1
3	3	1

Figure C-2 Ring Traversal Illustration

Withdrawn/Retirée

Table C-17 depicts rings from Figure C-1.

Table C-17 Example Ring Table

Column Name	Contents
ID FACE_ID START_EDGE	1 1 null
.. .. ..	
ID FACE_ID START_EDGE	18 1 394
.. .. ..	
ID FACE_ID START_EDGE	37 2 36

Note: Gaps in row sequence have been left to permit coding for rings from different faces to be illustrated.

C.2.4 TEXT PRIMITIVE

Text is implemented to allow the representation of names associated with vague or ill defined regions, such as the Appalachian Mountains. The text primitive is normally composed of three items, a primary key, the text string, and a coordinate string defining a shape line. Optional attributes may also be associated with the primitive, such as colour or height. A feature table may be referenced with this primitive table if a one-to-one relationship exists between the primary keys of the tables.

The shape line must contain at least one coordinate pair. Under this condition, it represents the lower left coordinate and orientation is controlled by defaults (minimum readable text and parallel to X axis.) In order to specify orientation, two coordinates pairs must be entered. The second pair defines the lower right of the string. Some fonts have ascenders and descenders which extend above or below the shape line. Third and subsequent points provide control points in the shape line. Individual characters along the string can be oriented in a smoothed rendition of the cubic spline or other curve-fitting function. Table C-18 defines the text primitive table structure.

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Table C-18 Text Primitive Structure

Column Name	Description	Field Type	Key Type	Op/Man
ID	Text primary key	I,1	P	M
*.TFT_ID	Text feature id	I,1	N	OF
STRING	The text string	T,*	N	M
SHAPE_LINE	The shape line	C/Z/B/Y,*	N	M

Table C-19 is an example of a text primitive table.

Table C-19 Example Text Primitive Table

Column Name	Contents
ID	1
DNTEXT.TFT_ID	529
STRING	Fiume Salso
SHAPE_LINE	14.41,37.74 14.45,37.73 14.52,37.69 14.60,37.69
ID	2
DNTEXT.TFT_ID	530
STRING	Simeto
SHAPE_LINE	14.80,37.71 14.81,37.68 14.80,37.66 14.81,37.65
ID	3
DNTEXT.TFT_ID	531
STRING	Belice
SHAPE_LINE	12.91,37.69 12.93,37.71 12.95,37.73

C.2.5 BOUNDING RECTANGLE TABLE

Both the edge and face primitive require a bounding rectangle for each record in their table. The definition found in Table C-20 is used for both the face and edge bounding rectangle tables. Since the outer ring of the universe face (face 1) is a topological artifact that does not have a geometric representation, the FBR for face 1 should contain nulls for XMIN, YMIN, XMAX, and YMAX.

Table C-20 Bounding Rectangle Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
XMIN	Minimum x coordinate	F/R,1	N	M
YMIN	Minimum y coordinate	F/R,1	N	M
XMAX	Maximum x coordinate	F/R,1	N	M
YMAX	Maximum y coordinate	F/R,1	N	M

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Table C-21 is an example of a face bounding rectangle table.

Table C-21 Example Bounding Rectangle Table

Column Name	Contents
ID	1
XMIN	null
YMIN	null
XMAX	null
YMAX	null
ID	2
XMIN	12.31
YMIN	37.97
XMAX	13.31
YMAX	37.99
ID	3
XMIN	14.54
YMIN	37.83
XMAX	14.58
YMAX	37.85

C.3 FEATURE CLASS

A feature class is composed of a variety of tables containing geometric, topologic, and attribute data. Complex feature relationships can be defined. Some features may require a single feature and associated primitive table, while others may need multiple tables linking features into a complex hierarchy. Note that the feature class definition is provided by a product specification.

Constructing feature classes requires the use of feature tables. If necessary, the feature class definition may require the use of a feature join table to accurately construct the feature in relational form. Annex C, Appendix 3 describes feature class relationships in greater detail.

C.3.1 FEATURE TABLES

A basic feature table consists of a feature identifier and one or more attribute columns. The specific nature of the attribute shall be described in a product specification. Each table represents a set; each row represents an element in that set. The row is identified with a primary key. Tables C-22 through C-28 define feature table contents for non-compound features.

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If the coverage is tiled, the feature table maintains two columns that identify the tile id and primitive id that are related to the feature. This column is named after the primitive table it relates to, followed by "_ID." The first field is the tile id (found in the tile reference coverage); the second field is the primitive row id in that tile.

All feature class definitions fall into one of five categories: area, line, point, text, or complex feature tables.

- **Area feature.**

  [Level 3] An area feature is composed of face primitives which relate to edge primitives.

Table C-22 Area Table Definition (Level 3)

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref id	S,1	N	MT[1]
FAC_ID	Primitive id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O

Notes:

1. If a primitive id column is of type K, then no tile reference column is required.

[Levels 2, 1, 0] An area feature is defined by a set of edges which are located in the Area_to_Edge table. This table list the edges in sequence moving in a clockwise direction around the outer most boundary of the area and counter clockwise around the boundaries of any inner areas or voids.

Table C-23 Area Table Definition (Levels 2, 1, 0)

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref id	S,1	N	MT[1]
AtoE_ID	Area to edge id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O

Notes:

1. If a primitive id column is of type K, then no tile reference column is required.

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Table C-24 Area_to_Edge Feature Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref ID	S,1	N	MT[1]
EDGE ID	Edge Primitive ID	S/I 1	N	M
Forward/Reverse	Edge Direction See Part 2 para. 11.1.4.2	T,1	N	M
FEAT ID	*.AFT	Any	Any	M

Notes:

1. If a primitive id column is of type K, then no tile reference column is required.

The implied Ring Construct table denotes an area feature.

Attributes associated with areal contexts may be retained, such as perimeter, diameter, size, or volume. For instance, in level 3, a surface material feature will be defined by face primitives and will have various descriptive attributes (such as surface material type, size of feature in square units, soil type, or canopy closure).

- **Line feature** Line features are composed of edge primitives. The primitive id column name will be EDG_ID. A linear river feature will typically contain attributes such as; jurisdiction, depth, and width. FROM_TO is an optional column used to provide directionality of a line feature with respect to it edge primitive(s). A FROM_TO value of 1 means the feature has the same orientation as its related edge(s); a value of -1 means the feature the opposite orientation.

Table C-25 Line Table Definition.

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref id	S,1	N	MT[1]
EDG_ID	Primitive id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O
FROM_TO	Line feature orientation	S,1	N	O

Notes:

1. If a primitive id column is of type K, then no tile reference column is required.

- **Point feature**. A point feature class contains node primitives, but can have numerous attributes describing the feature. The primitive column name will be END_ID or CND_ID. An airport point feature, for example, may contain many attributes such as the number of runways, number of terminals, elevation, and size.

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Table C-26 Point Table Definition.

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref id	S,1	N	MT[2]
*_ID[1]	Primitive id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O

Notes:

1. The asterisk (*) indicates a placeholder for the primitive table name: END or CND. If a join table exists, both the TILE_ID and *_ID columns will be found there.
2. If a primitive id column is of type K, then no tile reference column is required.

- **Text feature.** A text feature class is composed of a text primitive. The primitive column name will be TXT_ID. The text feature usually contains additional attributes, such font, colour, and font size.

Table C-27 Text Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
TILE_ID	Tile Ref id	S,1	N	MT[1]
TXT_ID	Primitive id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O

Notes:

1. If a primitive id column is of type K, then no tile reference column is required.

- **Complex feature.** Complex features can be created in many fashions, depending on the product specification. For instance, using other feature tables and primitives, geographic entities can be defined using complex features. The previous airport example could be redefined to include point, line, and area feature classes, when this composition is required for specified applications.

Table C-28 Complex Feature Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature primary key	I,1	P	M
*_ID[1]	Feature id	S/I,1	N	M
<AttributeN>	nth attribute	Any	Any	O

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Notes:

1. The asterisk (*) indicates a placeholder for the feature table name: PFT, LFT, AFT, CFT, or TFT. If a join table exists, both the TILE_ID and *_ID columns will be found there.

Feature may have distinct relations such as stacked/on, stacked/under, or alternative representations. When preserving this type of information an optional relations table may be invoked. Table C-29 describes feature relations.

Table C-29 Feature Relations Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	record id number	I,1	P	M
Fea1_id	id of feature which has a relation	Any	Any	M
Rel_Type	type of relationship (STK or STU, ALT	T,*	Any	M
Fea2_id	id of feature to which the relationship applies	Any	Any	M

The full implementation of ALT may involve relations between separate databases. Therefore, the relations must be passed along through database\library\coverage paths. An example of this type of relation is as follows:

1.	VMAP1\LIBRARY\BND\BRIDGEL.LFT	ALT	VMAP2\LIBRARY\DATABASE\BRIDGEP.PFT

When relation type is ALT and occurring on the same layer, then database\library\coverage paths are null.

C.3.2 FEATURE JOIN TABLES

Feature join tables are used to combine multiple feature tables into the relational form. These join tables allow a variety of constructions to be made, usually with one or more feature tables and one or more primitive tables. A feature join table connects the rows of the feature table with the rows of another feature or primitive table. Unlike feature tables, which have four categories (area, line, point, and complex), the join table is distinct. It may be used with each of the four types of feature tables, but does not require categories itself. Table C-30 defines feature join table contents.

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Table C-30 Feature Join Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
<*>_ID[1]	Feature key	I,1	N	M
Tile_ID	Tile reference id	I/S,1	N	MT/O
<**>_ID[2]	Feature or primitive primary key	I/S,1	N	M
FROM_TO	Linear feature orientation	S,1	N	O[3]

Notes:

1) The (*) indicates a placeholder for the name of the first table in the join, usually a feature class table name.
2) The (**) indicates a placeholder for the table name of the second table in the join, usually one of EDG, FAC, END, CND, or TXT.
3) Optional for line feature tables only. If a join table exists, the FROM_TO column will be found there.

A join table is used to relate one column in a table with a column in a second table. This is common when a 1:N or N:M relationship exists between the two tables. Thus, for example, if a complex feature has 1:N relations with four simple features each of different types, then four join tables are required.

The second column, defining the key in the first table, is the table's name followed by "_ID." The third column describes the primary key in the second table, and is defined in the same manner. For instance, in a feature table (DNPOINT.PFT) relating to a primitive (END), the linking key is DNPOINT.PFT_ID and the primary key is END_ID. The feature class schema table is used to express the column names for the join table.

C.4 COVERAGE

The coverage defines a set of feature classes that are interrelated using a given topology. Each coverage has one set of topological primitives and the collection of feature tables based upon these topological objects. All these tables are stored in one directory and are associated by file naming conventions (see C.1.2). The coverage will maintain a data dictionary for each feature table. It is possible to locate a coverage level data quality table, but this is optional.

C.4.1 COVERAGE RELATIONSHIPS

The general description of a coverage is stored in the coverage attribute table of its library. The relationships between the tables in a coverage are described by the mandatory feature class schema table.

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C.4.2 FEATURE CLASS SCHEMA TABLE

A feature class schema table defines the feature classes that are contained within the coverage. Each entry in the table specifies a feature class name, the name of the two tables involved, and the names of the columns being related. The feature name may be repeated to specify all the relationships in the feature table. The topological relationships need not be specified, since they are implied by table types. An entry in the feature class schema table implies that the logical consistency of the relationship has been assured. VRF requires structural integrity of these relationships. Table C-31 defines feature class schema contents.

Table C-31 Feature Class Schema Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
FEATURE_CLASS	The name of the feature class	T,8	N	M
TABLE1	The first table in a relationship	T,12	N	M
TABLE1_KEY	Join column in the first table	T,*	N	M
TABLE2	The second table in a relationship	T,12	N	M
TABLE 2_KEY	Join column in the second table	T,*	N	M

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Table C-32 is an example of a feature class table.

Table C-32 Example Feature Class Table

Column Name	Contents
ID	1
FEATURE_CLASS	SDRPOINT
TABLE1	SDRPOINT.PFT
TABLE 1_KEY	ID
TABLE2	END
TABLE 2_KEY	ID
ID	2
FEATURE_CLASS	SDRLINE
TABLE1	SDRLINE.LFT
TABLE 1_KEY	ID
TABLE2	EDG
TABLE 2_KEY	ID
ID	3
FEATURE_CLASS	SDRAREA
TABLE1	SDRAREA.AFT
TABLE 1_KEY	ID
TABLE2	FAC
TABLE 2_KEY	ID

C.4.3 VALUE DESCRIPTION TABLE

A value description table relates to associated feature class tables within a coverage. VDTs are required when coded attribute values are implemented within a coverage. There are two types of VDTs: integer and character. There will be no more than one of each type of VDT per coverage. If a column in a feature table requires a VDT, then every unique column value will have an entry in the VDT. If the table entry in a particular row in a VDT is set to Null, then the description associated with that entry is applicable to all tables that reference the VDT. Certain values (e.g., null or unknown) that are globally defined for all columns may not appear in a VDT; however, they will be documented in the product specifications. Table C-33 defines the format of a VDT.

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Table C-33 Value Description Definition Table

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
TABLE	Name of the feature table	T,12	N	M
ATTRIBUTE	Attribute column name	T,16	N	M
VALUE	Unique value of attribute	I/S/T,n	N	M
DESCRIPTION	Description of attribute value	T,*	N	M

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Table C-34 provides an example.

Table C-34 Example Value Description Table

Column Name	Contents
ID	1
TABLE	SDRPOINT.PFT
ATTRIBUTE	MCC
VALUE	0
DESCRIPTION	UNKNOWN
ID	2
TABLE	SDRPOINT.PFT
ATTRIBUTE	MCC
VALUE	2
DESCRIPTION	CONCRETE
ID	3
TABLE	SDRPOINT.PFT
ATTRIBUTE	MCC
VALUE	30
DESCRIPTION	EARTHEN
ID	4
TABLE	SDRPOINT.PFT
ATTRIBUTE	HYC
VALUE	0
DESCRIPTION	UNKNOWN
ID	5
TABLE	SDRPOINT.PFT
ATTRIBUTE	HYC
VALUE	6
DESCRIPTION	NON-PERENNIAL
ID	6
TABLE	SDRPOINT.PFT
ATTRIBUTE	HYC
VALUE	30
DESCRIPTION	DRY

C.5 LIBRARY

The function of a VRF library is to organize collections of coverages that pertain to one geographic region. In addition, a library must share one tiling scheme, if tiling is required. Each library must manage its own spatial extent. VRF uses a bounding rectangle to define this geographic extent and VRF also supports a coverage, the library reference coverage, which describes the library region in a graphical manner. All reference coverages must be spatially registered and be in the same coordinate system.

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Within each library, there are three mandatory tables. The library header table defines the contents of the library. The geographic reference table contains information pertaining to the geographic location of the library. A coverage attribute table lists the type of coverages contained in the library.

If the library is tiled, there will be an untiled tile reference coverage. There will also be an untiled library reference coverage that gives a general overview of the information contained in the library. In addition, it is possible to include a data quality coverage. The format for the data quality and library reference coverage follow the same rules as any normal VRF coverage. See Annex C, Appendix 5 for information concerning recommended data quality coverage contents.

If required, multiple records in each table can be used to describe more than one source, update, maintenance, etc.

C.5.1 LIBRARY HEADER TABLE

The library header table contains information identifying the library, general information about the contents, security, and source. Table C-35 describes the group of entities that compose the library header table. There will be as many rows as necessary to describe source(s) used.

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Table C-35 Library Header Table Definition

Column Name	Description of Contents	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
PRODUCT_TYPE	Series designator of product type	T,12	N	M
LIBRARY_NAME	Name of library	T,12	N	M
DATA_STRUCT_CODE	Highest level code for the library: 5 = Level 0 topology 6 = Level 1 topology 7 = Level 2 topology 8 = Level 3 topology	T,1	N	M
SCALE	Source scale of the library (i.e. 200) using the representative fraction denominator	I,1	N	M
SOURCE_SERIES	Series designator (e.g., 1501)	T,15	N	M
SOURCE_ID	Source id - number or name, that when used in conjunction with the series and edition, will identify a unique source	T,30	N	M
SOURCE_EDITION	Source edition number	T,20	N	M
SOURCE_NAME	Full name of source document	T,100	N	M
SOURCE_DATE	Significant date. A designed date that most accurately describes the basic date of the product for computation of the probable obsolescence date. It can be the compilation date, revision date, or other depending on the product and circumstances	D,1	N	M
SECURITY_CLASS	Security classification of the source: T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY"; administrative classification only) U = UNCLASSIFIED	T,1	N	M
DOWNGRADING	Originator's permission for downgrading required (yes or no)	T,3	N	M
DOWNGRADING_DATE	Date of downgrading (null if answer to previous entity is yes)	D,1	N	M
RELEASABILITY	Releasability restrictions	T,20	N	M

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C.5.2 GEOGRAPHIC REFERENCE TABLE

Table C-36 contains four fields that define the geographic parameters of the library, namely the geographic parameters, projections, registration points, and diagnostic points. The geographic parameters in this table serve two purposes. Firstly, they provide descriptive documentation of the coordinate reference system used in the database. Secondly, they allow multiple separately published libraries to be inversely projected into a common coordinate system for display and query. If the database is maintained in unprojected geographic coordinates, then the projection code and its corresponding projection parameters need not be included in the table. Refer to Part 3 for a valid list of projection codes and parameters. The rows of this table will be repeated for all occurrences of diagnostic and reference points necessary.

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Table C-36 Geographic Reference Table Definition

Column Name	Description of Contents	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
DATA_TYPE	Type of data in the library (GEO)	T,3	N	M
UNITS	Units of measure for this library	T,3	N	M
ELLIPSOID	Name of ellipsoid of the library	T,15	N	M
ELLIPSOID_DETAIL	Details about library ellipsoid including ellipsoid code	T,50	N	M
VERT_DATUM_REF	Name of vertical reference	T,15	N	M
VERT_DATUM_CAT	Category of vertical datum reference	T,4	N	M
SOUND_DATUM	Name of sounding datum	T,15	N	M
SOUND_DATUM_CAT	Category of vertical datum reference for soundings	T,4	N	M
GEO_DATUM_NAME	Name of geodetic datum	T,15	N	M
GEO_DATUM_CODE	Code of geodetic datum	T,4	N	M
PROJECTION_NAME	Name of the projection	T,20	N	M
PROJECTION_CODE	Code of the projection, if any; null if geographic coordinates	T,2	N	O
PARAMETER1	Projection parameter 1	F,1	N	O
PARAMETER2	Projection parameter 2	F,1	N	O
PARAMETER3	Projection parameter 3	F,1	N	O
PARAMETER4	Projection parameter 4	F,1	N	O
FALSE_ORIGIN_X	False Easting origin of projection	F,1	N	O
FALSE_ORIGIN_Y	False Northing origin of projection	F,1	N	O
FALSE_ORIGIN_Z	False origin for Z values	F,1	N	O
REG_PT	Registration point id	T,10	N	O
REG_LONG	Longitude of registration point	T,15	N	O
REG_LAT	Latitude of registration point	T,15	N	O
REG_Z	Elevation of registration point	T,5	N	O
REG_TABLE_X	X table coordinate of control pts	T,15	N	O
REG_TABLE_Y	Y table coordinate of control pts	T,15	N	O
REG_TABLE_Z	Z table coordinate of control pts	T,15	N	O
DIAG_PT	Diagnostic point id	T,10	N	O
DIAG_LONG	Longitude of diagnostic point	T,15	N	O
DIAG_LAT	Latitude of diagnostic point	T,15	N	O
DIAG_Z	Elevation of diagnostic point	T,5	N	O
DIAG_TABLE_X	X table coordinate of diagnostic pts	T,15	N	O
DIAG_TABLE_Y	Y table coordinate of diagnostic pts	T,15	N	O
DIAG_TABLE_Z	Z table coordinate of diagnostic pts	T,15	N	O

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C.5.3 COVERAGE ATTRIBUTE TABLE

Each library will contain a set of coverages. Each coverage will have a name and a pathname to its associated subdirectory. In the case of tiled coverages, the library does not store the explicit pathname, but it does identify the logical existence of a coverage under that path under each tile directory. The topological level associated with each coverage determines the nature of geometric and topological information available on that coverage. Table C-37 defines the coverage attribute table.

Table C-37 Coverage Attribute Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	U	M
COVERAGE_NAME	The coverage name	T,8	P	M
DESCRIPTION	Description string	T,*	N	M
LEVEL	The topologic level	I,1	N	M

Table C-38 is an example of a coverage attribute table.

Table C-38 Example Coverage Attribute Table

Column Name	Contents
ID	1
COVERAGE_NAME	SLP
DESCRIPTION	Surface Configuration
LEVEL	3
ID	2
COVERAGE_NAME	VEG
DESCRIPTION	Vegetation
LEVEL	3
ID	3
COVERAGE_NAME	SMC
DESCRIPTION	Surface Materials
LEVEL	3
ID	4
COVERAGE_NAME	SDR
DESCRIPTION	Surface Drainage
LEVEL	3
ID	5
COVERAGE_NAME	TRN
DESCRIPTION	Transportation
LEVEL	2
ID	6
COVERAGE_NAME	OBS
DESCRIPTION	Obstacles
LEVEL	2

Withdrawn/Retirée

C.5.4 TILE REFERENCE COVERAGE

For the most part, a library will contain tiled partitions, and will require a tile index coverage with associated feature attribute tables. Thus, if the tile reference coverage does not exist in a library, then no tiling scheme exists. The tile reference coverage consists of a set of faces identifying the tiles that the library uses to subdivide the region of interest. Tile attributes are used to optimize retrievals. At the library level, the tile geometry is simple, describing the location of the tile boundaries.

C.5.5 TILE ATTRIBUTES

The tile attributes are located in the area feature table (AFT) of the tile reference coverage. This table maintains a unique id and its associated tile directory name. This directory name may contain a nested directory list or pathname, relative to the coverage level. If a pathname is required, the separator character will be a backslash (\ ). Additional columns may exist for every feature class or coverage located in the library, but this is optional. The id of the area feature table will be used in the tile and primitive id for each coverage feature table (see C.3.1).

Table C-39 defines tile attribute columns.

Table C-39 Tile Reference Area Feature Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Tile primary key	I,1	P	M
TILE_NAME	Tile directory name	T,n	U	M
FAC_ID	Face primitive id	S/I/K,1	N	M

Note: The length of the Tile Name must be 64 characters or less.

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Table C-40 is an example of a tile area feature table.

Table C-40 Example of Reference Area Feature Table

Column Name	Contents
ID	1
TILE_NAME	M\J\12
FAC_ID	5
ID	2
TILE_NAME	M\J\22
FAC_ID	7
ID	3
TILE_NAME	M\J\23
FAC_ID	6
ID	4
TILE_NAME	M\J\24
FAC_ID	3

C.6 DATABASE

Information that applies to the whole collection of data belongs at the database level. Structurally, a database consists of a set of libraries. It is possible to include a data quality coverage. The format for the data quality coverage follows the same rules as any normal VRF coverage. See Annex C, Appendix5 for information concerning recommended data quality coverage content.

There are two mandatory tables: the library attribute table and the database header table. These two tables are described below.

C.6.1 LIBRARY ATTRIBUTE TABLE

This attribute table contains the name and extent for each library in the database. The library extents shall be a minimum bounding rectangle in latitude and longitude (decimal degrees). Table C-41 defines library attribute entities.

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Table C-41 Library Attribute Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	U	M
LIBRARY_NAME	Library name	T,8	P	M
XMIN	Minimum x coordinate	F/R,1	N	M
YMIN	Minimum y coordinate	F/R,1	N	M
XMAX	Maximum x coordinate	F/R,1	N	M
XMAX	Maximum y coordinate	F/R,1	N	M

Table C-42 is an example of a library attribute table.

Table C-42 Example Library Attribute Table

Column Name	Contents
ID	1
LIBRARY_NAME	TD
XMIN	-97.75
YMIN	31.167
XMAX	-97.667
YMAX	31.25

C.6.2 DATABASE HEADER TABLE

Table C-43 contains information that defines database contents and security information.

Table C-43 Database Header Table Definition

Column Name	Description of Contents	Column Type	Key Type	Op/Man
ID	Row id	I,1	P	M
VRF_VERSION	VRF version number	T,10	N	M
DATABASE_NAME	Directory name of the database	T,8	N	M
DATABASE_DESC	Text description of the database	T,100	N	M
MEDIA_STANDARD	Media standard used for the database	T,20	N	M
ORIGINATOR	Text for title and address of originator (a backslash "\" is used as a line separator)	T,50	N	M
ADDRESSEE	Text for title and address of addressee (a backslash "\" is used as a line separator)	T,100	N	M
MEDIA_VOLUMES	Number of media volumes comprising the database	T,*	N	M
SEQ_NUMBERS	Sequential number(s) for each	T,*	N	M

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	media volume in this database			
NUM_DATA_SETS	Number of libraries within database	T,*	N	M
SECURITY_CLASS	Security classification of database (the highest security classification of the transmittal including all datasets within the database) T = TOP SECRET S = SECRET C = CONFIDENTIAL R = RESTRICTED (or alternatively "FOR OFFICIAL USE ONLY") U = UNCLASSIFIED	T,1	N	M
DOWNGRADING	Originator's permission for downgrading required (yes or no)	T,3	N	M
DOWNGRADE_ DATE	Date of downgrading	D,1	N	M
RELEASABILITY	Releasability restrictions	T,20	N	M
OTHER_STD_ NAME	Free text, note of other standards compatible with this database	T,50	N	O
OTHER_STD_ DATE	Publication date of other standard	D,1	N	O
OTHER_STD_VER	Other standard amendment number	T,10	N	O
TRANSMITTAL_ID	Unique id for this database	T,*	N	M
EDITION_NUMBER	Edition number for this database	T,10	N	M
EDITION_DATE	Creation date of this database	D,1	N	M

C.7 DATA QUALITY

The data quality table may be stored at the database, library, or coverage level. It contains information on the completeness, consistency, date status, attribute accuracy, positional accuracy, and other miscellaneous quality information. It also contains information about the source from which the geographic data was derived. Lineage information should be included in the associated narrative table, named "LINEAGE.DOC." While the contents and location of a data quality table within a VRF database are product specific, it is highly recommended that at least one table exist at the library level. Annex C, Appendix5 contains more information about storing data quality information in VRF. Table C-44 defines the contents of the data quality table.

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Table C-44 Data Quality Table Definition

Entity Name	Description of Contents	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
VRF_LEVEL	Either database, library, coverage	T,8	N	M
VRF_LEVEL_NAME	Name of database, library, coverage	T,8	N	M
FEATURE_COMPLETE	Feature completeness percent	T,*	N	M
ATTRIB_COMPLETE	Attribute completeness percent	T,*	N	M
LOGICAL_CONSIST	Logical consistency	T,*	N	M
EDITION_NUM	Edition number of data set	T,8	N	M
CREATION_DATE	Date of creation of data set	D,1	N	M
REVISION_DATE	Date of revision of data set	D,1	N	M
SPEC_NAME	Name of product specification (e.g., DCW)	T,*	N	M
SPEC_DATE	Date of product specification	D,1	N	M
EARLIEST_SOURCE	Date of earliest source	D,1	N	M
LATEST_SOURCE	Date of latest source	D,1	N	M
QUANT_ATT_ACC	Standard deviation of quantitative attributes	T,*	N	O
QUAL_ATT_ACC	Percent reliability of qualitative attributes	T,*	N	O
COLLECTION_SPEC	Name of collection specification	T,*	N	M
SOURCE_FILE_NAME	Name of included source file	T,12	N	O
ABS_HORIZ_ACC	Absolute horizontal accuracy of database, library, or coverage horizontal accuracy	T,*	N	M
ABS_HORIZ_UNITS	Unit of measure for absolute horizontal accuracy	T,20	N	M
ABS_VERT_ACC	Absolute vertical accuracy of database, library, or coverage	T,*	N	M
ABS_VERT_UNITS	Unit of measure for absolute vertical accuracy	T,20	N	M
REL_HORIZ_ACC	Point to point horizontal accuracy of database, library, or coverage	T,*	N	M
REL_HORIZ_UNITS	Unit of measure for point to point horizontal accuracy	T,20	N	M
REL_VERT_ACC	Point to point vertical accuracy of database, library, or coverage	T,*	N	M
REL_VERT_UNITS	Unit of measure for point to point vertical accuracy	T,20	N	M
COMMENTS	Miscellaneous comments - free text	T,*	N	M

Withdrawn/Retiree

C.8 NARRATIVE TABLE

The narrative table will contain any descriptive information about a related table. The contents of the TEXT column will be product specific.

Table C-45 Narrative Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
TEXT	Text information	T,*	N	M

C.9 NAMES PLACEMENT COVERAGE

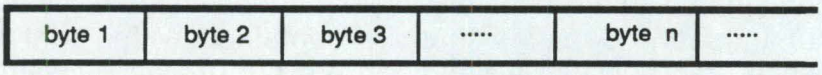
The names placement coverage provides the user a way to locate a place in a library by using a place name. This is a special type of thematic query. The most common use of the names placement coverage is to enter a query string (e.g., "London"), have the software locate all the places whose name match that string, and display their geographic locations and full name. The name feature class contains a point feature table and an entity node primitive table.

C.10 VRF ENCAPSULATION

Encapsulation defines the structure of data fields and the grouping of these fields. A very simple table-oriented data encapsulation system is defined for VRF which allows the use of binary coded numeric data as well as text data and which uses references to identify the location of data elements within numerous related tables stored in files. The use of tabular structures permits large blocks of related data to be accessed easily, providing a stable access time for any storage media.

C.10.1 DATA ORGANIZATION

All VRF data is organized in the form of files. A file is a stream of bytes with a name. The stream of bytes is ordered sequentially:



Files may be created, deleted, opened, closed, read (from byte m to byte n), and written (from byte m to byte n). VRF uses two types of files: directories and tables. These two data structures are used to implement the entire VRF data model. Fields in a table are important because they identify the data types contained within each table.

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C.10.1.1 THE DIRECTORY

The directory is a list of the names and locations of other files, including directories:

Directory			
Name	Type	Address	Length
File Name	Directory or Table File	Location on Media	Length In Media Storage Units

A directory identifies the beginning of a file. File names must be unique within a directory. A file referenced by a directory is said to be contained in that directory. A file contained in a directory may be referenced by a special form of its name called a pathname (because it contains the location path to the file). A pathname has of the following form:

<directory name><separator><file name>

where:

< > indicates that the enclosed name element is to be replaced with the actual text string indicated.

VRF uses the backslash character (\) as the generic pathname directory separator. For platforms requiring a different separator, software will replace the backslash with the appropriate separator character. For example, if a file named ROADS.LFT is contained in a directory named URBANAREAS, and the separator is (\), the resulting pathname would be:

URBANAREAS\ROADS.LFT

Directories are themselves files, so they may be contained in other directories. They are referenced by pathname the same way as other files. Thus, if URBANAREAS is contained in LIBRARY1, the resulting pathname would be:

LIBRARY1\URBANAREAS

Finally, pathnames may be combined. Since the directory that contains a file can be contained within a directory itself, it is necessary to have a form of file name that uniquely identifies that file contained within that directory (file names, while unique within a directory, are not unique between directories). For our example, that form would be:

LIBRARY1\URBANAREAS\ROADS.LFT

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When used with a medium that implements directories, VRF makes use of media directories. VRF will implement its own structure only when implemented on media without directories or when media directories are inefficient. VRF directories are strictly hierarchical; each file is contained in exactly one directory.

C.10.1.2 TABLES

A table is the organization structure for all data content. There are two types of tables, the primitive table and the attribute table. A class of the attribute table is the feature table. Figure C-3 graphically shows these four distinct table types. As seen in the figure, a VRF table may have an associated narrative table and an index file for variable-length records. A primitive table (discussed in C1.2.2) may have these two properties of a VRF table, but it may also have a spatial index file and a bounding rectangle table. An attribute table also possesses the properties of a VRF table, but must have value description tables which provide the data dictionary for the table. Feature tables are discussed in C1.2.2.1. Finally, a feature table inherits the properties of an attribute table, but may also have a thematic index file.

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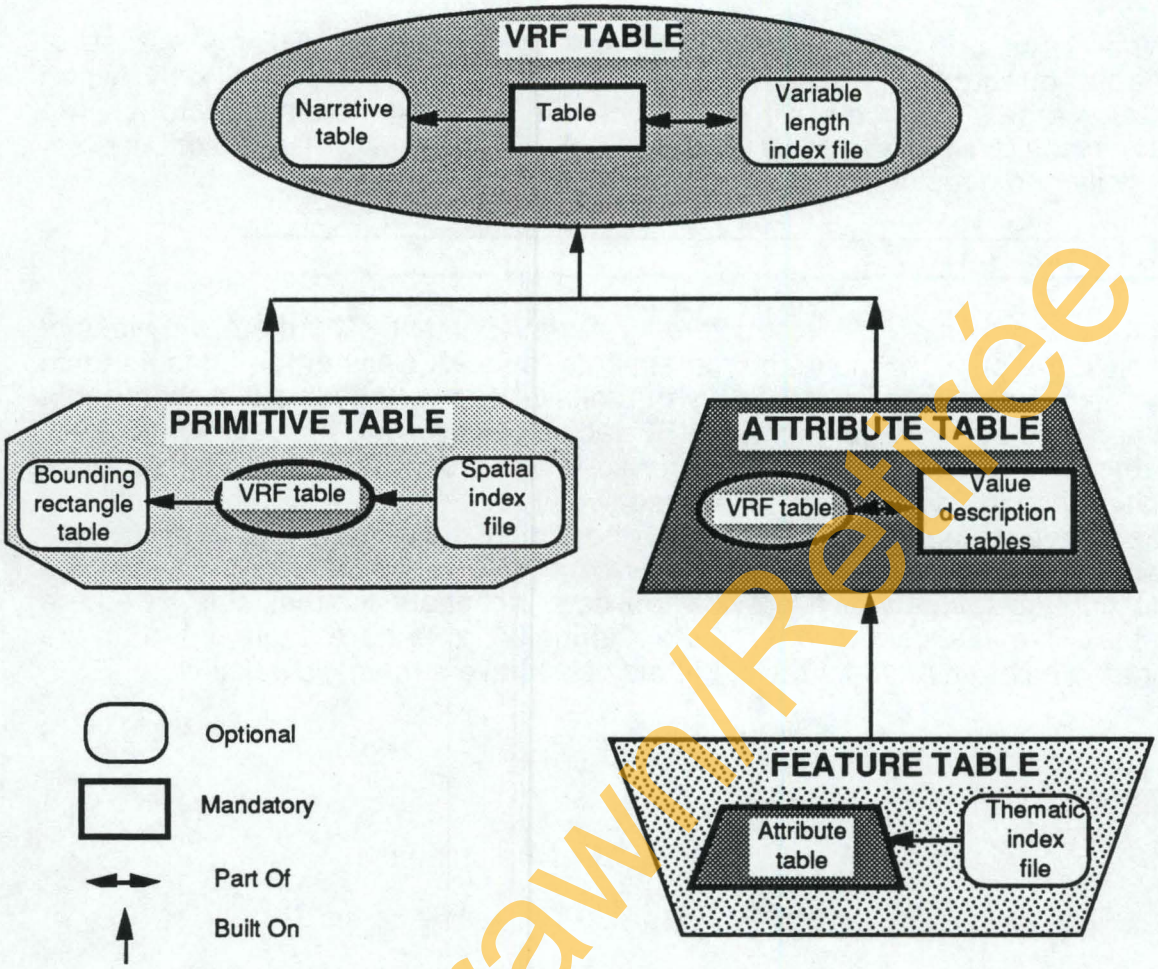


Figure C-3 VRF Table Types

C.10.1.2.1 VRF TABLE COMPONENTS

All tables are a matrix of rows and columns. Each row contains a set of fields corresponding in number and composition to the definitions of the columns. All rows in a table have the same field definitions. Columns are defined by data and key type. Each column has a name that is unique within the table. Each row in the table is defined by a row identifier (row id).

VRF tables consist of the following parts: a table header, which contains the metadata about the table and the column definitions; the table contents, which contain the actual rows that make up the table; and a row id. Table C-46 depicts a schema that defines the principal structure of any table in VRF.

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Table C-46 VRF Table Structure

Table Header Metadata and column definitions:	
a. Table description b. Narrative file name (optional) c. Column definitions: Column name Field type Field length Key type Column textual description Optional value description table name Optional thematic index file name Optional column narrative file name	
ID	**Table Contents**
Indicates the starting position of each row.	The data composing the table that match the column definitions.

While this document describes the column definitions for required VRF tables, it is possible to append product-specific columns or attributes to any VRF table. It is not possible to remove any mandatory columns from any table.

C.10.1.2.2 TABLE DEFINITION

Records can be of variable length; indices can be used to directly access the files as needed. A table will begin with a header defining the table contents, followed by a series of records (rows). Where table records are not of fixed length, an external index containing record offsets and length (in bytes), will be used to provide direct access. Figure C-4 depicts a variable length record table.

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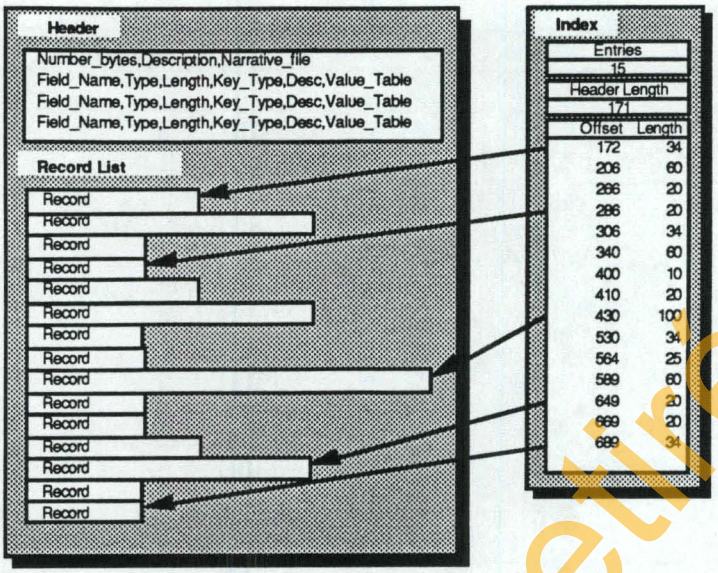


Figure C-4 Variable-Length Record Table

In addition to variable-length indexes, VPF also supports spatial and thematic indexes. Spatial indexes contain references to row data that are based on the value of a coordinate column. Thematic indexes contain references to row data that are based on the value of noncoordinate columns.

C.10.1.2.2.1 HEADER

A table's header is first composed of two parts. The first part is a four-byte integer which indicates the length of the following text string. To accommodate different hardware architecture, after the length field a byte order field may be inserted. A value of "L" in the byte order field indicates a "least-significant-byte-first" encoding; an "M" indicates a "most-significant-byte-first" encoding. "Least-significant-byte-first" encoding is assumed if the byte order field is not present. This second part, the header definition text string, contains three components, each of which is separated by a semicolon. The semicolon (;) indicates the end of the component. The first component is the table description. This will always begin with the table file name, followed by the description. An optional narrative table name is found in component two. If one does not exist, the dash symbol (-) is used. The final component is the column definition substring. The column definitions are separated by colons (:), which indicate the end of the subcolumn definition. If an entry is not applicable to the field (e.g., a thematic index does not exist) then the dash symbol (-), followed by eleven spaces to fill out the fixed-length field, is used to indicate a null value. Trailing null values should not be included. For each column in the table, there will be:

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- Column name, followed by an equal sign (=)
- Data type indicator, followed by a comma (,)
- Number of data type elements, followed by a comma
- Key type indicator, followed by a comma
- Column description, followed by a comma
- Value description table name, followed by a comma
- Thematic index name, if any, followed by a comma
- Column narrative file name, if any, followed by a comma

Table C-47 describes the header definitions of every VRF table.

Table C-47 Header Definitions of VRF Tables

Field	Description	Field Type
Header length	Length of ASCII header string (i.e., the remaining information after this field)	I,1
Byte order	Byte order in which table is written: L - least-significant-first M - most-significant-first (semicolon separator)	T,1 T,1
Table description	Text description of the table's contents (semicolon separator)	T,n (n≤80) T,1
Narrative table	An optional narrative file which contains miscellaneous information about the table (semicolon separator)	T,n (n≤12) T,1
Column definitions	The following fields repeat for each column contained in the table:	
Name	Name of the column (equal sign separator)	T,n (n≤16) T,1
Data type	One of the field types found in table 56 (comma separator)	T,1 T,1
Number	Number of elements (comma separator)	T,n (n≤3) T,1
Key type	Key type (comma separator)	T,1 T,1
Column description	Text description of the column's meaning (comma separator)	T,n (n≤80) T,1

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Value description table name	Name of an associated value description table (comma separator)	T,n (n≤12) T,1
Thematic index	Name of thematic indexes (comma separator)	T,n (n≤12) T,1
Narrative table name	Name of an associated narrative table (comma separator)	T,n (n≤12) T,1
End of column	(colon separator) (repeat for each column)	T,1
End of header	(semicolon separator)	T,1

The specific field separator may not be used as part of the field contents. For example, the Table Description may not contain a semicolon (;), but it may contain a colon or comma.

Table C-48 displays an example text header for a Surface Drainage Area Feature Table. For presentation purposes, each component in the table definition string is listed on a separate line in Table C-48. Furthermore, the example does not show the 4 byte definition string length or the byte-order character. It has 13 columns with column ID being the primary key column.

Table C-48 Second Component of Area Feature Table

```
;SDRAREA.AFT, Surface Drainage Area;
-;
ID=I,1,P,Required Row ID,-,-,:
F_CODE=T,5,N,FACC Code,CVAL.VDT,F_CODE.ATI,F_CODE.DOC,:
RRC =I,1,N,Railroad Categories, IVAL.VDT,:
HYC=I,1,N,Hydrological Category,IVAL.VDT,:
HFC=I,1,N,Hydrographic Form Category,IVAL.VDT,:
EXS=I,1,N,Existence Category,IVAL.VDT,:
WID=F, 1,N,Width (meters) ,:
WVA=I,1,N,Water Velocity Average (m/sec),IVAL.VDT,:
WDA=I,1,N,Water Depth Average (meters),IVAL.VDT,:
MCC=I,1,N,Material Composition Category,IVAL.VDT,:
BVR=I,1,N,Bank Vegetation Right,IVAL.VDT,:
BVL=I,1,N,Bank Vegetation Left,IVAL.VDT,:
BGR=I,1,N,Bank Gradient Right (%),:;
```

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C.10.1.2.2.2 RECORD LIST

The body of data contained within the table is the record list; the header and the table index serve only to define the contents and provide effective access to this list. These records can be of fixed or variable length as needed. Figure C-4 illustrates this relationship.

C.10.1.2.2.3 VARIABLE LENGTH TABLE INDEX

The variable-length index is a separate file which contains record offsets and length (in bytes). This index is provided to allow direct access of tables with variable-length records, but is not required for fixed-length record files.

The format of this file has a header and data portion. The header has two integers header, where the first integer is the number of records (n) in the table and the second integer is the total size (bytes) of the VRF Table Header. The data portion of the index file is a two dimensional array of integers of n entries, where n is equal to the number of records in the table. For each entry in the array, the first 4-byte integer indicates the byte offset from the beginning of the index file. The second 4-byte integer indicates the number of bytes in the associated table record. Figure C-4 (Section C.10.1.2.2) illustrates this relationship.

C.10.1.2.3 NARRATIVE TABLES

Each VRF table may have an associated narrative file describing miscellaneous information. The purpose of this file is to provide the database designer with the ability to maintain any comments or information that may be pertinent to the associated feature table. This narrative table name is stored in the feature table's header information.

C.10.1.3 SPATIAL INDEX FILES

For each primitive (face, edge, point, and text), there can exist a spatial index file which will speed queries by software. These files are recommended, especially for large libraries. The retrieval performance can be improved by upwards of 40 times. These indices are created on the coordinate column in each primitive. Annex C, Appendix6 contains more information on spatial indices.

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The format of a spatial index is as follows:

- **Header record.** The header will contain one integer defining the number of primitives (NUMPRIM) and another integer defining the number of nodes (NNODE) in the index. Between the two integers are four (xmin, ymin, xmax, ymax) long floating point coordinates defining the bounding box.

- **Bin array record.** This record is a two-dimensional array the length of NNODE described in the header record. This array maintains a long integer id and a long integer feature count at that id.

- **Bin data records**. There are NUMPRIM records where each record contains an 8-bit bounding rectangle and a list of primitive ids that fall within this rectangle. These primitive ids point into the associated primitive table.

C.10.1.4 THEMATIC INDEX FILES

A thematic index may be created for any column in an attribute table. There are two types of indexes, depending on the data content in a column: an inverted list thematic index or a bit array thematic index.

For categorical data or data with few distinct values, such as soil polygons where numerous polygons are assigned soil class designations from a relatively small number of classes, an inverted list is used. One entry in the index file is created for each distinct value in the column; correspondingly, a list of table record ids is stored with the value.

If the data in a column is all unique, especially in the case of an index for character strings, a bit array can be stored for each unique byte/character in the column. Each bit in the bit array represents a row in the indexed table. An "ON" bit at a particular position means that the corresponding row in the table contains a specific byte/character pattern.

The character string form of the thematic index is used for names placement index implementations.

The thematic index file may be partitioned into three data groups: a fixed-length header, a variable number of index (or directory) entries (another index within an index), and a set of rows. Each row contains VPF record ids stored either as a list or as a bit array. Each directory entry describes the element being indexed and the location of the row containing the list (or set) of record ids related to the element.

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- **Header**. The thematic index header contains 60 bytes of information that pertain to the type of index it is, the table it is associated with, and the column in that table. The layout of the header record is shown in Table C-49. An optional ordering of the entries in the index directory can be specified using the ordering flag at offset 56 in the index header. An 'S' in the ordering flag indicates an ascending sort order in the index directory. Entries are assumed to have no specific ordering otherwise.

- **Index directory**. The index directory contains repeating records for each distinct element being indexed. The structure of an index directory record is shown in Table C-50. The number of entries is stored in the header record. Entries in the index directory give an offset at which the actual data is stored. There is also a count indicating the number of items maintained for a particular index value. If the count field in an index directory has a value of zero, the offset field contains actual data; otherwise the offset field contains an indirect address for the indexed data.

- **Index data**. For each index entry there exists a data record consisting of either a list of row ids from the indexed file or a bit array.

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Table C-49 Thematic Index File Header Record Layout

Byte Offset	Width	Type	Description
0	4	Integer	Combined length of the index file header and the index directory.
4	4	Integer	Number of directory entries. This is the number of items being indexed by a particular index file.
8	4	Integer	Number of rows in the data table from which this index file was derived.
12	1	Character	Type of index file; either "I" for inverted list index, or "B" for bit array index.
13	1	Character	Type of the data element being indexed; one of: "I"—4-byte integer "T"—character string "S"—2-byte integer "F"—4-byte floating point "R"—8-byte floating point
14	4	Integer	Number of data elements comprising one directory entry. This field will usually have a value of 1; an exception is a thematic index built on a text field.
18	1	Character	Type specifier for the data portion of an index file. Record ids in inverted list index can be stored by using either a 2-byte integer (type "S") or a 4-byte one (type "I"). Bit array index files always use type "S."
19	12	Character	The name of the VPF table from which the index file has been derived; no path information is included.
31	25	Character	The name of the column in the VPF table from which index entries have been pulled.
56	1	Character	Ordering flag ('S' indicates an ascending order in tile index directory; no specific order otherwise).
57	3	Character	Unused and reserved.

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Table C-50 Structure of Index Directory Record

Byte Offset	Width	Type	Description
HDR +n*(d+8)	d	Character string 2-byte integer 4-byte integer 4-byte floating point 8-byte floating point	The element being indexed.
HDR +n*(d+8)+D	4	Integer	The offset from the beginning of the file to the location of the row associated with this index entry.
HDR +n*(d+8)+d+4	4	Integer	The number of indexed records associated with this entry. (For bit array index files, this is the number of bytes.)

Note: n is {0 ... number of index entries-1}, and d = size of (indexed type). HDR is the length of the index file header record.

The following example shows an inverted list thematic index created on a feature table column of data type "S" (short integer). The name of the column is USE_CODE. The name of the table is CULAREA.AFT. the index table header is thus:

Table C-51a Thematic Index Header Example

Byte Offset	Width	Type	Value
0	4	Integer	60 (header length)
4	4	Integer	3 (number of directory entries)
8	4	Integer	293 (number of the indexed row)
12	1	Character	I (inverted list)
13	1	Character	S (short integer source data)
14	4	Integer	1 (data length = 1)
18	1	Character	S (short indexed id)
19	12	Character	CULAREA.AFT
56	1	Character	S (sorted index directory)
57	3	Character	" "

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The value at byte offset 60 is the value of the element being indexed. The number of rows from the table CULAREA.AFT is contained at address HDR+n*(d+8)+d+4 (in this case at byte offset 66). The first entry in the directory has a USE_CODE value of 2, and there are 5 rows that contain the value. The CULAREA.AFT rows can be found at address 90. Another index directory entry starts at offset 70. This entry has a count of zero, indicating that the offset field contains the row number for the CULAREA.AFT table. The index directory is thus:

Table C-51b Thematic Index Directory Example

Byte Offset	Width	Type	Value	
60	2	Short Integer	2	(index value)
62	4	Integer	90	(offset)
66	4	Integer	5	(count)
70	2	Short Integer	3	
72	4	Integer	20	(direct row id)
76	4	Integer	0	(count of zero)
80	2	Short Integer	4	
82	4	Integer	100	
86	4	Integer	4	

The index data are thus:

Table C-51c Thematic Index Data Example

Byte Offset	Count	Row numbers
90	5	8 9 10 11 12
100	4	22 23 24 25

C.10.1.5 FEATURE INDEX

A feature index may be created for any VRF coverage. This optional index is composed of a Feature Class Attribute table (FCA) and one or more Feature Index Tables (FITs). FITs allow quick retrieval of feature information when given a selected primitive by providing pointers to all features that incorporate that primitive. There could be one FIT for each primitive type in a coverage. If a FIT is defined for a primitive type, then all feature classes in the coverage associated with that feature type must be indexed. All FCAs and FITs reside at the coverage level.

The FCA contains 4 columns: a feature class id, the feature class name, the feature type, and a feature class description. It is illustrated in Table C-52.

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Table C-52 Feature Class Attribute Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Feature class id	I,1	P	M
FCLASS	Feature class name	T,8	U	M
TYPE	Feature type (P=point, L=line, A=area, T= text, C=complex	T,1	N	M
DESCR	Description	T,*	N	M

Every primitive/feature reference, both directly and indirectly, as in the case of complex features, results in one entry in the appropriate FIT for that primitive and the corresponding feature. If a feature is composed of multiple primitives, each of those primitive/feature relationships is recorded. Conversely, if a primitive is applicable for more than feature, multiple relationships are similarly maintained. When a primitive is referenced by a complex feature via an intermediate feature, the relationship between the primitive and the complex feature, as well as that between the primitive and the intermediate feature are recorded in FITs.

The FIT is illustrated in Table C-53.

Table C-53 Feature Index Table Definition

Column Name	Description	Field Type	Key Type	Op/Man
ID	Row id	I,1	P	M
PRIM_ID	Primitive id	I,1	N	M
TILE_ID	Tile reference id	S,1	N	MT
FC_ID	Feature class id	I,1	N	M
FEATURE_ID	Feature id	I,1	N	M

C.10.1.6 ALLOWABLE FIELD TYPES

The field types depicted in Table C-54 are allowed and provide the ability to encode any data set. All variable-length types include a count item "n" (as depicted in Table C-54) preceding the data. The count is a 4-byte integer. This count item contains the number of bytes in text strings and the number of tuples in coordinate strings.

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Table C-54 Allowed Field Types

Abbrv	Field Type	Null/No Value	Length (bytes)
T,n	Fixed-length text	"N/A"	n
T,*	Variable-length text	zero length	n+4
L,n	Fixed-length text	"N/A"	n
L*	Variable-length text	zero length	n+4
N,n	Fixed-length text	"N/A"	n
N*	Variable-length text	zero length	n+4
M,n	Fixed-length text	"N/A"	n
M*	Variable-length text	zero length	n+4
F,1	Short floating point	NaN (not a number)	4
R,1	Long floating point	NaN	8
S,1	Short integer	bit pattern 10000000 00000000	2
I,1	Long integer	bit pattern 10000000 00000000 00000000 00000000	4
C,n	2-coordinate array	Both coordinates short floating point equal to null	8n
C,*	2-coordinate string	Length = 0	8n+4
B,n	2-coordinate array	Both coordinates long floating point equal to null	16n
B,*	2-coordinate string	Length = 0	16n+4
Z,n	3 Coordinate array	All coordinates short floating point equal to null	12n
Z,*	3-coordinate string	Length = 0	12n+4
Y,n	3-coordinate array	All coordinates long floating point equal to null	24n
Y,*	3-coordinate string	Length = 0	24n+4
D,1	Date and time	Space character filled	20
X,1	Null field	-	-
K,1	Triplet id	Type byte = 0	1—13

C.10.1.7 NAMING CONVENTIONS

The following define the naming conventions for VRF file and column names. (See also the VRF reserved names in C.1.2.)

- All naming will use ISO 646 (ASCII) characters.

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- For **file names**, the first character must be an alpha character from A to Z. The remaining 7 characters can be alphanumeric, including the underscore ("_") character.

  A file name may have a trailing period with a 3-character suffix. The suffix may contain only characters from A to Z, except that X is not allowed as the last character of the suffix.

- All names are to be in lower case.

  Any table with variable-length records will maintain a variable-length index file with the same file name as its associated table except that the last character will be X, with the exception of the FCS, whose variable-length index file will be named FCZ.

- **Directory names** (names for libraries, databases, and coverages) are restricted to the same rules as for file names, except that there will be no suffix.

- **Column names** follow the same restrictions as file names, but can be 16 characters in length. The dollar sign ($), pound sign (#), dash (-), period (.), and slash (/) are additional allowable characters. The column name ("ID") is reserved and must be used to identify each table record.

- If a column is defined with a triplet id, the fields within the triplet id will be named:

Field one	ID	The internal tile primitive id
Field two	TILE_ID	The tile reference id
Field three	EXT_ID	The external tile primitive id

  The "\" will be used as a separator between the column name and the triplet id field. Thus, when referring to the internal primitive id within a triplet id column (LEFT_FACE) the column name will be named "LEFT_FACE\ID."

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ANNEX C APPENDIX 1

C1 VECTOR RELATIONAL FORMAT

C1.1 GENERAL REQUIREMENTS

Vector relational format (VRF) is a generic geographic data model designed to be used with any digital geographic data in vector format that can be represented using nodes, edges, and faces. VRF is based upon the georelational model, combinatorial topology, and set theory.

VRF is designed to provide flexibility in encoding, directly accessing, and modeling digital geographic databases for a variety of applications on different computer systems. VRF characteristics are as follows:

- **Sheetless database support.** VRF is designed to support a sheetless database by providing logically continuous topological relationships even when the database is physically partitioned into tiles. VRF structures support the query and retrieval of data that extends across tile boundaries.

- **Neutral format.** VRF has a neutral relational format that is used in combination with individual product specifications. VRF is topologically structured and supports various levels of topology, from simple cartographic vectors to polygon coverages with full two-dimensional cell topology.

- **Attribute support.** VRF uses relational tables for attribute handling. Such tables support both simple and complex feature types.

- **Data dictionary.** VRF contains a self-defining data dictionary and lookup tables that provide a schema for user understanding of features and their attributes.

- **Text and metadata support.** Text information may be either attributes of features or "free floating" cartographic primitives. VRF is compatible with the use of all written languages, including accented characters and diacritical marks. In addition to basic cartographic information, VRF supports a variety of metadata files for carrying supportive information concerning all or part of the database.

- **Index file support.** Any index files necessary to enhance database retrieval performance are also utilized within VRF. These can include spatial, thematic, disk location, tile, and gazetteer indices.

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- **Direct use.** VRF allows application software to read data directly from storage media without prior conversion to a working format. VRF uses tables and indices that permit direct access by spatial location and thematic content.

- **Flexible, general-purpose schema.** VRF can represent digital geographic data in vector format by providing flexibility in the modeling of any data organization, from fully layered to completely integrated. VRF supports two-dimensional and three-dimensional coordinates, multiple scales, and the creation of multiple products.

- **Data quality.** VRF includes standards for data quality reporting and representation. It provides multiple methods for the representation of the spatial and aspatial aspects of data quality.

- **Feature definitions.** VRF organizes features and thematic attributes to ensure logical consistency and completeness.

C1.1.1 RELATIONSHIP BETWEEN VRF AND SPECIFIC PRODUCTS

The definition of data content shall be established in product specifications. VRF establishes a standard data model and organization, providing a consistent interface to data content. The product specification determines the precise contents of feature tables and their relationships. VRF can also accommodate additional tables that are not required by VRF itself. Figure C-5 illustrates the relationship between VRF and specific products.

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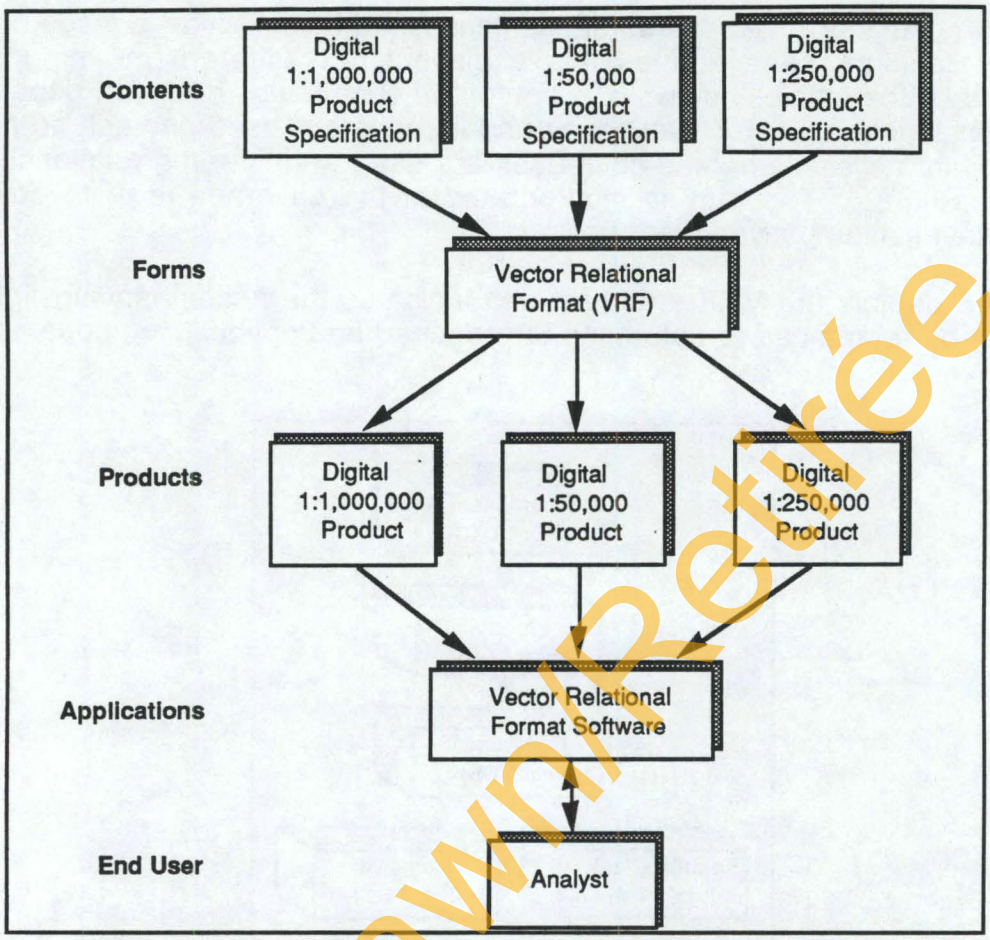


Figure C-5 Relationship Between VRF and Specific Products

C1.2 DETAILED REQUIREMENTS

C1.2.1 VRF STRUCTURAL LEVELS

This section discusses the logical framework of the Vector Relational Format (VRF). Implementation details.

The VRF model, which follows the data model described in Part 2 Section 5, may be considered to be layered. At the lowest level, a VRF database consists of geometric and cartographic primitives or topologic entities. These primitives (i.e. topological entities) define the spatial aspects of entities. Feature classes contain thematic information that helps apply meaning to those primitives. Both feature classes and primitives make up coverages, which in turn make up libraries; and finally, a database is made up of libraries. An analogy can be drawn between VRF and written language. Letters are at the bottom of the language hierarchy. Words are made up of letters. In turn, sentences are made

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up of words. An essay is created from sentences, and a collection is made up of essays. Each of these entities has a distinct and different meaning not possessed by the entities below. The content of each entity, however, depends on the constituent entities. Databases and libraries are used primarily to help organize data access, whereas coverages are used to define the relationships between features. Topology is incorporated at the coverage level to define spatial relationships between features.

Figure C-6 depicts the VRF structure and indicates the accompanying figure which can be referenced to determine the required and optional components of a VRF level.

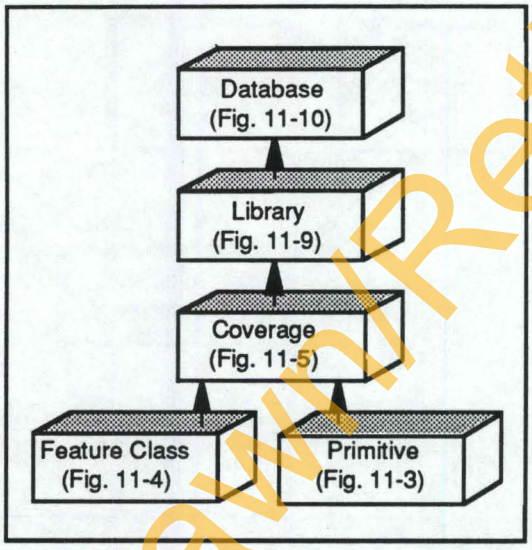


Figure C-6 VRF Structural Levels

C1.2.2 PRIMITIVES (TOPOLOGICAL ENTITIES)

There are three geometric primitives (topological entities) in VRF: nodes, edges, and faces. There are two classes of node primitives: entity (isolated) nodes and connected nodes. There is one type of cartographic primitive, text. These four primitives are combined to model any geographic phenomena using vector geometry. All primitives (except text) are linked to each other by topological relationships.

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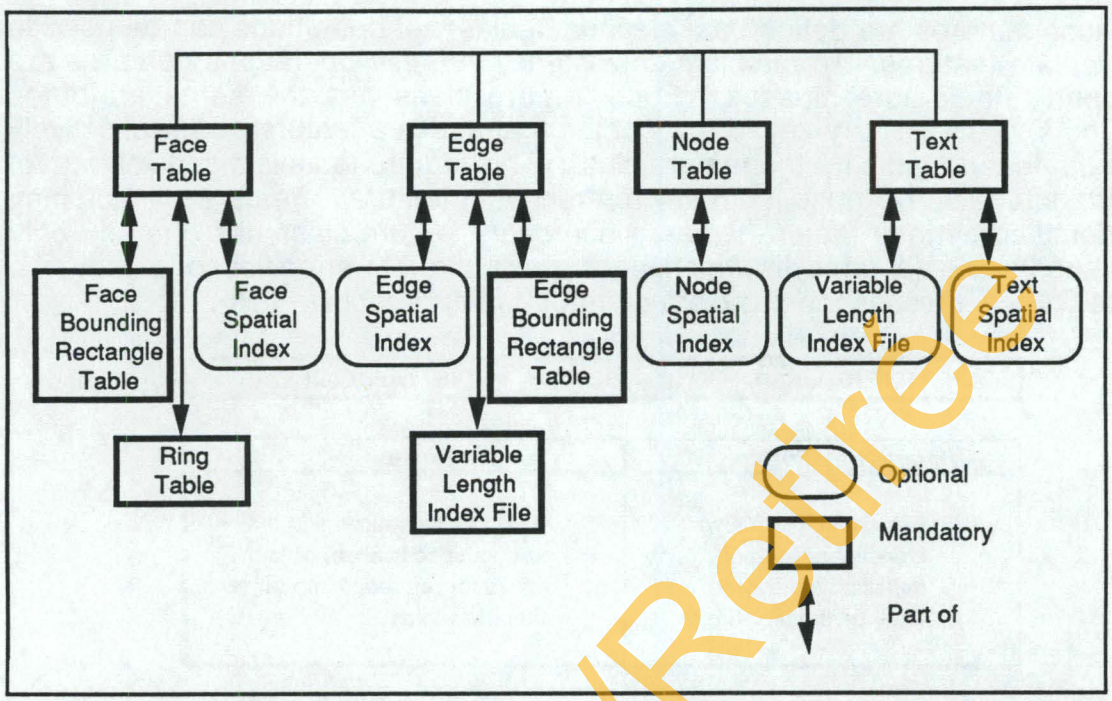


Figure C-7 Primitive (Topological Entity) Directory Contents

C1.2.3 FEATURE CLASSES

Features are defined from tables of primitives and attributes by relational modeling. Tables are related to each other by their keys, which are columns with common domains. A column's domain is a combination of its field type and its semantics. The row id is an example of a domain that VRF uses as a key; it specifies not only field type but also use. Each primitive has a special primary key, which is provided by its row identifier in its containing table. The actual relationship between tables (e.g., A is on top of B) is determined by a product specification.

C1.2.3.1 FEATURE DEFINITION

A feature is represented by a set of one or more primitives, a single primary row of attribute data, and zero or more other rows of attribute data. Every feature will have one primary row in a feature table that uniquely identifies it. For example, an airport complex feature will be identified by one row in a complex feature table, but includes the additional information contained in other feature tables. A simple feature (e.g. a building) may consist of only a single face and a single row of attribute data.

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Because features are defined as relational tables, set operations can be used to manipulate features. To maintain consistency in these operations, features are grouped into feature classes. Each feature class has the same attributes (columns). The primary-keyed rows of the features in a feature class collectively form the feature table for the feature class. This feature table is a special form of an attribute table because it directly references a feature. Feature classes may be identified by their feature tables, since every feature class has one and only one such table (a table in which each row uniquely specifies one feature). Table C-55 expresses the basic structure of a feature table in VRF.

Table C-55 VRF Feature Table Structure

Primary Key/Foreign Key	Attributes
Either a primitive row identifier or feature definition table id (may be the table id).	Attributes as specified in the product specification, or join values for reference into other attribute tables.

C1.2.3.2 FEATURE JOIN TABLES

A feature class may have attribute tables in addition to the feature table. These are related to the feature table by common key values. A one-to-one relationship between the features and rows in these tables is not required to uniquely specify the feature. Simple features are composed of one or more primitives, compound features are composed of two or more primitives of the same type that lie in more than one tile, and complex features are composed of one or more simple or complex features.

A feature join column designates which primitives belong to which features. Four types of feature joins represent all the possible relationships between features and primitives. These are: one-to-one, many-to-one, one-to-many, and many-to-many. Annex C, Appendix 3 provides a detailed discussion of these four types of join columns and tables.

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C1.2.3.3 FEATURE CLASS TYPES

There are two types of feature classes in VRF: simple and complex. The structural scheme of simple and complex feature classes is discussed in 5.1.6. VRF allows for a compound feature, which is a special case of the simple feature that is built from more than one primitive of the same type and may cross tile boundaries (see section C1.2.4.4). VRF also allows for the definition of text features, which consists of a text primitive table, and optionally a text attribute table. The text feature class is not a true feature class, but it is often useful to process text as if it were a feature. For instance, many maps contain text annotation that does not reference a specific geographic entity. The text "Himalaya Mountains" may not define any geometric primitive or feature, but merely provide associative information to the user.

C1.2.3.4 CONSTRUCTING FEATURE CLASSES

A feature class consists of a set of tables that includes at least one primitive table and one attribute table. The information stored in the columns defining the attributes and primitives is important, not the number of tables required to define a feature class. The rules for constructing feature classes are stored in the feature class schema table, which describes how each table relates to each other table in the feature class.

Figure C-8 is an example of a simple feature class. Within the schema table, the feature class is named TRNLINE. The first table in the relation is called TRNLINE.LFT. The second table is named EDG, which is the standard label for the edge primitive. The foreign key id in TRNLINE.LFT relates to the primary key id in EDG. TRNLINE.LFT has four attributes: F_CODE, LOC, TUC, and RST. The edge primitive contains the required columns for level 2 topology. Annex C, Appendix 3 provides additional information on feature classes and feature joins.

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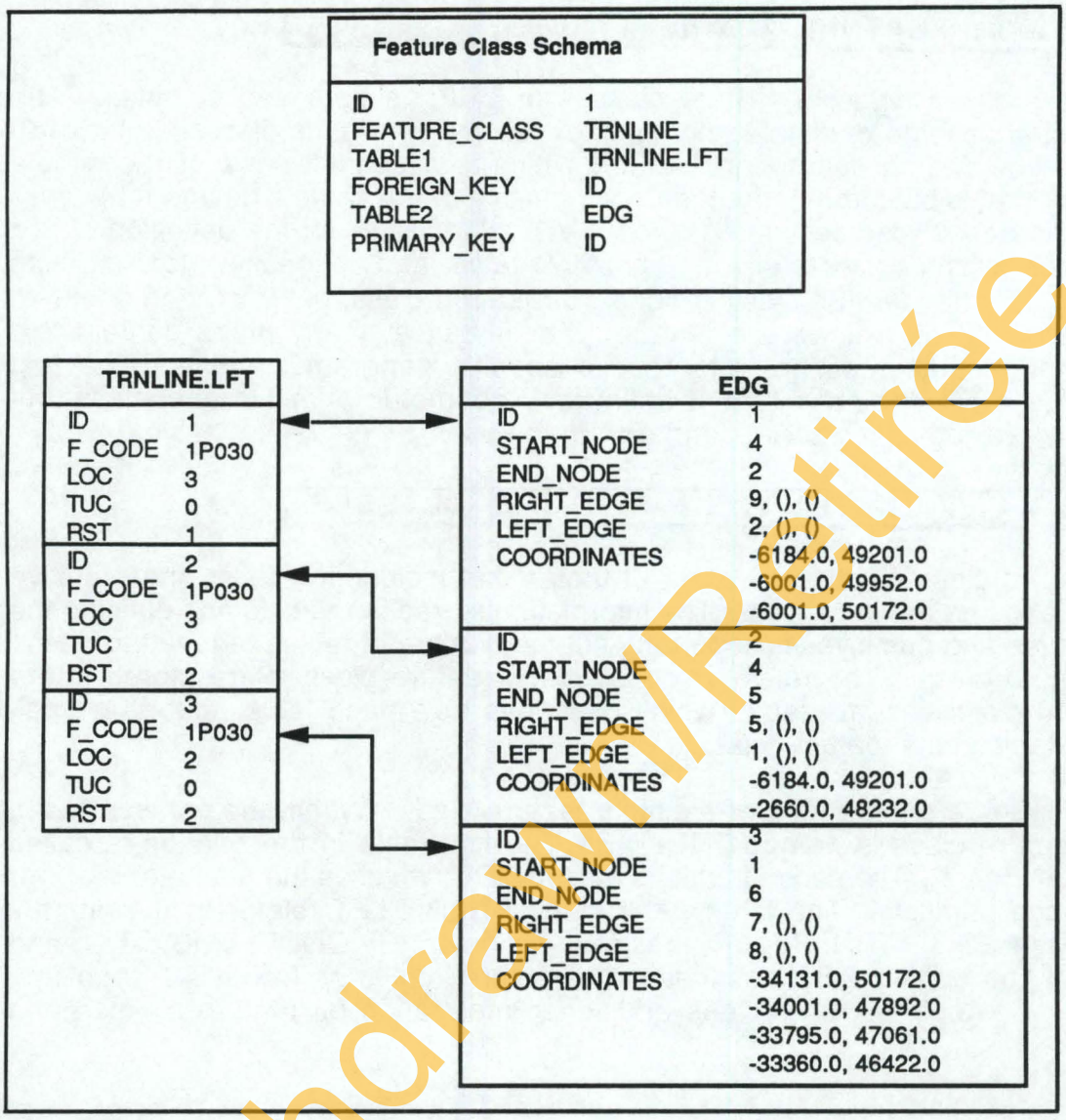


Figure C-8 Schema Table and Simple Feature Class

C1.2.4 COVERAGE

A coverage is a set of simple and complex feature classes (consisting of primitive and attribute tables) whose primitives interconnect according to coverage topology (level 0, 1, 2, or 3). All of the file structures that make up a coverage are stored in a single directory. A coverage is generally analogous to a single map sheet or separation in conventional cartography.

At the coverage level (see Figure C-9), there are four important components: the feature class schema table, the feature tables themselves, the value

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description tables, and tile directories or primitives. While the construction of feature classes and schema tables was discussed previously in C1.2.3.4, it is important to explain topology and its importance at the coverage level. Note that it is optional to maintain a data quality table at the coverage level.

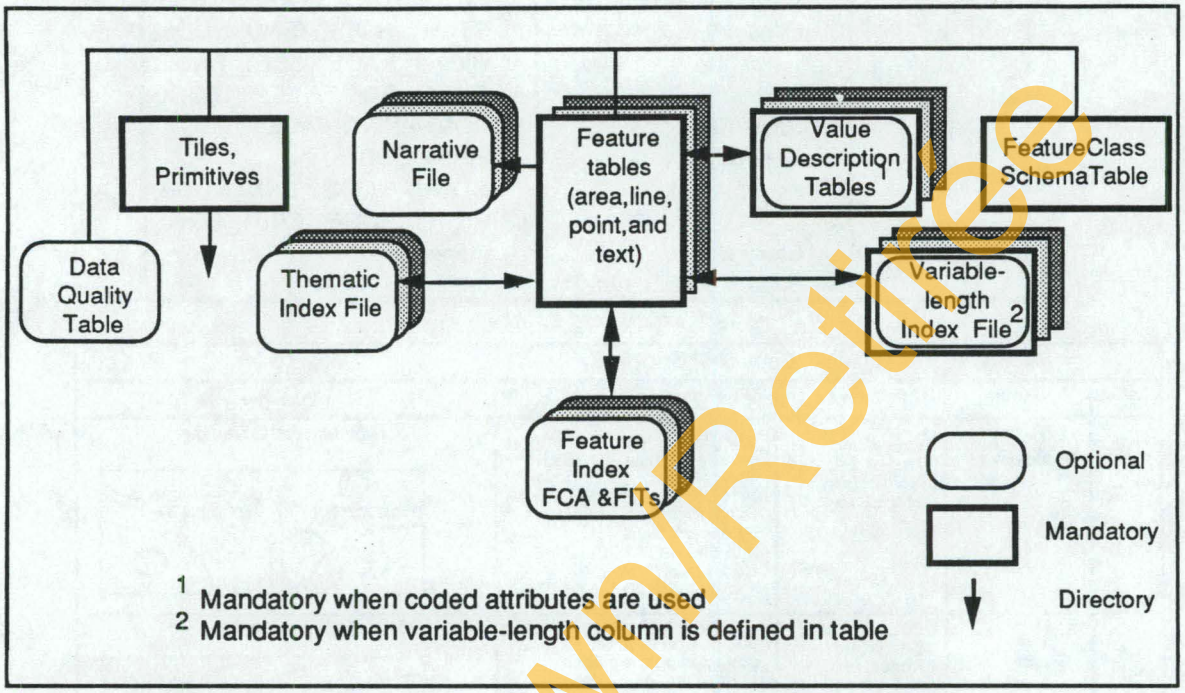


Figure C-9 Coverage Contents

C1.2.4.1 VRF TOPOLOGY

There are four recognized levels of topology in a VRF coverage, ranging from level 3, where all topological connections are explicitly present, to level 0, where no topological information is explicitly present. Figure C-10 summarizes these levels and includes a description, example, and composing primitives. Since text does not participate in topological relationships, it is not listed in Figure C-10. Text may be included with other primitives at any topological level, even though it does not participate in topology. The columns carried in the edge and node tables depend on the level of topology. These columns represent the connectivity and adjacency for the topology. For instance, the edge table in Figure C-8 does not contain level 3 topology columns (RIGHT_FACE and LEFT_FACE) because faces do not exist in level 2 topology. Table C-56 contains the entities associated with columns that are mandatory in each primitive table for the required level of topology.

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Table C-56 Mandatory Primitives for Each Level of Topology

Level	Primitive	Mandatory Columns
3	Face	RING_PTR
3	Ring Table	FACE_ID, START_EDGE
3	Edge	START_NODE, END_NODE, RIGHT_FACE, LEFT_FACE, RIGHT_EDGE, LEFT_EDGE
3	Entity Node	CONTAINING_FACE
3,2,1	Connected Node	FIRST_EDGE
2,1	Edge	START_NODE, END_NODE, RIGHT_EDGE, LEFT_EDGE
2,1,0	Entity Node	(none)
0	Edge	(none)

Levels of Topology

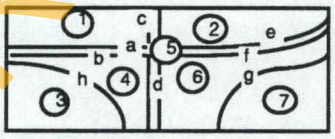
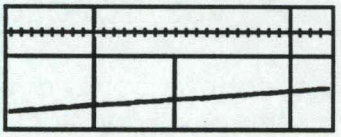
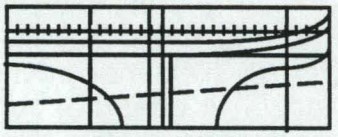
Level	Name	Primitives	Description	Example
3	Full Topology	Connected Nodes, Entity Nodes, Edges, and Faces	The surface is partitioned by a set of mutally exclusive and collectively exhaustive faces. Edges contain Left Face, Right Face, LForward, RForward, Start and End Node information. Edges meet only at nodes.	Surface Material Coverage 
2	Planar Graph	Entity Nodes, Connected Nodes, and Edges	A set of edges and entity points, where, when projected onto a planar surface, the edges meet only at nodes. Edges contain Start Node and End Node LForward, RForward information.	Drainage Coverage 
1	Chain-node	Entity Nodes, Connected Nodes, and Edges	A set of entity points and edges that meet at nodes. Edges contain Start Node and End Node, LForward, RForward information.	Lines of Communication Coverage 
0	Cartographic Spaghetti	Entity Nodes and Edges	A set of entity points and edges. Edges contain only coordinates and attributes.	CAD Drawing 

Figure C-10 VRF Topology

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C1.2.4.2 VALUE DESCRIPTION TABLES

The data dictionary is supported by using tables within a coverage. These tables are required to provide general descriptions of the data contained in a coverage in any VRF database. A value description table (VDT) is provided to describe any attribute found in a feature table. Depending on the data type of the attribute column, the interpretation will be different. There are three types of attribute values: distinct values, integer lookup tables, and character lookup tables.

- **Distinct values**. Distinct values are attributes that can be identified directly by their value, without requiring any additional description. For instance, contour lines have a value, but the value "100" is self-defining. The column definition may be "contour elevation (in feet)," so that a value of 100 will be self explanatory. Distinct values do not require a value description table. Floating point values and other range information is categorized as a distinct value.

- **Integer lookup tables**. In many cases, the attribute value is intended as a lookup table into some distinct coding scheme for meaning. In this case, an integer VDT must be used. For instance, an attribute describing feature accuracy may have three possible values: 0, 1, or 2. The integer VDT would contain three records, repeating the attribute name for each of the three values. The implied meaning of these values is stored, where 0, 1, and 2 map to "unknown," "high," and "low."

- **Character lookup tables**. Similar to the integer VDT, there is the character VDT. Not all column definitions maintain integer data; many can require character data. For instance, the use of the feature attribute coding catalogue (FACC — see Part 4) uses a five digit character string. Storing each FACC attribute in a character VDT will allow the code to have a descriptive string associated with it.

C1.2.4.3 TILED COVERAGES

Tiling is subdividing a coverage into smaller geographic coverage subsets (groups). This group of smaller coverages is then referred to as a tiled coverage. Formally, a tiled coverage is one or more coverages, all of which share the same set of feature classes, with the same definitions. A tiled coverage contains the same attribute information as an untiled coverage. The tiled coverage is subdivided into multiple coverages according to a tiling scheme. The tiling schemes, size, boundaries of tiles, the handling of features on borders, and text that crosses borders, are all part of a product specification. Each tile in a tiling scheme has a unique tile identifier. Figure C-11 displays one method for separating the database into tile partitions. Annex C, Appendix 4 contains more information on tiling.

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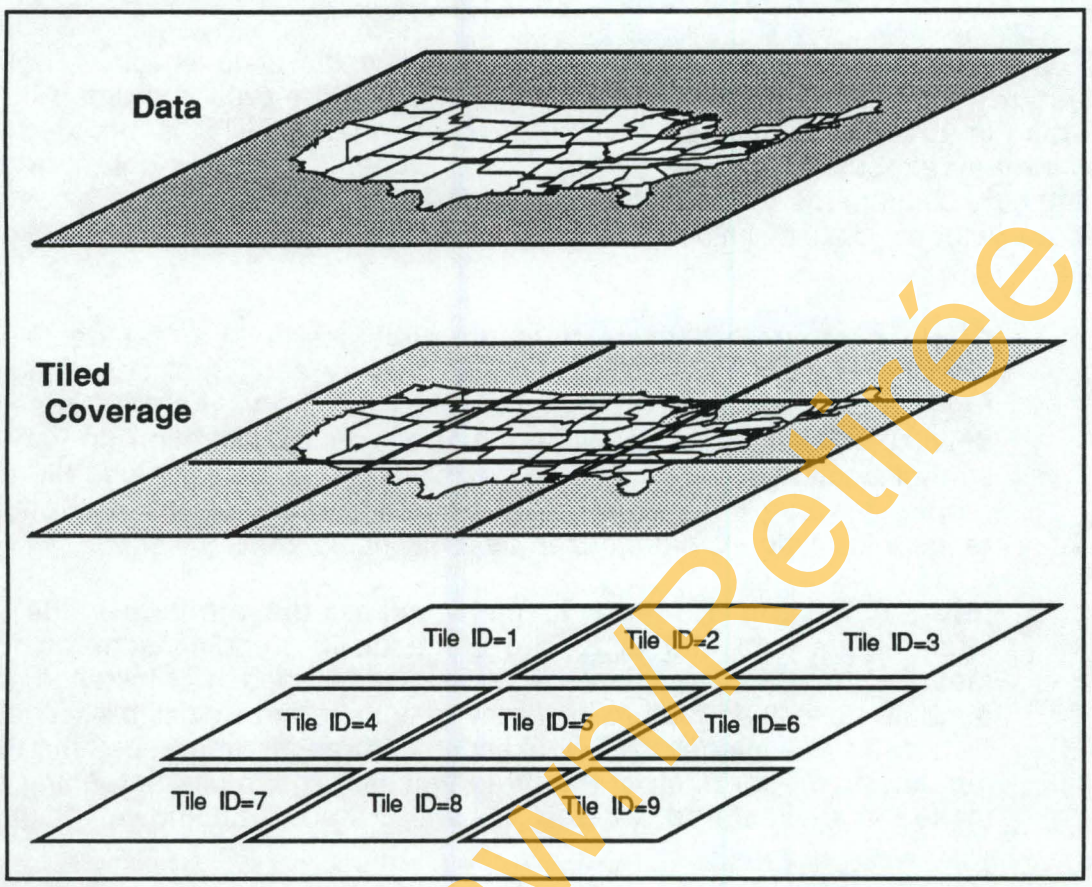


Figure C-11 A Tiling Scheme

Each tile will be a separate subdirectory under the coverage directory and contain separate tables for those features within the tile. A tiled coverage will contain a single feature table for each feature class. Features in this table are joined with their corresponding primitives using a combination of tile ID and primitive ID. There should be no subdirectory carried in a coverage directory for any tile that is devoid of data in that coverage.

Primitive definition occurs wholly within a tile. When primitives are broken by tile boundaries, the following occurs:

1. Edges: A connected node is placed at the edge-tile intersection. A corresponding node with the identical geographic coordinate is also placed in the adjacent tile.

2. Faces: A face broken by a tile boundary has a new edge constructed and inserted at the boundary for each tile to close the face internal to the tile. These edges contain cross-tile (adjacent face) information in their ID triplets but do not take part in cross-tile edge topology.

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3. Face 1: Edges will not be inserted solely to close face 1 (universe face). For example, where face 2 is broken by the tile boundary and the rest of the tile is defined by face 1, only the tile boundary edges necessary to close face 2 are stored, as illustrated in Figure C-12.

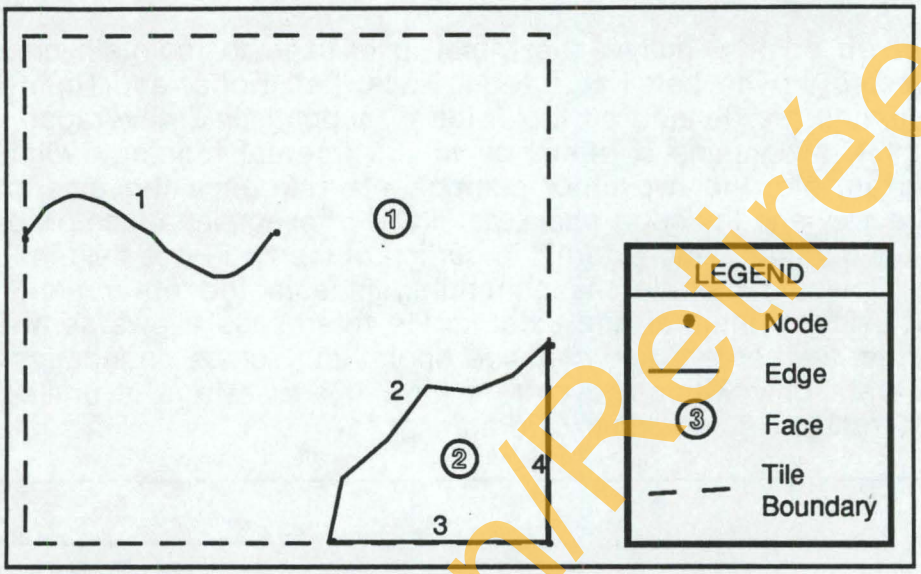


Figure C-12 Storage of Tile Boundaries

A component coverage is a portion of a tiled coverage from a single untiled coverage. Component coverages are complete except that they do not contain feature attribute or schema tables. This information belongs to the tiled coverage as a whole. If the component coverages are distributed separately, then each must contain its own copy of the feature table information. However, to save space in such a partial distribution, the feature attribute tables should contain only entries for those features that are wholly or in part present in that particular set of component coverages.

C1.2.4.4 CROSS-TILE FOREIGN KEYS

VRF provides a mechanism for seamless databases in which features can be maintained, whether or not a tiling scheme is present. Each component coverage of a tiled coverage contains its own primitives, while the feature tables are maintained at the coverage level. Annex C, Appendix 2 contains a discussion which fully describes this concept.

- In a feature table it is necessary to maintain columns that identify the tile id and primitive id that are related to the feature. The primitive id column is named after the primitive table it relates to, followed by "_ID". These columns may be included in a fixed length record format

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or embedded in the triplet id scheme. If the triplet id is used then the second field in the triplet id is the tile id (found in the tile reference coverage); and the third field is the primitive row id in that tile. The first and fourth fields in the triplet id are null. An index file must be added if the triplet id is used since records will no longer be fixed length.

- For an edge primitive, the triplet id is used to maintain cross-tile topology. The Left Face, Right Face, Left Edge, and Right Edge columns are defined as triplet ids to support tiled coverages. The triplet id contains a reference to the internal topology within the current tile; the two other components reference the external tile directory and the edge within that tile. For example, a face divided by a tile boundary, the external id portion of the Left Face field in Figure C-13 would include the continuing face in the other tile. This inclusion of internal and external tile references allows software to detect tile borders and continue operations across boundaries or to operate only within the current tile. If a coverage is untiled, the external tile id and primitive id are null.

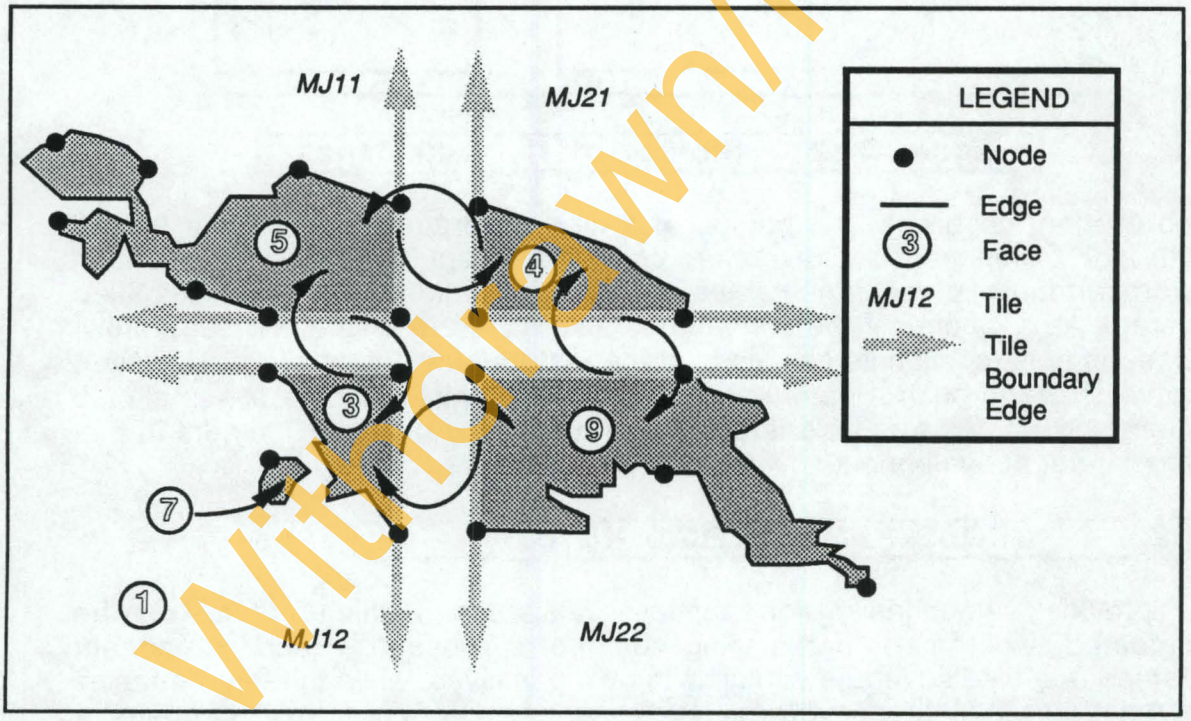


Figure C-13 Face Cross-Tile Matching

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C1.2.5 LIBRARY

A library is a collection of coverages that share a single coordinate system and scale, have a common thematic definition, and are contained within a specified spatial extent. If any of the coverages composing the library are tiled, then all coverages must either use the same tiling scheme, or be untiled. The contents and organization of the libraries are determined by a product specification. All of the tables and coverages making up the library are contained within a single master directory (Figure C-14).

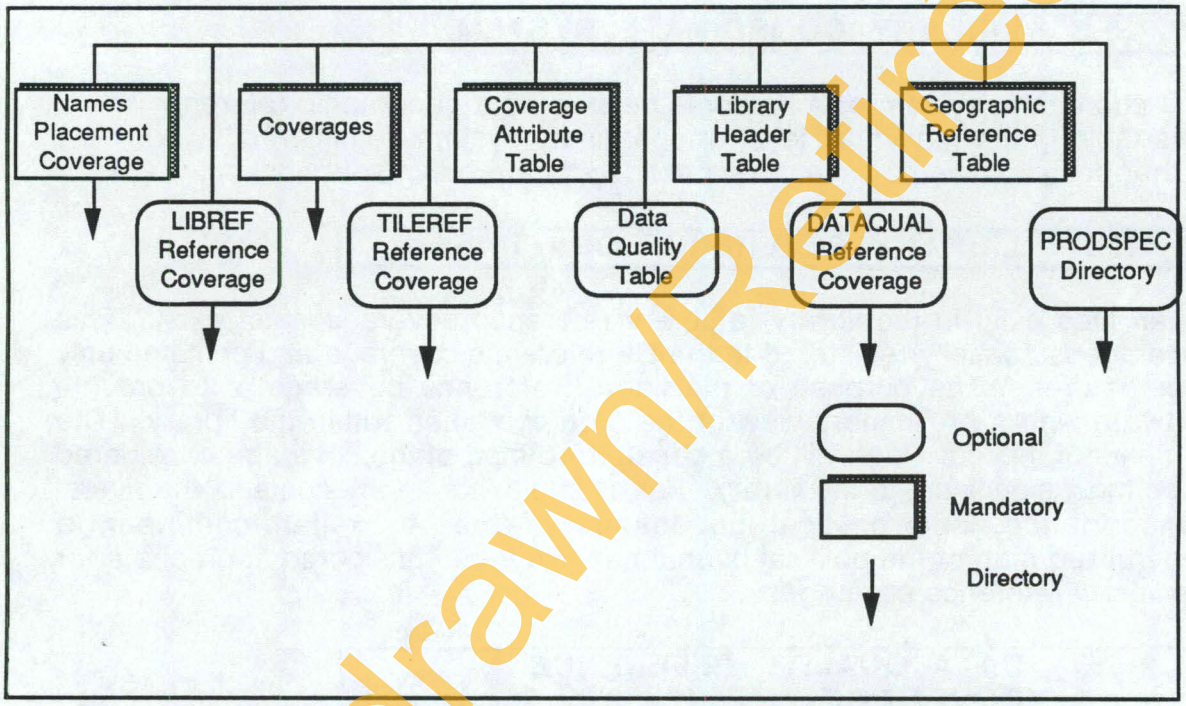


Figure C-14 Library Contents

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C1.2.5.1 TILE REFERENCE COVERAGE

A tile reference is mandatory if a library contains tiled coverages. The spatial extent of the library and its tiling scheme are represented in the tile reference coverage. The outside face of a tile reference coverage defines the spatial extent of the library, and its internal faces define the tiling scheme used by the tiled coverages within the library. The reference coverage contains a set of faces identifying the tiles that the library uses to subdivide the region of interest. The reference coverage is a standard untiled coverage with level 3 topology.

C1.2.5.2 LIBRARY ATTRIBUTES

Like coverages, libraries have attributes. There is one primary attribute row per library, and zero or more other attribute rows. Additional metadata that is product specific may be stored in VRF tables in a product-specific directory named PRODSPEC. Libraries are also the level at which coverage primary and related attribute tables reside. The coverage attribute table acts as a topics list for a library. General information about the library is present in the library header table.

C1.2.5.3 LIBRARY COORDINATE SYSTEM

The coordinate system of a library is defined by a geographic reference table. This table is the maximum level of coordinate system definition allowed. Any further definition would have to be provided by a product specification.

C1.2.5.4 LIBRARY REFERENCE COVERAGE

When tiles exist in the library, a library reference coverage must exist. This coverage is spatially registered to the tile reference coverage and contains only line features. The purpose of the library reference coverage is to provide software with a preliminary view of the data contained within the library. The contents of this coverage will be a generalized map of the coverage considered to be most significant to the library. For example, if a library contains the rivers, transportation, and political boundaries of the Australian continent, a generalized map of the political boundaries might be considered appropriate for the library reference coverage.

C1.2.5.5 DATA QUALITY REFERENCE COVERAGE

It is possible to include a data quality coverage. This coverage is spatially registered to the tile reference coverage. Its purpose is to describe important information that may pertain to the entire library. Annex C, Appendix 5 contains more detailed information about the contents of this coverage.

C1.2.6 DATABASE

A database is a collection of related libraries and additional tables. The library attribute table acts as a table of contents for the database. Database transmittal information is contained in a database header table. Additional metadata that is product specific may be stored in VRF tables in the product-specific directory. Figure C-15 illustrates the arrangement of database tables and coverages.

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It is possible to include a data quality coverage. Its purpose is to describe important information that may pertain to the entire database. Annex C, Appendix 5 contains more detailed information about the contents of this coverage.

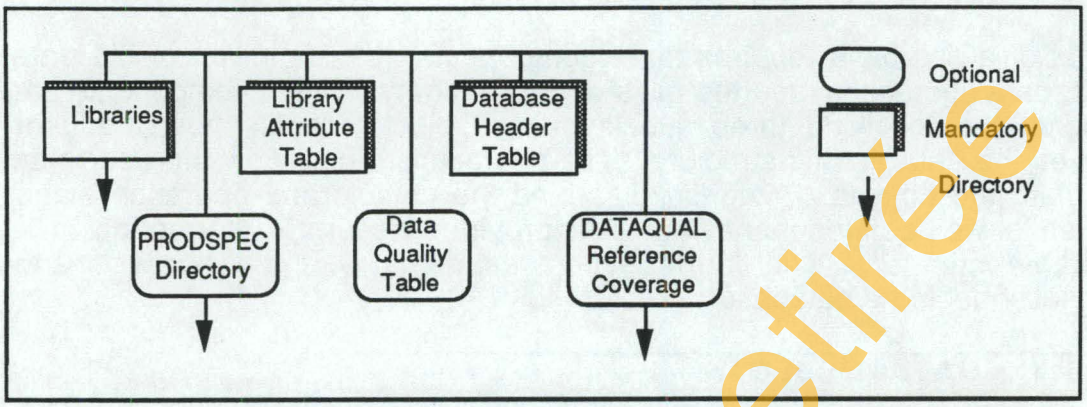


Figure C-15 Database Contents

C1.3 INTRODUCTION TO THE VRF DATA MODEL

VRF is a general, user-oriented data format for representing large spatially referenced (geographic) databases. VRF is designed to be used directly; that is, software can access the data without time-consuming conversion processing. VRF is designed to be compatible with a wide variety of users, applications, and products.

To achieve its generality and user orientation, VRF uses a the data model found in Part 2-5, that provides a flexible but powerful organizational structure for any digital geographic database in vector format. VRF defines the format of data objects, and the georelational data model supporting VRF provides a data organization within which software can manipulate the VRF data objects.

The following paragraphs discuss in general the data model, as described in Part 2-5, implementation that serves as the basis of VRF. C1.3.1 discusses the basic concepts that form the foundation for all geographic data models. C1.3.2 describes the relational model, while C1.3.3 describes the planar topology model.

C1.3.1 DATA MODEL CONCEPTS

A model is a fundamental description of a system that accounts for all known properties of that system. The system is a view of geographic reality, or information tied to specific locations in coordinate space. Since this particular model is stored in a computer, it is called a data model. A data model provides

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the most abstract representation of a system; it describes a collection of entities, including their relationships and semantics. The purpose of a data model is to define and capture a view of reality in a consistent and uniform manner. It provides a framework to visualize the structure and behavior of these entities in a system.

A model of a database requires three components: the definition of the data objects, data operations, and the rules of data integrity. These components are defined in the following three subclauses. Objects identify how the user perceives the data and its structure. The operations define how the user may manipulate the objects. Integrity rules bind the objects and operations, and establish a well-defined behaviour that provides accurate information in a predictable manner. The fourth subclause deals with the purpose and functionality behind a database.

C1.3.1.1 DATA OBJECTS

Data objects identify how the user perceives the data and its structure. These objects also define the most primitive partitions of the data model architecture. For instance, an international database may contain a wide variety of objects concerning nations. The relevant objects could be areas, civil divisions, populations, resources, products, and water bodies. Relationships can be defined for these objects where populations and resources are grouped by civil divisions.

C1.3.1.2 DATA OPERATIONS

Data operations define how a user may manipulate the objects; where, for instance, an object's attributes may be displayed, or new attributes could be defined, or, perhaps, new objects created. In most cases, an algebra is defined that accurately manipulates the data objects and binds the scope of operations within the data model. Classical database operations include retrieval, creation, deletion, and modification. More specific operations are defined for applications using the database.

C1.3.1.3 DATA RULES

The rules of data integrity constrain the operations on objects in order to preserve overall stability. The goal is to prevent operations that yield corrupt, incorrect, or ambiguous results. Integrity rules constrain the set of valid states of databases that conform to the data model. These rules define the accuracy of the database.

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C1.3.1.4 DATABASE PURPOSE

One function of a database is to provide centralized control of operational data that is vital to an organization. A data model attempts to closely mesh the data objects, operations, and integrity rules into a cohesive system with optimal performance. The advantages of centralized database control are well established, and the use of a data model allows a database to provide the following functionality to an organization.

- **Consistency.** The database will provide access to data in a formal manner. This will establish a consistent view of the data, enabling efficient data exchange.
- **Simplicity.** A basic objective is to provide an intuitive, straightforward, and understandable interaction between the user and the data.
- **Non-redundancy.** Duplication of data will be avoided wherever possible, especially when repetition provides little additional information.
- **Multiple applications.** The data model needs to support multiple end user applications because user views of the database will be different.
- **Flexibility.** A critical requirement of an effective database is the ability to accept new data. A database needs to have the dynamic flexibility to grow with the needs and requirements of its users.
- **Integrity.** The integrity rules should be defined in a consistent manner for all data objects and operations. The use of well-defined rules prevents operations that lead to data corruption and misinformation.

In summary, a data model provides a powerful approach to achieving optimum centralized control of critical data within a system. Using a variety of integrity rules and established operations upon defined data objects, the database provides users with the necessary tools for extracting data in support of many applications.

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C1.3.2 RELATIONAL DATA MODEL CONCEPTS

The relational data model provides a powerful architecture for database design because of its ability to handle a wide variety of data and applications.

C1.3.2.1 RELATIONAL DATA OBJECTS

The relational model uses simple tabular data structures to portray the data in a natural, well-defined manner. These data structures contain columns and rows, where columns define attributes, the values for which are taken from a range of data defined across a given domain. The content of the rows represents the actual data entities. The strength of the relational model is its ad-hoc ability to establish meaningful data, transforming data into information as a function of user perspective. For instance, a relational table "ROADS" can be defined as having three columns: name, class, and structure. The rows that compose the ROADS table would contain distinct information about each road in each field in the database. The six following properties distinguish relational tables from non-relational data objects.

- Entries in columns must be single-valued; a field may not contain a list of attributes.
- Entries within a column must be of the same data type.
- Each row must be unique, and duplicate rows are not permitted.
- Columns may appear in any order.
- Rows may also appear in any order.
- Each column must have a unique name.

C1.3.2.2 RELATIONAL DATA OPERATIONS

The relational model supports eight set operations: select, project, product, join, union, intersection, difference, and division. Since the relational model is founded on set theory, the operations themselves are based on fundamental mathematical principles. These operations allow data objects to be manipulated and created in a specific manner, producing stable results.

C1.3.2.3 RELATIONAL DATA RULES

The integrity rules constrain operations performed on objects in order to preserve stability. The goal is to prevent operations that yield corrupt, incorrect, or ambiguous results. The entity integrity rule requires the entry of a null value in columns in relational tables for which the value is always known or understood. The referential integrity rule ensures that a foreign key referenced into another table stays within recognizable bounds. For example, a foreign key is not permitted that references a record number of 500 in a table that only contains 300 records. Additional, more subtle domain rules can also be defined to constrain entries in and operations on the database.

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C1.3.3 PLANE TOPOLOGY MODEL CONCEPTS

Conceptually, plane topology can be defined as a planar graph, where geographic reality is decomposed into a finite set of 0 cells (points), 1 cells (lines), and 2 cells (areas). This terminology is defined by an algebraic topology that establishes rules for decomposing continuous three-dimensional objects into representations of finite models. Once this topologic mapping has been performed, a system can be modeled in a way that permits more complex relationships between objects to be established.

The purpose of topology is to capture and retain knowledge concerning a cell's spatial and thematic relationships with its neighbouring cells. For a topologic model to be valid, these relationships must remain constant regardless of changes in scale, shape, or size. With topology embedded in a data model, very useful relations can be established, such as adjacency and connectivity. Topologic and geometric relationships (such as size, angle, and shape) provide powerful resources that allow geographic reality to be fully modeled.

C1.3.3.1 TOPOLOGICAL OBJECTS

Plane topology extends graphic models of points and lines to the development of a more powerful and expressive model that contains spatial relationships. In addition to metric capabilities (distance, shape, or size), topology determines spatial neighbour relations. By defining more rigorous and complex relationships in the data model, the true properties of a system can more effectively represented. Various mathematical models are available. In addition, simpler models can be used to create more complex ones. The most simple is the graphic model. More complex and useful surface-based models are built upon the graphic, using topology to capture additional analytical information.

A graphic model represents geometric information based on point and line primitives. This model provides the base for other models that define more complex relationships. The point primitive is composed of a location in an established coordinate space. Most representations are two dimensional (x,y) or three dimensional (x, y, z). A line is composed of a minimum of two points, with more details concerning linear or spline interpolation between the end points.

Because of the complexity of geographic information and the limitations of a graphic model, plane topology provides a better model for defining relationships. The use of a planar topology model (based on the two-dimensional manifold), for instance, maps more concisely in the two-dimensional space that current computing systems can manage. VRF provides four distinct levels of topology: full planar topology (level 3); a linear planar graph (level 2); a non-planar linear graph (level 1); and no topology defined, indicating a geometric model (level 0). VRF uses the notion of topology as a

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constraint to enforce integrity rules upon the feature definitions. As the entities require fewer topological relationships, the rules can be relaxed. For instance, if linear features in a transportation network are being modeled, then the requirement of full planar topology may be relaxed because it is not necessary.

Plane topology defines relations between cells without modifying the underlying geometry. The concept of an area can be visually retained in graphic models, but only allows one view of the data. Topology establishes a framework that provides more information for analysis. For instance, in Figure C-16, the edges 1, 2, 3, 4, and 5 are grouped together and label the enclosed region area "a" (a face), assigning relationships and thematic attributes to this region. Another feature that encompasses area "b" (a face), including the edges 5 through 12, can be defined. Topology defines relationships on each 0-, 1-, and 2-cell in a model. Area "b" (a face) is defined to be "left-of" edge 5; edge 7 can be defined to follow edge 6 in a cycle. This topologic information provides the power to determine orientation, adjacency, and connective relationships between objects.

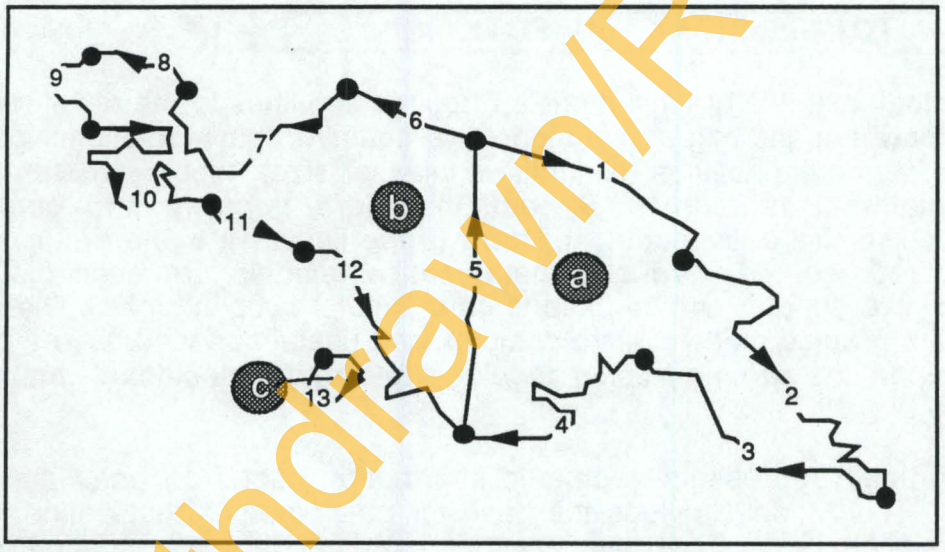


Figure C-16 The Definition of Areas (Faces)

The concept of topology is not restricted to geometric primitives. Topology is also mandatory to thematic information. An area is usually labeled, or contains information pertaining to the enclosed region. For instance, an area can have a category (soil class, surface material type) or a numeric value (population size, number of airports). Topology is used to provide operations and information to distinguish between these thematic objects. Thematic topology can define relations between features without requiring the primitive geometry. For instance, a set of the islands in the Pacific Ocean (Oahu, Maui, Hawaii, Molokai, etc.) can be defined as different features with differing geometric primitives, but they can be related to one another as the Hawaiian Islands.

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C1.3.3.2 TOPOLOGICAL OPERATIONS

There are three main topological operations: connectivity, containment, and adjacency. Connectivity defines what object is next to another, irrelevant of size or scale. For example, edge topology in VRF makes use of a winged-edge structure. Winged-edge topology establishes the spatial location of the current edge and its topologic neighbours by expressing where it was coming from and where it is going to. Containment explains the object(s) that may encompass the current object or surround the object also contained within. The point-in-polygon operation is an example of containment. Adjacency describes the objects that are next to the current object. Buffer operations are used to determine those objects that can be within a certain neighbourhood of the current object.

C1.3.3.3 TOPOLOGICAL RULES

The integrity rules of the topological model are contained in the definition of the objects themselves. A plane model restricts itself to planar geometry, where all entities must lie in the same plane. In addition, all faces must be mutually exclusive and not overlapping. These constraints allow the objects to be defined in context and allow operations to be performed in a consistent manner. While these rules may seem to restrict the system model, they define the data model's domain, taking advantage of the underlying structures. By restricting the faces to be constructed of non-overlapping regions, powerful set operations can be applied to the objects (such as union, intersection, or join).

C1.3.4 THE VRF GEORELATIONAL DATA MODEL

VRF uses a combination of the relational and the planar topologic data models to provide a hybrid model for geographic data management, analysis, modeling, and display. The georelational model provides the data structure foundations for a spatial database, and software provides the rules and operators that manipulate topology, geometry, and relational objects in the form of tables. Whenever an operation requires thematic information, the use of relational and topologic table operations are used to supply the result. If the operation is spatially related, geometry and topology together will be used. This triad of categories (geometry, topology, and relational tables) provides a robust database architecture.

VRF adheres to the georelational data model, but only defines the objects and the data structures that compose the objects. The georelational operations and algebra are not part of the standard, but are implemented in software. Every VRF object is described in the form of a relational table, composed of columns defining the syntax of each field and rows that contain the actual data.

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In Figure C-17, the VRF georelational model is graphically depicted, expressing the fundamental relationships between topology, geometry, and table (thematic) information. The greatest strength of the VRF standard is that it provides a general format for large spatially referenced databases. Using the georelational data model to organize this data with a clear, concise methodology provides a general interface for computing systems. VRF provides all the fundamental access strategies to allow user software system to access the data without conversion.

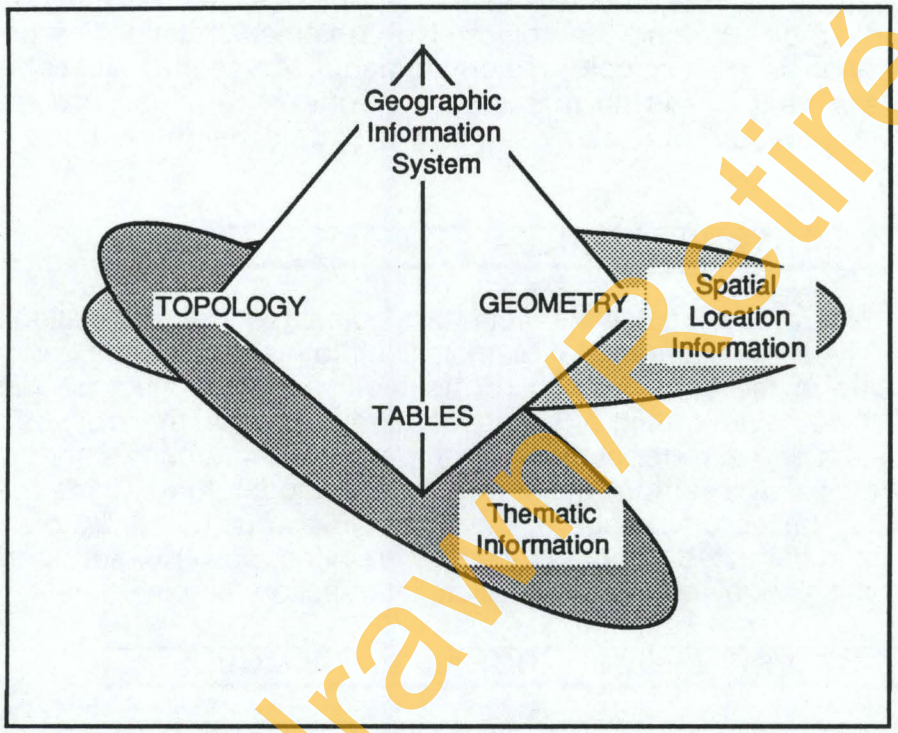


Figure C-17 The Georelational Data Model

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ANNEX C APPENDIX 2

C2 WINGED-EDGE TOPOLOGY

Winged-edge topology is an essential part of the VRF data model. The function of winged-edge topology is to provide line network and face topology and also to maintain seamless coverages across a physical partition of tiles. The following sections define the components of winged-edge topology, the algorithm used to traverse the winged-edge network, and cross-tile topology.

C2.1 COMPONENTS OF A WINGED EDGE

Winged-edge topology uses three specific components (columns) on an edge primitive table to provide connectivity between nodes, edges, and faces. Given level 1, 2, or 3 topology, the edge primitive will contain specific columns for each topologic level. As shown in Figure C-18, there are three topologic constructs: node, edge, and face information on each edge.

- **Node information**. Each edge will contain a start node and an end node column. This topologic information is used to define an edge direction (digitizing direction).

- **Edge information.** Right and left edge connect an edge to its neighbour edges (thus the term "winged edge"). The right edge is the first edge connected to the end node that is encountered when cycling around the node in a counterclockwise direction. The left edge is the first edge connected to the start node that is encountered when cycling around the node in a counterclockwise direction.

- **Face information**. With level 3 topology specified, each edge will contain a left and right face. Left and right face are determined solely by the edge direction. This information allows an edge to know its neighbouring faces.

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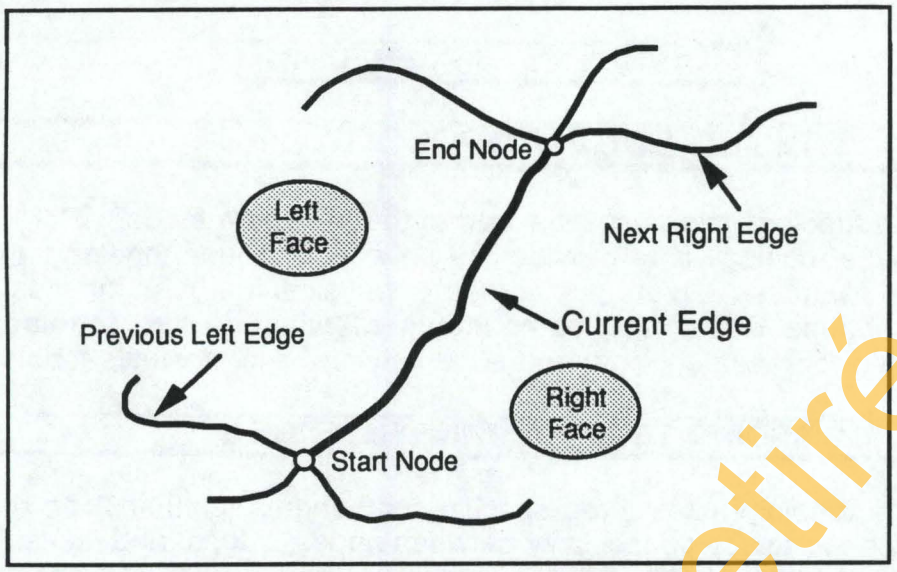


Figure C-18 Winged-Edge Components

C2.2 WINGED-EDGE ALGORITHM

Given the definition of a winged edge, every coverage containing faces and edges is created in the same way. With the enforcement of a planar topologic model, a consistent navigation algorithm can be applied. Faces and edges are defined in C.2.

Figure C-19 depicts a collection of faces and accompanying edges. To navigate a face, the following algorithm is used:

a. Determine which face to draw (face 2).

b. Locate start edge (edge 5 is the arbitrary start edge in the ring table).

c. Because face 2 is the right face for edge 5, read the right edge record (edge 1).

d. Face 2 is to the right for edge 1, so go to the right edge (edge 2).

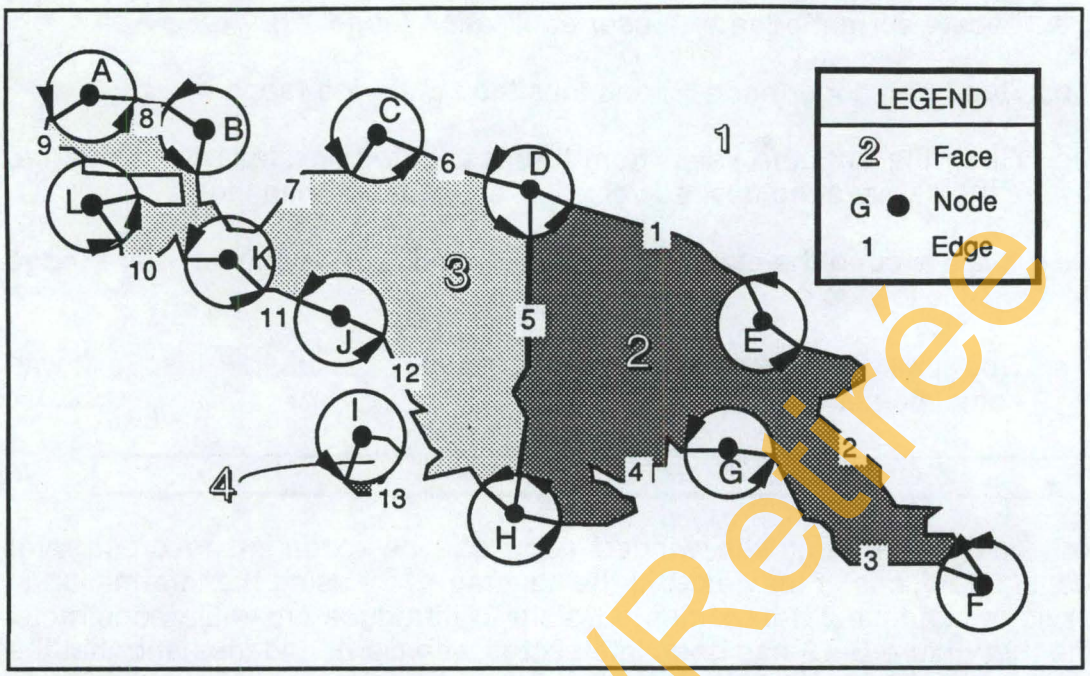
e. Retrieve edge 3, which is the right edge for edge 2.

f. Edge 4 is the right edge for edge 3.

g. Face 2 is to the left of edge 4, so retrieve the left edge (edge 5).

h. Since edge 5 is the original start edge, the face has been navigated completely.

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ID	START_ NODE	END_ NODE	RIGHT_ FACE	LEFT_ FACE	RIGHT_ EDGE	LEFT_ EDGE	COORDS
1	D	E	2	1	2	6	
2	E	F	2	1	3	1	
3	F	G	2	1	4	2	
4	H	G	1	2	3	5	
5	H	D	2	3	1	12	
6	D	C	1	3	7	5	Not Shown
7	C	B	1	3	8	6	
8	B	A	1	3	9	7	
9	A	L	1	3	10	8	
10	K	L	3	1	9	11	
11	K	J	1	3	12	10	
12	J	H	1	3	4	11	
13	I	I	4	1	13	13	

Figure C-19 Example Winged-Edge Topology

The same figure can be navigated as a linear network, regardless of the existence of face topology (ring list, left face, right face). Assume that a line feature table exists for this example and that every line feature has an attribute column that is used to determine the correct edge selection in the network. The value of a line attribute will determine the traversal criteria and also determine when it will end. The starting point and end point of the traversal is dependent upon the users application. The algorithm is as follows:

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a. Locate current edge with user application (edge 12).

b. Read end node (node H) and thus the right edge (edge 4).

c. Read the attribute value from the associated line feature. Does the attribute have the desired value? If so, continue with step e.

d. Cycle around the start node (node H) and retrieve the left edge (edge 5). Go to step c.

e. Decision. Has the network been completely traversed? If so, exit with complete network. If not, go to step b.

C2.3 CROSS-TILE TOPOLOGY

Network navigation using the winged edge can be extended to cross over physical tile partitions, if they exist in the coverage. By using the information in the previous examples, it becomes possible to introduce cross-tile constructs. Assume that Figure C-19 has been intersected with tile boundaries and that the new coverage in Figure C-20 has been created (with generalized edges along edge 5 in Figure C-19). The following discussion concerns retrieving the island separated into the four tiles shown in Figure C-20. Only two of the tile edge tables have been included for the sake of brevity. Note that the face (face 1) must be traversed counterclockwise if the entire island is to be traversed. Since all features, with respect to the universe face, are inner rings, the traversal method must be applied counterclockwise. Navigating clockwise would only retrieve the equivalent of face 2 in Figure C-20.

The same face algorithm described above is used, and the face retrieval proceeds as follows:

a. Start with tile MJ21, edge 1. Read the left edge; notice that choosing either of two edges is possible. Choose to cross into tile MJ11, edge 6.

b. Chain from edge 6, 5, 4, 3, 2, and 1 within tile MJ11.

c. From edge 1, go across to tile MJ12, edge 1.

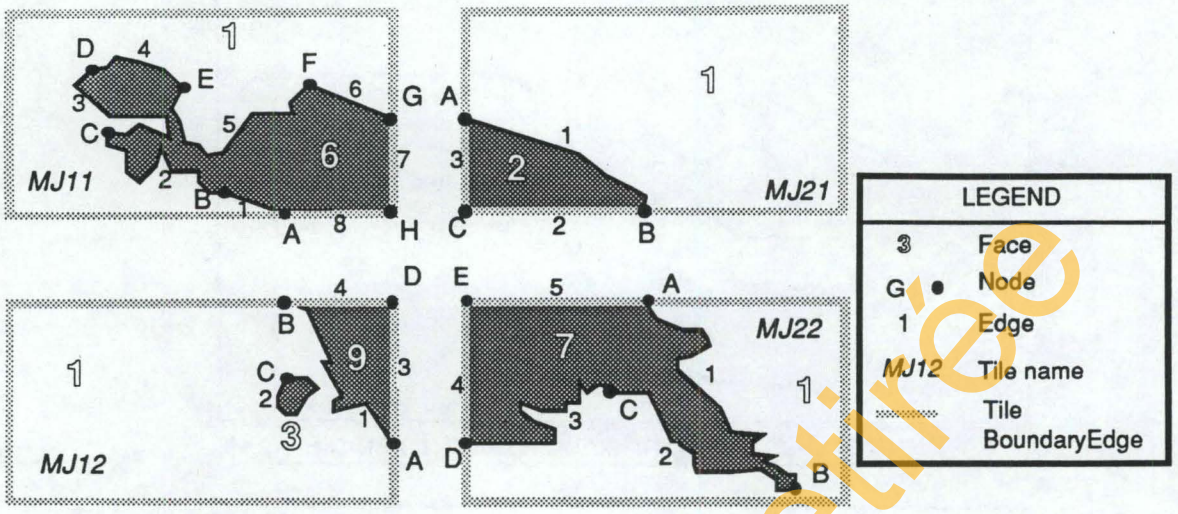
d. Cross tiles into tile MJ22, edge 3.

e. Chain through edges 3, 2, and 1.

f. Cross into tile MJ21, edge 1.

g. When the end of the face cycle is reached, exit.

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TILE MJ21

ID	Start Node	End Node	RightFace Face,Tile,ExFace	LeftFace Face,Tile,ExFace	RightEdge Edge,Tile,ExEdge	LeftEdge Edge,Tile,ExEdge	Coordinates
1	A	B	2, 0, 0	1, 0, 0	2, MJ22, 1	3, MJ11, 6	Not Shown
23	B	C	2, 0, 0	1, MJ22, 71,	3, 0, 0	1, 0, 0	
	C	A	2, 0, 0	MJ11, 6	1, 0, 0	2, 0,0	

TILE MJ22

ID	Start Node	End Node	RightFace Face,Tile,ExFace	LeftFace Face,Tile,ExFace	RightEdge Edge,Tile,ExEdge	LeftEdge Edge,Tile,ExEdge	Coordinates
1	A	B	7, 0, 0	1, 0, 0	2, 0, 0	5, MJ21, 1	Not Shown
2	B	C	7, 0, 0	1, 0, 0	3, 0, 0	1, 0, 0	
3	D	C	1, 0, 0	7, 0, 0	2, 0, 0	4, MJ12, 1	
4	D	E	7, 0, 0	1, MJ12, 91,	5, 0,0	3, 0, 0	
5	E	A	7, 0, 0	MJ21, 2	1, 0, 0	4, 0, 0	

Figure C-20 Cross-Tile Edge Example

C2.4 NAVIGATING FACES USING WINGED EDGES

Since all rings are navigated using winged edge topology, the composition of a face's outer and inner rings are governed by the rules of winged edge topology. Because edges are never considered as lying inside a face, but always as the border of at least one face, floating edges will be considered as an inner ring of a face. Figures C-21a, C-21b, and C-21c, illustrate some cases of inner and outer rings.

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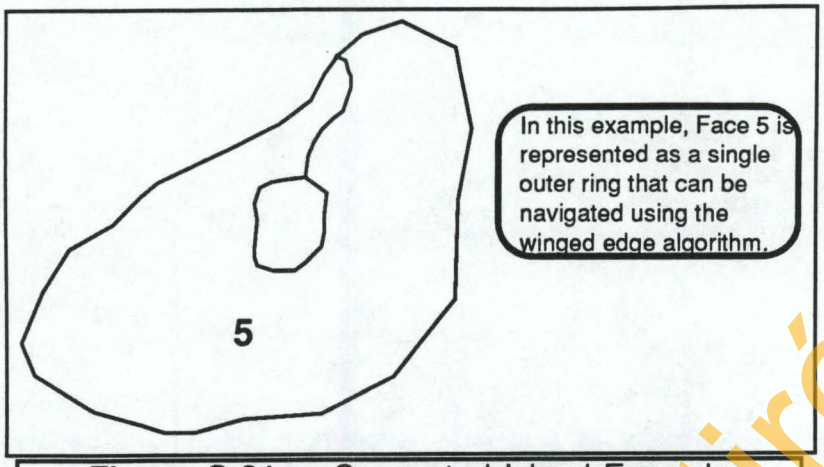


Figure C-21a Connected Island Example

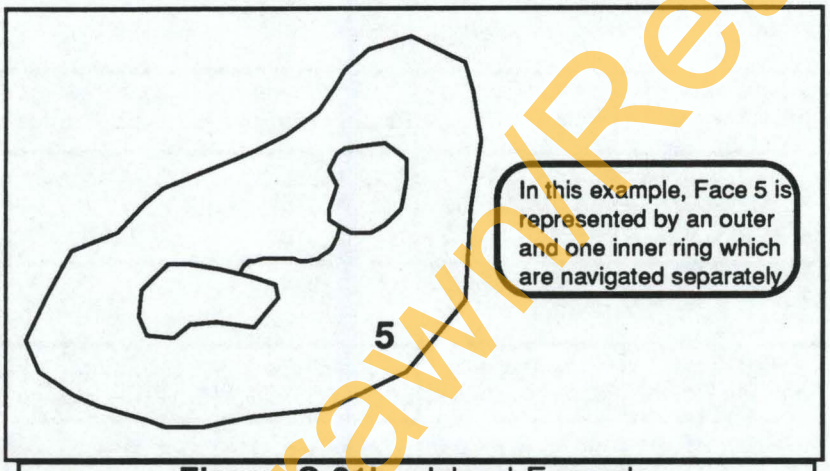


Figure C-21b Island Example

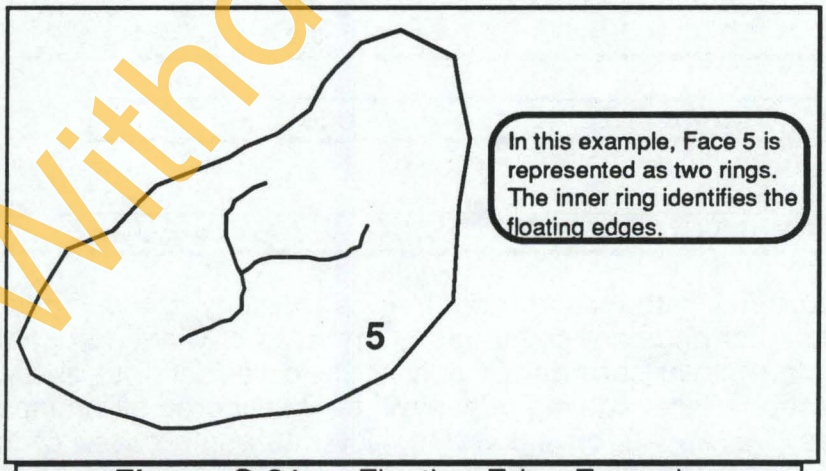


Figure C-21c Floating Edge Example

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ANNEX C APPENDIX 3

C3 FEATURE CLASS DISCUSSION

There are four ways to implement feature classes depending on their relationships between primitives and other features.

C3.1 ONE-TO-ONE RELATIONSHIP

When there is a 1:1 relationship, the table relations are straightforward. The row id of the feature table is used as a foreign key into the row id of the primitive table. This is also true in reverse, as illustrated in Figure C-22.

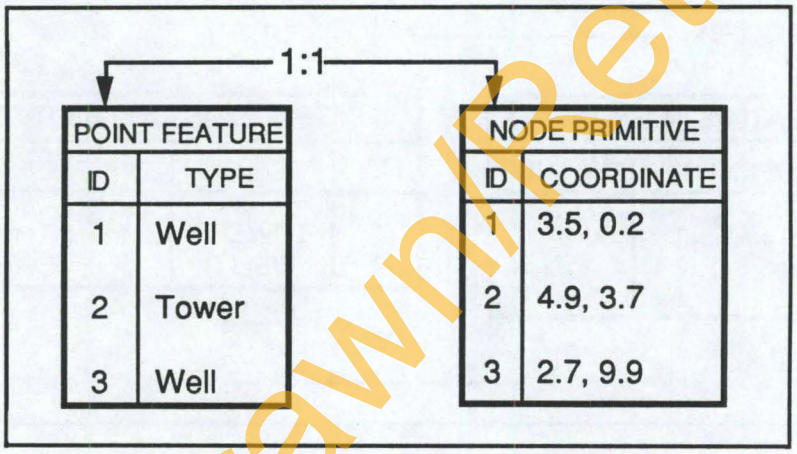


Figure C-22 One-to-One Relationship Example

C3.2 MANY-TO-ONE RELATIONSHIP

When there are coincident features on the same primitive (for instance, when a river and a road contain the same edge), the relationship changes to M:1. The row id relationship defined will not work. A foreign key join column needs to be added to the feature table that will contain the row id into the edge table. Figure C-23 expresses this relation graphically.

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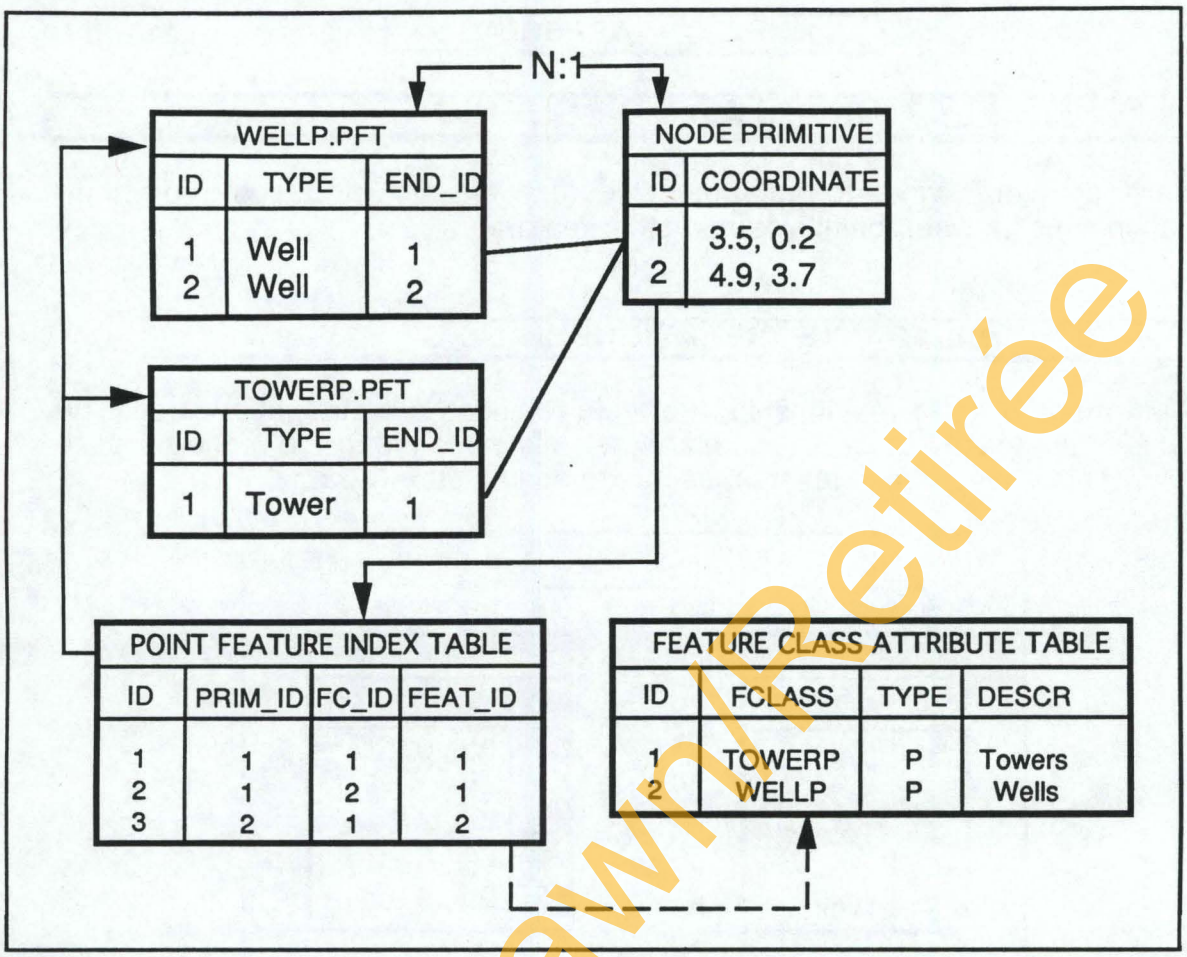


Figure C-23 Many-to-One Relationship Example

Depending on the feature table type, Table C-57 lists the column names that shall be used as the join column name. A feature index (FCA and one or more FITs) may also be used to improve the speed of data access.

Table C-57 Feature Table Join Column Definitions

Area Feature	FAC_ID
Line Feature	EDG_ID
Point Feature	END_ID
Point Feature	CND_ID
Text Feature	TXT_ID

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C3.3 ONE-TO-MANY RELATIONSHIPS

The next type is where one feature is composed of many primitives. This relation requires an additional join column established on the primitive table. The row id of the feature relates to the join column of the primitive table.

This join column is composed of the feature tables name, appended with "_ID", as illustrated in Figure C-24.

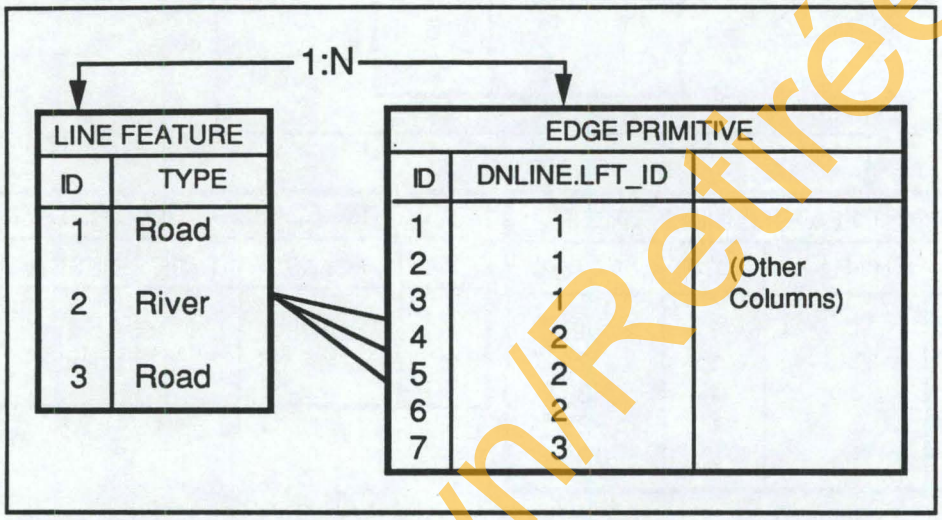


Figure C-24 One-to-Many Relationship Example

C3.4 MANY-TO-MANY RELATIONSHIP

This is where many features can relate to many primitives and the inverse. Many features can relate to one primitive and many primitives can relate back to one feature. This relation is best established using the join table. As seen in Figure C-25, the join table will be longer than either the feature or the primitive table.

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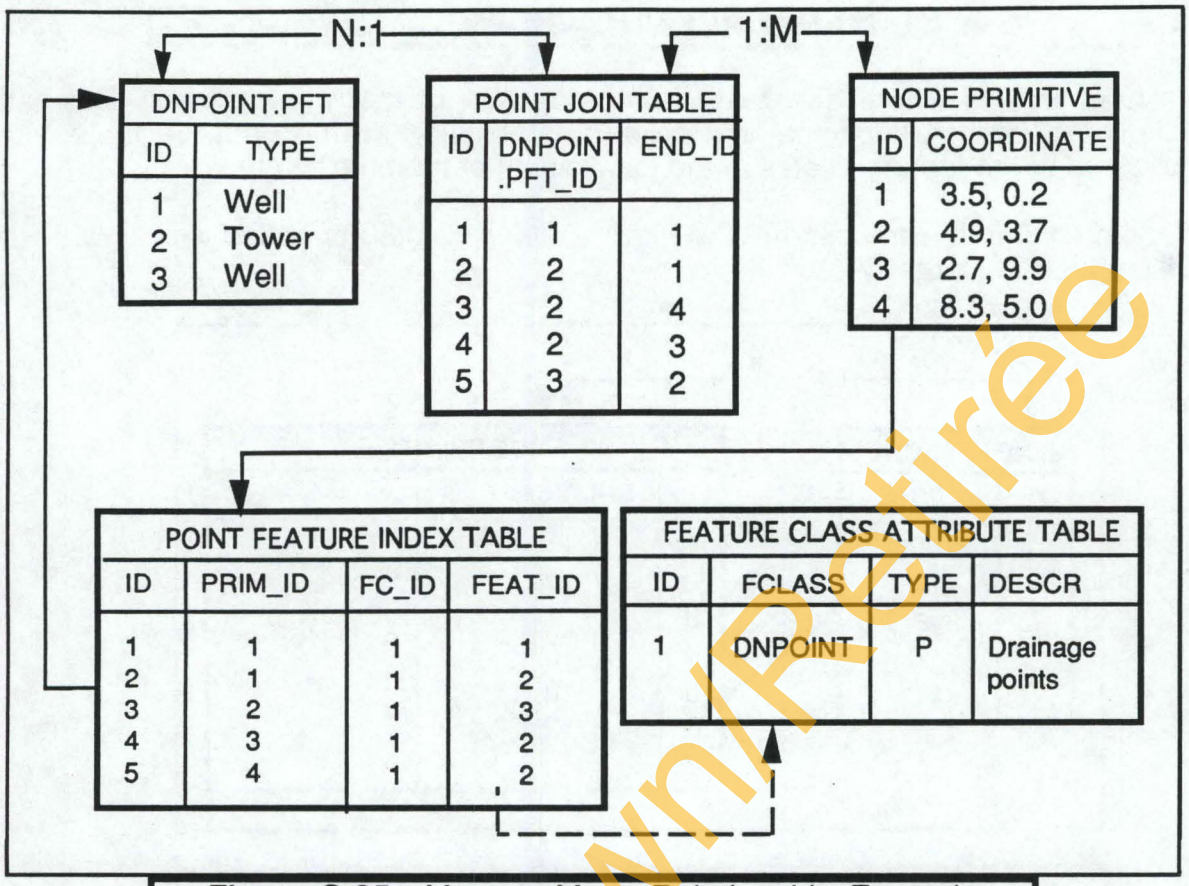


Figure C-25 Many-to-Many Relationship Example

C3.5 COMPLEX FEATURE RELATIONSHIPS

A complex feature may only be constructed from simple features or other complex features. This forms a hierarchical feature relationship. The need for complex features arises when a group of features requires different attributes than that of other features. For instance, in Figure C-26, a complex feature of administrative areas has been defined. Assume that there are more attributes that are specific to administrative areas that are not shown in the figure. Since area, line, and point features may also be lakes, rivers, roads, wells, and buildings, it is better to leave those features and their attributes in their separate feature classes.

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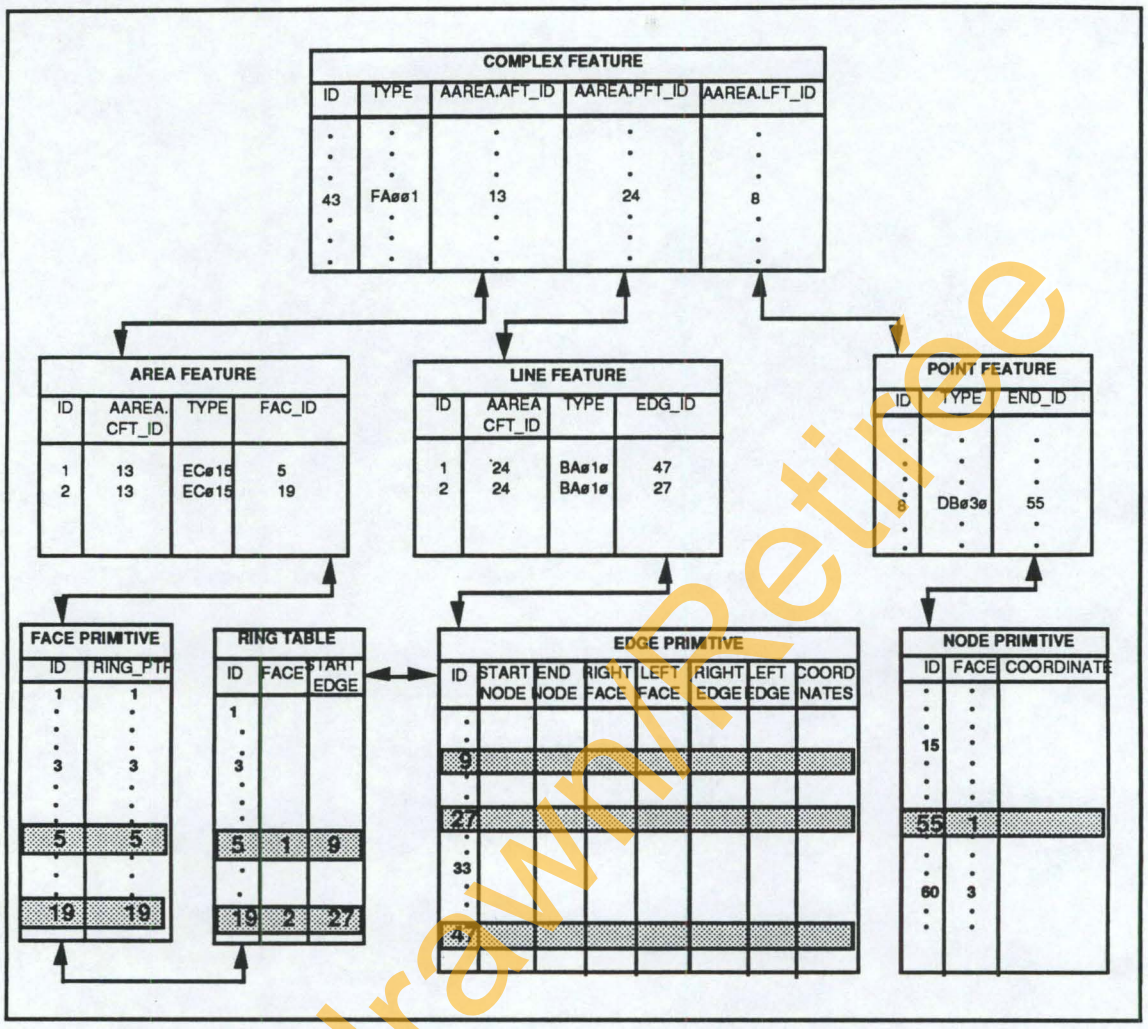


Figure C-26 Complex Feature Relationships

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ANNEX C APPENDIX 4

C4 TILING

Global scale databases inevitably consist of large amounts of data. In processing geographic data, entire files often need to be managed in memory, imposing a definite limit on database size. Tiling is the method used to break up geographic data into spatial units small enough to fit within the limitations of the desired hardware platform and media. Thus, the actual tile size is a product-specific question dependent upon the minimum hardware configuration and distribution media. The following paragraphs describe how VRF implements tiling to subdivide a database.

C4.1 CROSS-TILE TOPOLOGICAL PRIMITIVES

One shortcoming of past tiling implementations occurs when primitives are split up into different files, which also removes the topologic connectivity of the feature. If a lake feature's primitive is split into two separate tiles, the topological connection between the primitives of the lake is lost. They will still appear together when both tiles are drawn on the screen, but any analysis that tries to follow the original connectivity of the lakeshore will have to do a lot of extra processing and searching. It would thus be advantageous for the primitives of the tiled lake shoreline to refer to each other. There is a need for primitives that cross tile boundaries to refer both to the tile boundary itself (in order to maintain polygon topology) and to its cross-tile continuation in order to simplify retrieval of the original feature. VRF meets this need by referring to edges using a triplet id which can contain either an internal reference to a boundary or edge within the current tile or an external reference to an edge in a neighbouring tile or both.

C4.2 FEATURE CLASSES

Tiling introduces a constraint on feature classes as well as primitives. Tiling is a low-level implementation issue related to hardware and storage limitations, and should have no effect upon conceptual structures like feature classes. Unfortunately, when primitives are broken up into separate tables for tiling, their corresponding attributes are broken up as well. VRF resolves this by maintaining the attribute tables and feature class tables unbroken and structuring them so that they can be processed sequentially rather than all at once, thus obviating the need to break them up to meet hardware limits. These tables are stored within a coverage, and the actual file subdivisions representing the tiles appear as directories underneath the coverage. The problem concerns connecting a primitive, now stored in one of many smaller files, to its attributes, now stored in a single large file. This is done in accord with standard relational design rules by adding a column for each feature class onto the primitive file, containing the row id from the master table that has the

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attributes for that primitive. If five feature classes are derived from the primitive topological layer, then five extra columns will be added to that primitive table.

VRF handles tiling and data partition problems at the primitive level by means of the triplet id to maintain cross-tile topology and the extra feature class columns on the primitive to maintain links to the more logically consistent single attribute table. There is also the need to maintain the tiles themselves and to store reference data about the tiles, their size, scheme, and so forth. This is accomplished with the tile reference coverage.

C4.3 TILE REFERENCE COVERAGE

The tile reference coverage is a polygon coverage representing only the tiles. No other data besides tile boundaries and tile labels is used. This is stored as a separate coverage at the library level and acts as a graphic index to the tiling scheme, showing all of the tiles and only those tiles in the library, their names and their relations to each other. The area feature table of this coverage plays a very important role. Since it can store attributes about each tile, it can be used to hold data density figures, tile data volume, summary contents for each feature class, and other metadata to assist in managing the database at a coarse tile-by-tile level. The tile size, actual tile layout, and handling of text that crosses tile borders are not addressed in this standard since they are all product-specific questions.

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ANNEX C APPENDIX 5

C5 VRF DATA QUALITY

This appendix describes basic strategies for storing data quality (DQ) information within VRF databases. The following subclauses discuss general data quality concepts, implementation of the data quality table, and data quality coverages within VRF.

C5.1 GENERAL CONCEPTS

The multilevel structure (i.e., primitive, feature class, coverage, library, and database) of a VRF database affects the strategies used to store DQ information. DQ information is often available at varying levels of specificity, from individual feature attributes to expressions of quality germane to an entire database. Therefore, it is necessary for the VRF data producer to determine the appropriate level in the hierarchy for the various types of DQ information present. When developing an implementation strategy, the data producer should also review the available DQ information within the context of coverage (thematic) associations as well as spatial extent, as these will influence the use of standard data quality tables and/or the development of separate data quality coverages.

When DQ information is stored at multiple levels in a VRF database, lower level information always takes precedence over that at higher levels. Data producers should account for this when compiling DQ information to be stored in VRF. For example, a data producer may make a general statement at the library level that a coverage has been derived from a range of sources, and specify at the primitive level what a given feature's exact origins are. Alternatively, some variations may be organized by simple spatial divisions, such as source map boundaries. In such a case, feature level source information would be highly repetitious, and a data quality coverage might be most effective.

C5.2 DATA QUALITY TABLES

The data quality table (see C.7) is a device for storing standard and nonstandard types of DQ information. Standard information is explicitly defined within the DQ table. Nonstandard information is that which is not accounted for in the DQ table and must be stored outside the standard fields. The DQ table can be implemented on the database, library, or coverage level, depending upon the uniformity of the affected data with respect to known DQ characteristics. Key characteristics are source, positional accuracy, attribute accuracy, logical consistency, completeness, resolution, and lineage. All of these characteristics can be documented within standard DQ table fields, with the exception of lineage.

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C5.2.1 LINEAGE

Lineage information must be stored within the DQ table narrative file, which should be given the name "LINEAGE.DOC." The lineage file is an important component of the DQ documentation system, since the data producer must inevitably make key decisions affecting the data's fitness for use that cannot be described in standard fields. Lineage information may also change significantly from coverage to coverage, even when all of the data is derived from a single source. At a minimum, the lineage file should contain information on processing tolerances, interpretation rules applied to source materials, and basic production and quality assurance procedures. All lineage information available through the source should also be incorporated here.

C5.2.2 PLACEMENT OF DQ TABLE

When implementing DQ tables, the user must determine at what level within the VRF hierarchy the DQ table(s) should be established. This will vary depending upon the specific nature of the DQ information. For example, entire libraries originating from a single source may be best served with a single table at that level, augmented by a series of data producer-defined tables implemented at the coverage level to document more specific information. The DQ table can also be implemented on multiple levels simultaneously, with general (broad) information provided at the higher levels, and progressively more detailed information specified at the lower levels. At a minimum, some form of DQ information should be present at the database or library levels to provide an overview of characteristics and to describe the techniques used to store DQ information within the database as a whole. With respect to VRF tables in general, the data producer is not restricted to the standard DQ table. It can be augmented as needed with producer-defined related files within the hierarchy.

C5.3 DATA QUALITY COVERAGES

Data quality coverages delineate spatial variations in DQ information across a database or a library by assigning unique quality characteristics to areas. Within this context, the database and library levels must be viewed as having distinct spatial extents to which attributes can be assigned, while data quality coverages are created to document spatial variations on a more detailed level. DQ coverages are very useful as visual reference data that allow data producers to capture anomalous data behavior within the context of known spatial variations. They are, by definition, level 3 topology coverages. They can be physically stored at any level (above the feature level) within the VRF hierarchy, independent of the level of information being represented. The manner in which the DQ information is structured within the coverage will be dependent upon the relationships between spatial variations, data sources, and lineage information. Edges, as well as areas, can also be attributed within DQ coverages, for example, to document the interaction of disparate data sets that

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are not well reconciled. A more specific example is where contour lines from different data sources meet along a common edge and fail to match positionally. In this case, the data producer could document this discrepancy as an attribute of the seam (edge) between the adjacent sources.

Unlike tabular DQ information, the data producer should refrain from creating "nested" DQ coverages at multiple levels, as these can greatly complicate the interpretation of the information. Rather, the user is encouraged to adopt a more integrated approach, where general information is carried on lower level polygons in addition to level-specific information.

C5.3.1 COVERAGE COMPONENTS

VRF provides a variety of mechanisms for storing DQ information within coverages, including attribute tables, standard data quality tables, optional user-defined relational tables, and non-feature-linked text (annotation). The mechanisms employed vary depending primarily upon the types of information being stored, rather than the VRF level at which it will reside. DQ coverage attribute tables offer the highest degree of flexibility in storing DQ information, since users can design their own table formats and specifically code those components that vary spatially across the data set. Standard DQ tables are particularly useful for data sets where characteristics change radically (with respect to source) from one area to another. In this application, data quality tables are stored as multiple records, with each complete DQ table record corresponding to a face. Within this context, it may be particularly appropriate for data producers to implement subsets or supersets of the standard DQ table. Additional relational tables are useful in normalizing complex data, a technique that is particularly helpful when addressing thematic-based variations in DQ information (see C5.3.2.2 below). Finally, text information is useful for describing phenomena without well-defined spatial extents or for annotating special conditions that do not occur with sufficient frequency to justify creating attribute fields to describe them.

C5.3.2 COVERAGE EXAMPLES

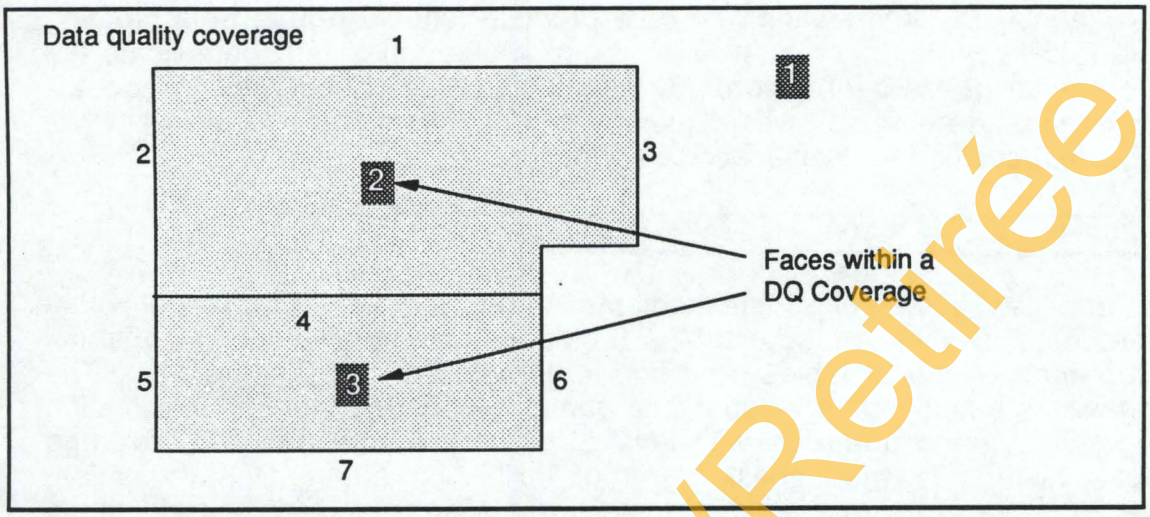
The following subclauses provide examples of how DQ coverages may be designed under a variety of conditions. The user is encouraged to adopt these approaches when appropriate and to modify them when necessary. Whenever possible, the producer should use coverage level descriptive tables to document the strategy employed in designing and developing DQ coverages for a database.

C5.3.2.1 SHARED REGIONS AND COMMON ATTRIBUTES

The most simple DQ coverage is one where spatial variation of DQ information is shared by all coverages within a library, and DQ attributes are well defined.

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Recognizing that some nonstandard DQ information may be associated with certain regions, simple relational tables with fields keyed to coverage identifier can be constructed. Edge attributes may also be stored in a separate table. An example of this concept is shown in Figure C-27.



DQ.AFT

ID	DATE	SOURCE	RELIABILITY
1	Null	Null	Null
2	6/78	ONC	Good
3	7/83	ONC	Fair

DQ.AFT

ID	COMMENTS
1	None
2	Some features badly match
3	None
4	All features mismatched
5	None
6	Many features mismatched
7	Many features mismatched

DQ.COM

ID	DQ.AFT_ID	COVERAGE	COMMENTS
1	Null	Null	Null
2	2	HYNET	Some contours are missing

Related table for other coverage comments

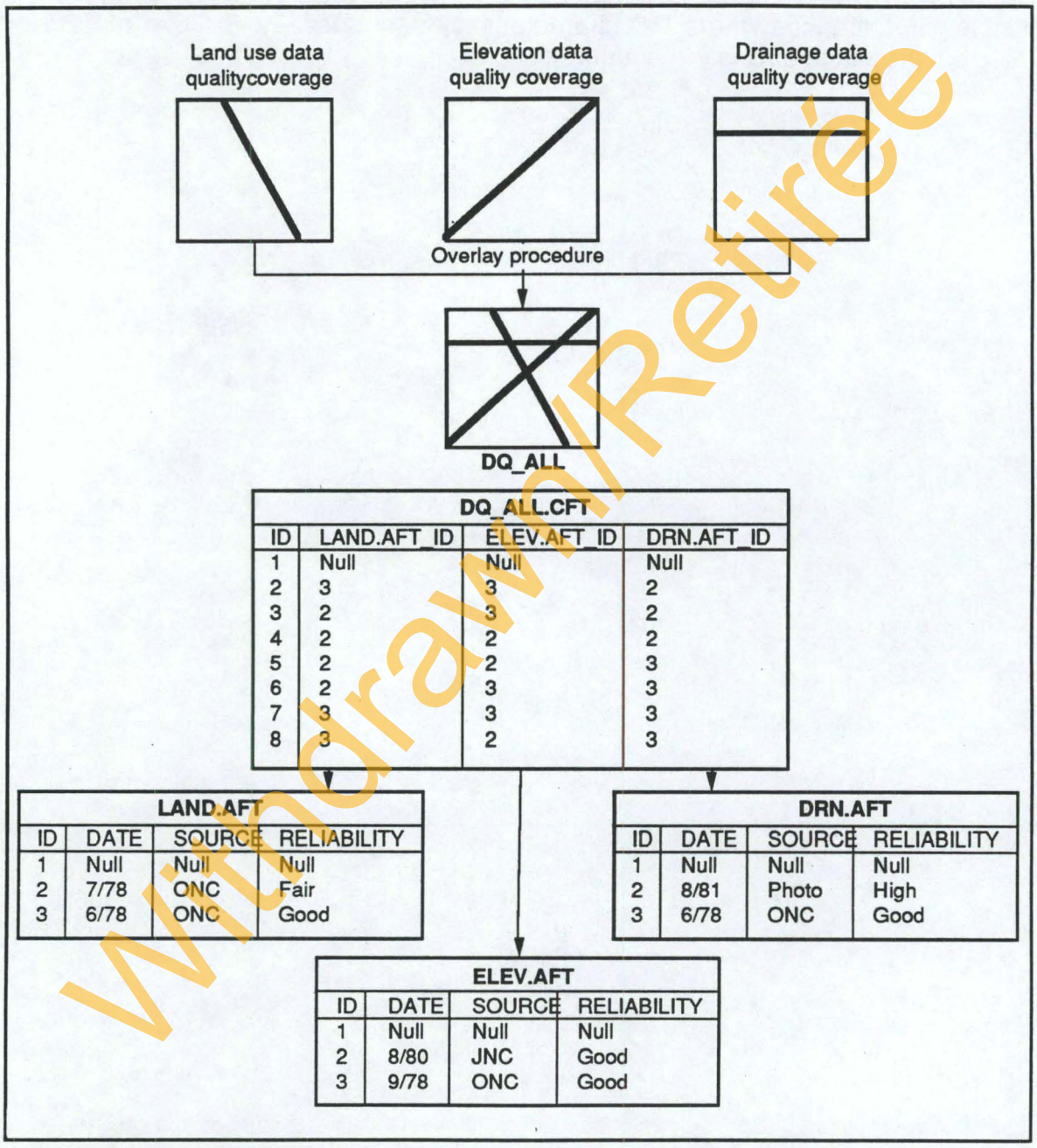
Figure C-27 Data Quality Coverage

C5.3.2.2 COVERAGE-SPECIFIC INFORMATION

The previous subclause described the basic constructs for describing characteristics of any data set with common spatial components to the reliability information. However, in some cases, the data producer may wish to describe characteristics, within a single coverage, where quality information has spatial extents that vary from coverage to coverage. Figure C-28 describes a scenario for organizing information under these conditions. The basic approach is to

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develop a single integrated coverage where the smallest faces are the product of the intersection of the various coverage-based data. Coverages organized in this manner are relatively easy to maintain, particularly for selective updating where new faces affect more than one primary data coverage. An alternative approach would be to maintain a series of separate coverages.



DQ_ALL.CFT

ID	LAND.AFT_ID	ELEV.AFT_ID	DRN.AFT_ID
1	Null	Null	Null
2	3	3	2
3	2	3	2
4	2	2	2
5	2	2	3
6	2	3	3
7	3	3	3
8	3	2	3

LAND.AFT

ID	DATE	SOURCE	RELIABILITY
1	Null	Null	Null
2	7/78	ONC	Fair
3	6/78	ONC	Good

DRN.AFT

ID	DATE	SOURCE	RELIABILITY
1	Null	Null	Null
2	8/81	Photo	High
3	6/78	ONC	Good

ELEV.AFT

ID	DATE	SOURCE	RELIABILITY
1	Null	Null	Null
2	8/80	JNC	Good
3	9/78	ONC	Good

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Figure C-28 Coverage-Specific Information

C5.4 CONCLUSION

VRF provides a number of options for encoding data quality information. The information itself can be encoded at any level within the VRF structure depending upon its basic thematic and spatial characteristics. VRF data producers are encouraged to make use of the data quality table whenever possible. In instances where DQ characteristics vary spatially, the use of data quality coverages is strongly recommended.

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ANNEX C APPENDIX 6

C6 SPATIAL INDEXING

The purpose of a spatial index is to optimize retrieval of feature information based on a spatial or geographic query. The spatial index helps software retrieve the correct records in O log(n) time instead of the linear search time of O log (n*n). VRF provides four levels of spatial decomposition of the database: the tile directory, the spatial index, the bounding rectangle, and the primitives' coordinates.

C6.1 SPATIAL DECOMPOSITION IN VRF

VRF supports four types of spatial decomposition and indexing.

C6.1.1 TILE DIRECTORY

The first level is the data organization of the tile. Tiles maintain primitives spatially distributed into separate directories; thus, software will only enter a tile when it is known that the query will fall within its borders.

C6.1.2 SPATIAL INDEX FILE

The spatial index is the level where the most speed can be obtained in a query. It is recommended that each primitive maintain its associated spatial index file. Background on this file can be found in C6.2 below.

C6.1.3 BOUNDING RECTANGLE FILE

Mandatory for the face and edge primitive is the bounding rectangle table. This table allows rapid retrieval of the primitives spatial extent and is used after the spatial index routine generates the selected primitive ids. This check is necessary to ensure that the spatial index has, in fact, provided an accurate response to the query.

C6.1.4 PRIMITIVE COORDINATES

Sometimes it is necessary to exhaustively check the primitives themselves for a spatial query. Point and text features do not require bounding rectangles, so it is necessary for the software to check the coordinates to insure accurate retrieval of primitive ids.

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C6.2 SPATIAL INDEX FILE

The spatial index file internal structure in VPF is based on an adaptive grid binary tree. This method is powerful because it can handle all types of spatial queries (point, rectangle, and amorphous polygon). The input primitives are broken down into a grid-based binary tree. At each cell (of the tree) there is an 8-bit MBR and a list of the primitive ids that are found at this level of the tree.

The tree is created by storing primitive ids at a cell of the tree. If the cell fills to the buffer limit, then the cell is split into right and left sons of the cell. The primitive ids are then distributed into either son depending on the primitive MBRs. If a primitive MBR falls across both tree cells, the primitive id remains in the parent cell.

When examined spatially, the spatial index divides a tile into subelements (the cells of the tree); as shown in Figure C-29. Each split results in dividing the parent cell into half. The first split is into right and left halves; the next split is into top and bottom halves; then right and left halves again; and so on.

The actual format of the spatial index file consists of the following:

- a header containing the number of primitives, the minimum bounding rectangle of the entire spatial extent of the tree (usually a tile), and the number of cells in the tree;
- a bit array of the tree. Each bit represents the tree cell id. It is set to 1 if primitive ids exist at the cell; and
- each tree cell written as a record. The format is an 8-bit integer MBR and a list of primitive ids at that cell of the tree.

Tree navigation. For any cell, the cell from which it was generated is the integer value obtained by dividing by two. Thus, cell 3 points back to cell 1 [INT(3/2)], as does cell 2.

New cells created by splitting are numbered by multiplying the current cell by two and adding one for the second new cell. Thus, cell 2 becomes cells 4 and 5, and cell 3 becomes cells 6 and 7.

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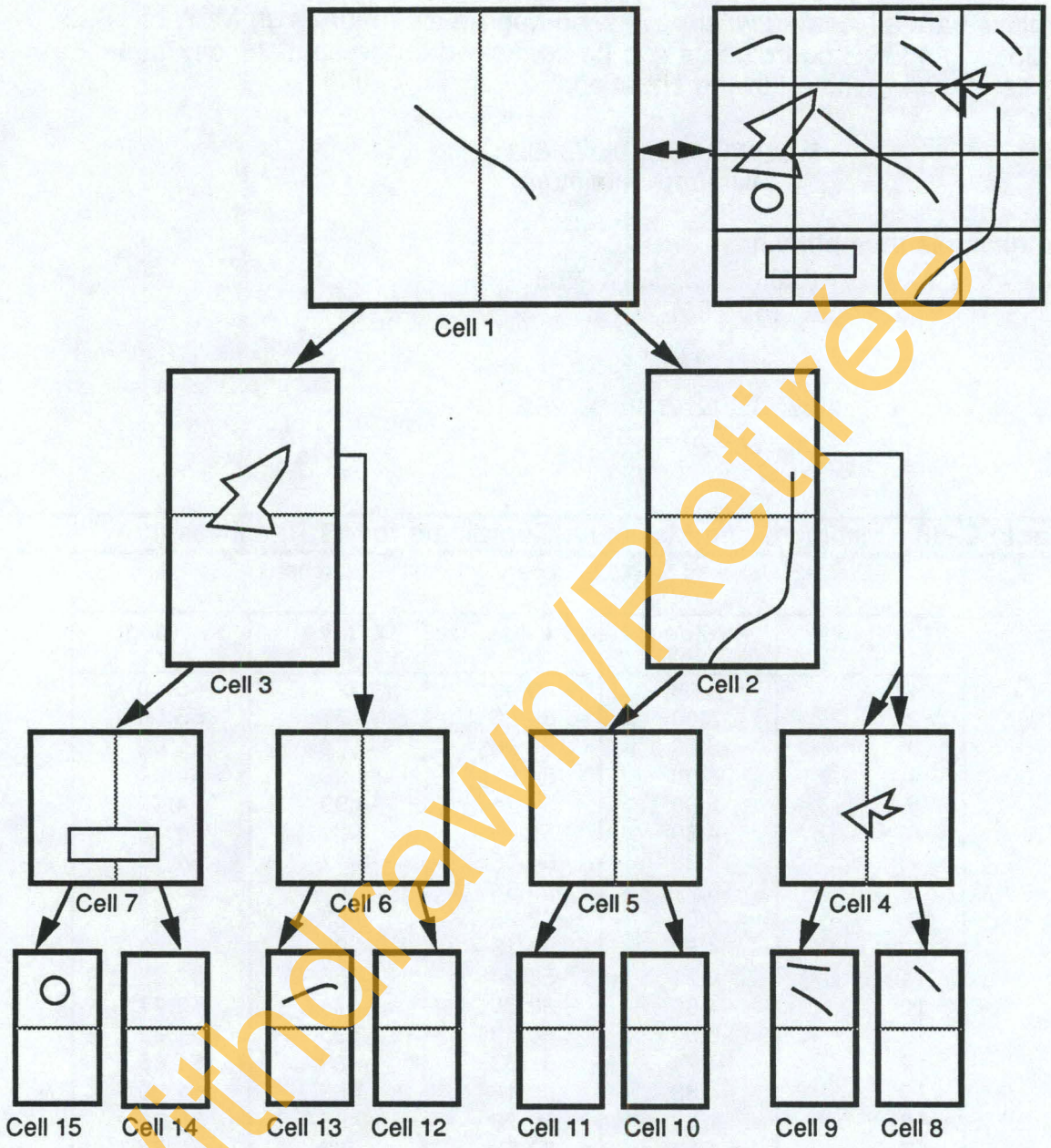


Figure C-29 Spatial Index Cell Decomposition

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Spatial index coordinate system. The coordinate system for the spatial index is based upon 1-byte integers, so a primitive's MBR must be converted to the spatial index coordinate system. All coordinates are relative to the lower left corner of the tile and range from 0 to 255.

Examples of spatial index creation. Table C-58 is a listing of the minimum (x_1, y_1) and maximum (x_2, y_2) coordinates of the MBRs of 19 face primitives. The coordinate values in Table C-58 are all in degrees. The

primitives are all located within a 5- by 5-degree tile that has an MBR of (-5, 50), (0, 55). The MBR coordinates can be converted to the spatial index coordinate system by using the following equation:

$$\frac{(\text{Coordinate} - \text{minimum})}{(\text{Maximum} - \text{minimum})} \times 255$$

Our example thus becomes:

$$\frac{(\text{Latitude} - 50)}{(55 - 50)} \times 255$$

and

$$\frac{(\text{Longitude} + 5)}{(0 + 5)} \times 255$$

Table C-58 Minimum and Maximum Coordinate for 19 Primitives in a Tile.

Note: Universe or Tile Boundary is Primitive Number 1

Primitive Ids	x_1 (deg)	y_1 (deg)	x_2 (deg)	y_2 (deg)
1	-5.00	50.00	0	55.00
2	-5.00	54.63	-3.57	55.00
3	-5.00	52.00	-2.74	55.00
4	-5.00	54.91	-4.99	54.94
5	-5.00	54.76	-4.99	54.77
6	-4.80	54.06	-4.31	54.42
7	-3.28	54.05	-3.17	54.15
8	-0.71	53.54	0	53.74
9	-0.57	53.68	-0.53	53.69
10	-4.60	53.13	-4.05	53.43
11	-4.71	53.24	-4.56	53.33
12	-4.80	52.75	-4.78	52.77
13	-5.00	50.53	-2.35	51.82
14	-4.71	51.63	-4.68	51.65
15	-4.68	51.16	-4.65	51.20
16	-1.03	50.78	-0.95	50.84
17	-1.59	50.58	-1.08	50.77
18	-1.99	50.69	-1.96	50.70
19	-5.00	50.16	-4.99	50.17

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The results of this conversion are listed in Table C-59.

Table C-59 Minimum and Maximum Spatial Index Coordinates

Note: Universe or Tile Boundary is Primitive Number 1.

Primitive Ids	x_1	y_1	x_2	y_2
1	0	0	255	255
2	0	236	74	255
3	0	102	116	255
4	0	250	1	253
5	0	242	1	244
6	10	206	36	226
7	87	206	94	212
8	218	180	255	191
9	226	187	228	189
10	20	159	49	176
11	14	165	23	170
12	9	140	12	142
13	0	26	136	94
14	14	83	17	85
15	16	59	18	62
16	202	39	207	43
17	173	29	200	40
18	153	35	155	36
19	0	8	1	9

If the MBRs of each primitive are plotted, they appear as shown in Figure C-30. In Figure C-31, dividing lines have been added to Figure C-30 to show that primitive 13 is present in both the left and right halves of the tile, and that primitive 3 is present in both the top and bottom halves of the tile.

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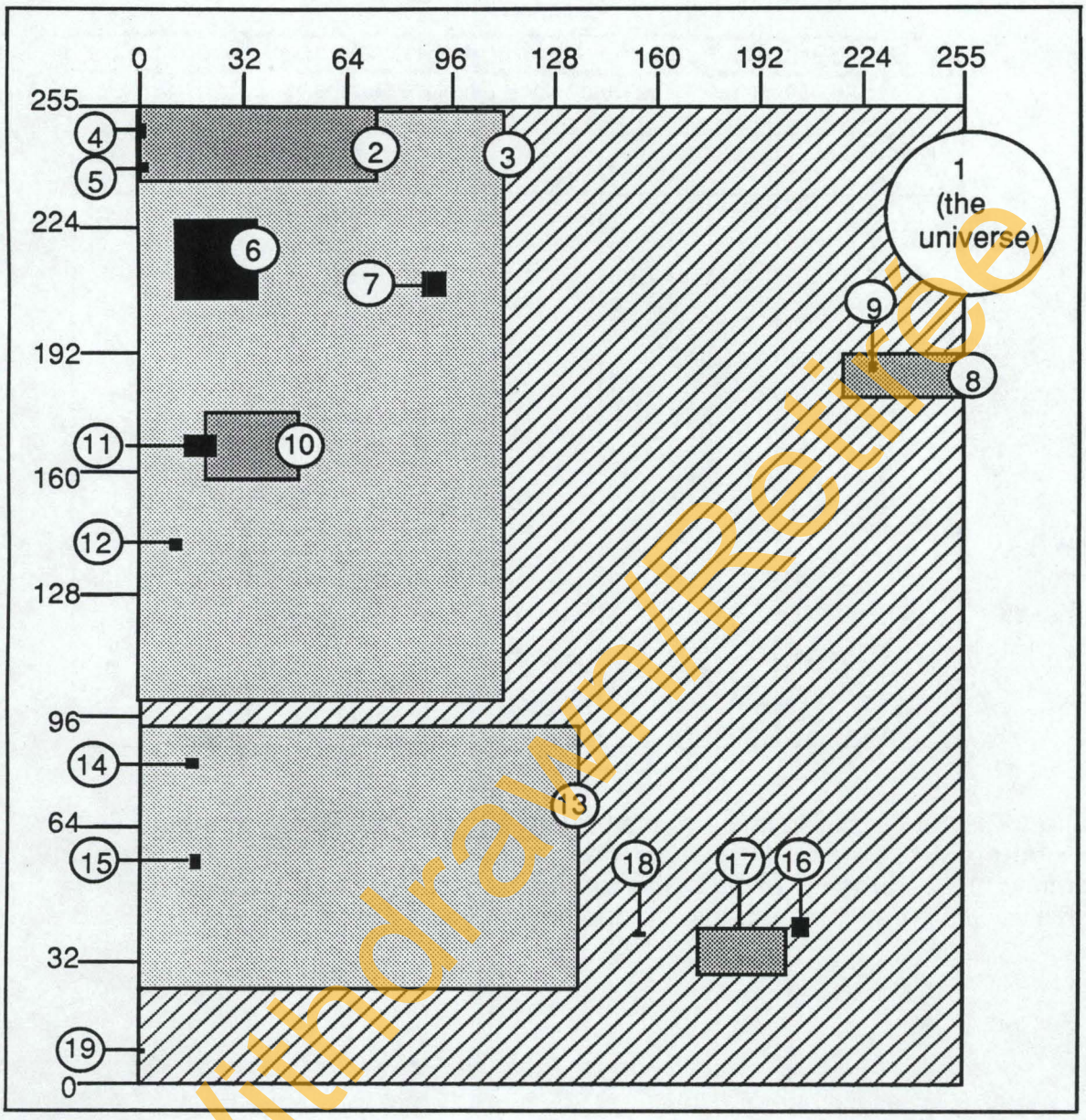


Figure C-30 Location of MBRs in Tile

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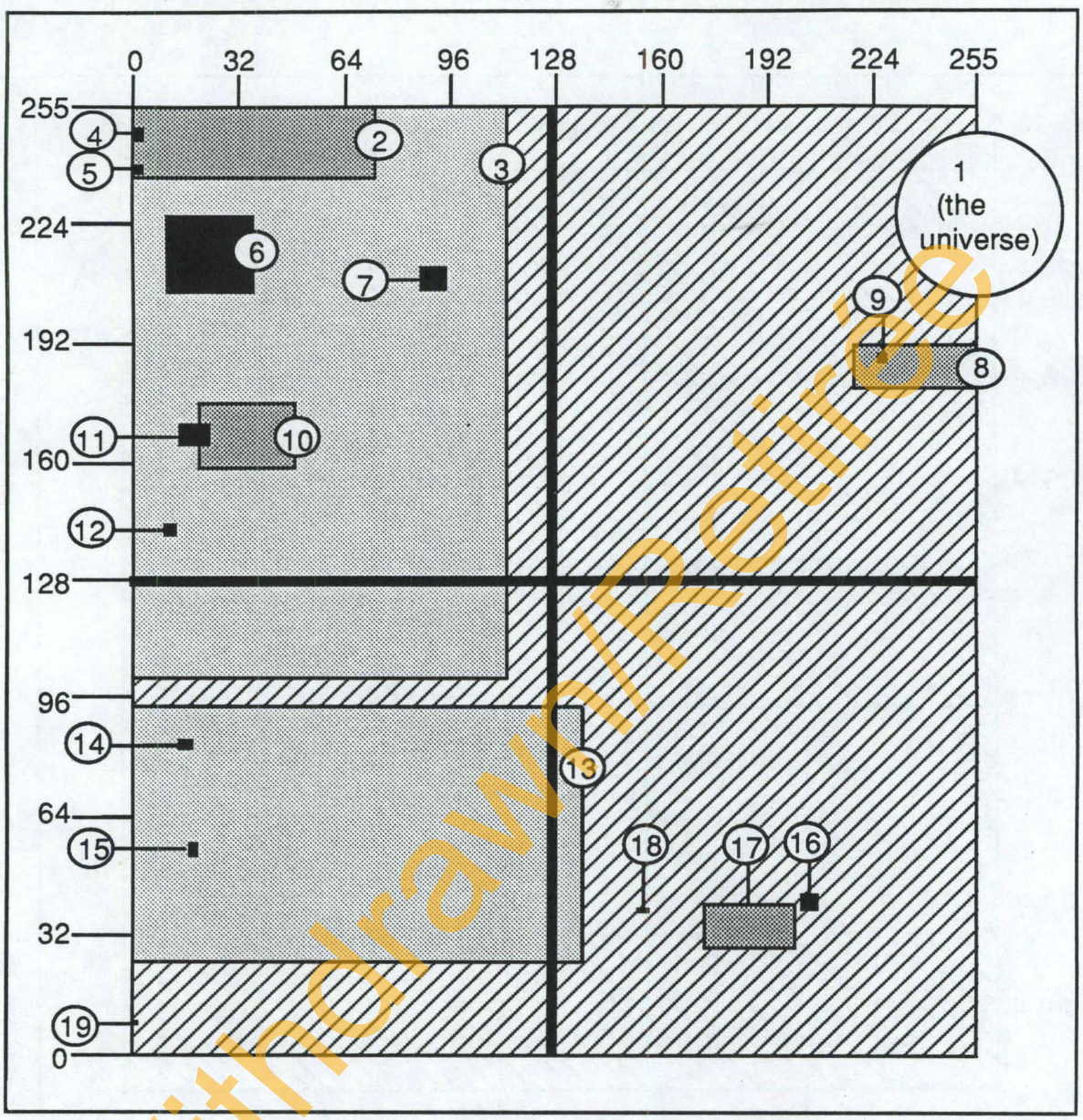


Figure C-31 Tile Content Divided in Four Quarters

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Example of tree creation. The first split of the tile puts primitives 8, 9, 16, 17, and 18 into cell 2 and places primitive 3 into cell 3 (Figure C-33). Primitive 13 and the universe primitive (1) must be held in cell 1 (Figure C-32) because neither of the split cells contains the entire MBR for either 13 or 1.

The next split (of cell 3; Figure C-34) puts primitives 2, 4, 5, 6, 7, 10, 11, and 12 into cell 6 and primitives 14, 15, and 19 into cell 7. Note that no primitives were allocated to cells 4 and 5, since all of the primitives on the right half of the tile could be held in cell 2.

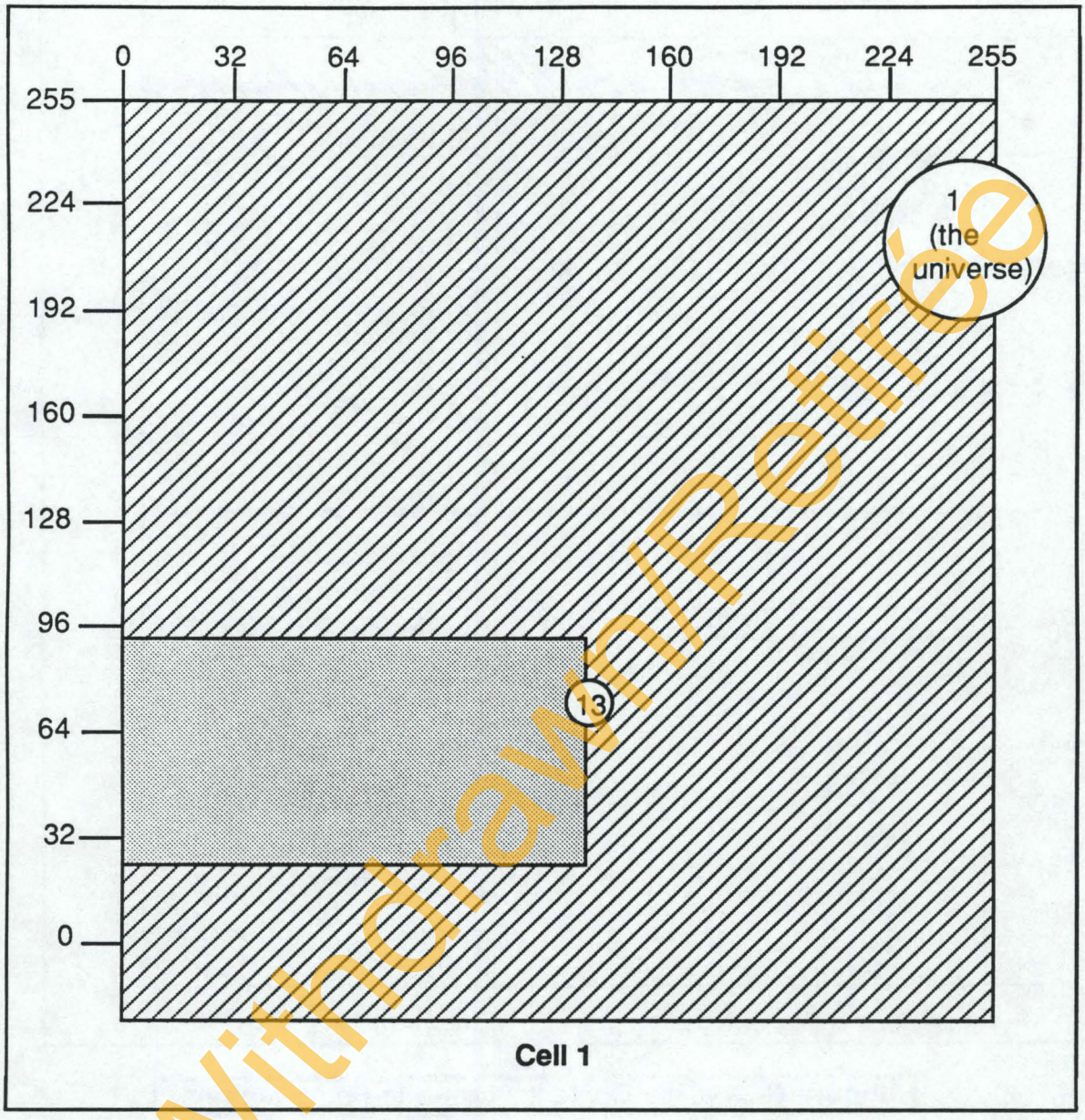


Figure C-32 Content of Cell 1

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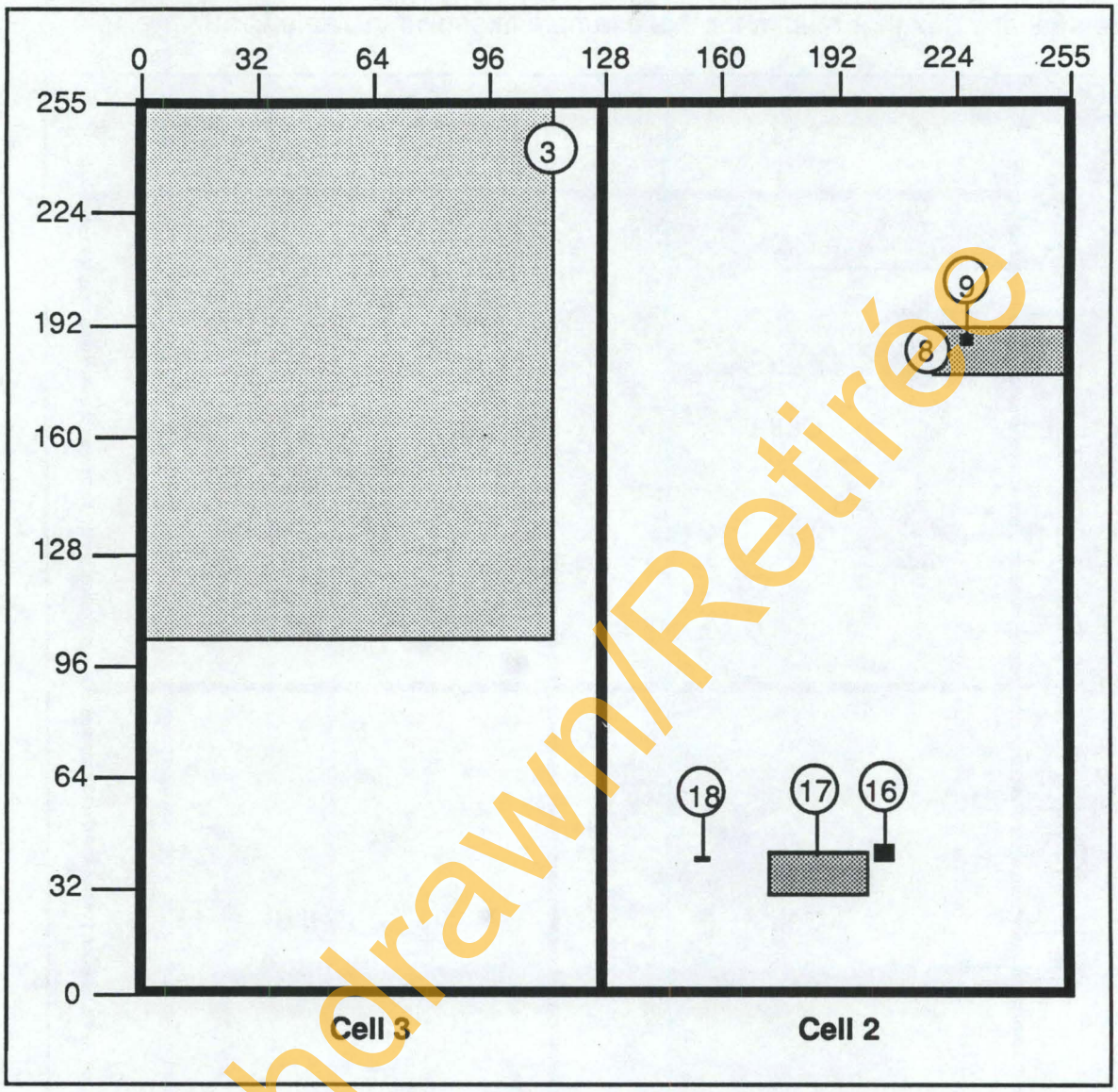


Figure C-33 First Cell Split

All of the primitives in this example have now been allocated to the tree. For more complex tiles, the tree process continues until either (a) no cell has more than some maximum desired number of features; or (b) the subdivision process reaches the coordinate integer limit (255).

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The spatial index that results for this example is shown in Table C-59.

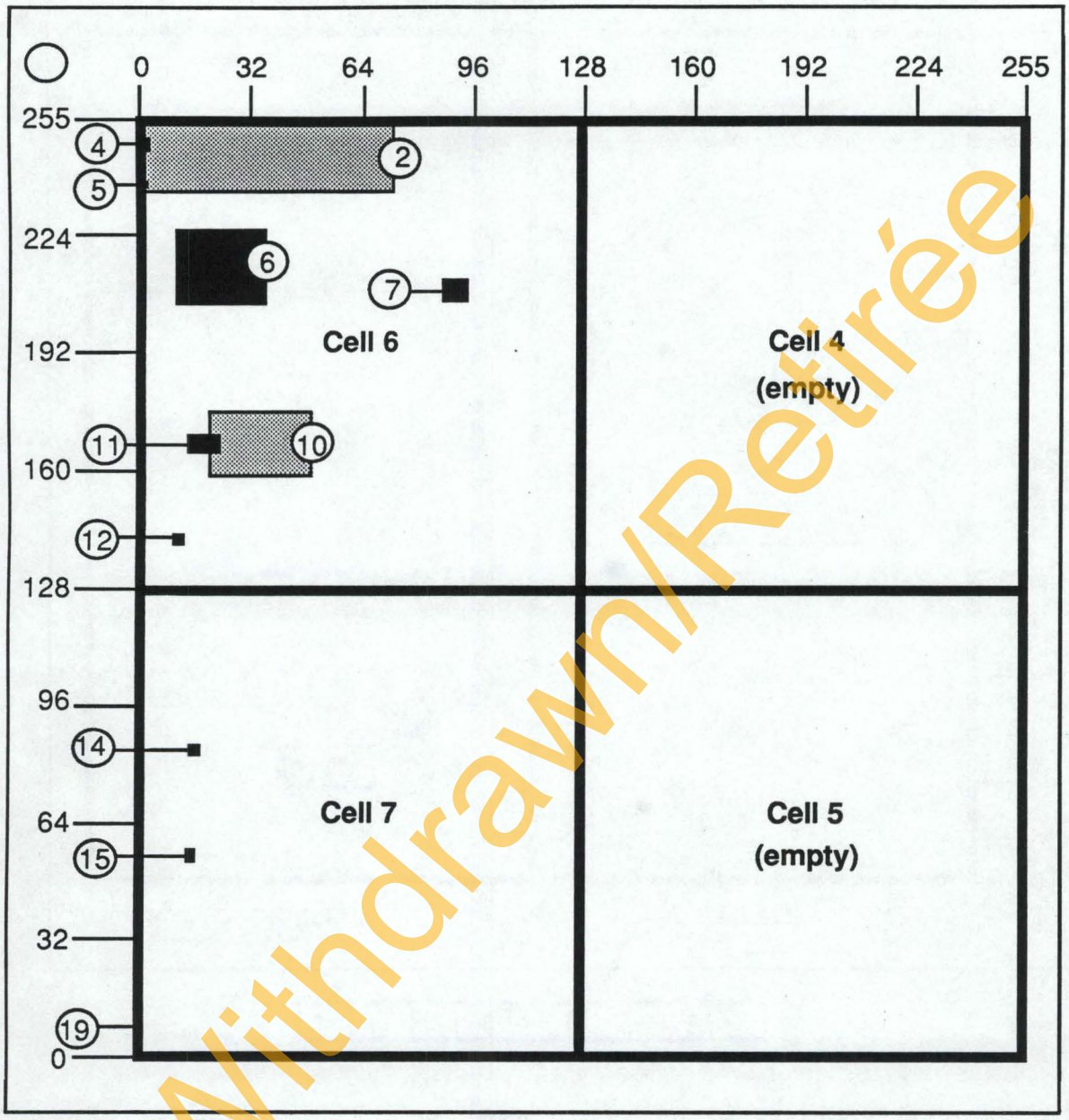


Figure C-34 Second Cell Split

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Table C-60 Example of Spatial Index

Header:

Number of features: 19 MBR: -5.00, 50.00, 0.00, 55.00 Number of cells: 7

Directory:

Cell	Offset	Feature count
1	0	2
2	16	5
3	56	1
6	64	8
7	128	3

Data:

Row	x_1	y_1	x_2	y_2	Primitive ids
Cell 1					
1	0	26	136	94	13
2	0	0	255	255	1
Cell 2					
3	153	35	155	36	18
4	173	29	200	40	17
5	202	39	207	43	16
6	226	187	228	189	9
7	218	180	255	191	8
Cell 3					
8	0	102	116	255	3
Cell 6					
9	87	206	94	212	7
10	10	206	36	226	6
11	0	242	1	244	5
12	0	250	1	253	4
13	0	236	74	255	2
14	20	159	49	176	10
15	14	165	23	170	11
16	9	140	12	142	12
Cell 7					
17	0	8	1	9	19
18	16	59	18	62	15
19	14	83	17	85	14

Withdrawn/Retirée

Spatial query. A spatial index can support a spatial query in several ways. For node primitives, software may require the point to be within a specified distance of a pixel designated during the query process, or within a box generated during the query process. For an edge primitive, the software may specify that candidate edges are to be within some specified perpendicular distance of the query pixel or have MBRs that intersect a query box. For a face primitive, the software may define the candidate edges as having MBRs that intersect a query box, be fully contained within the query MBR, or be determined by solving the "point-in-polygon" puzzle. In any case, the spatial index forms the starting point for the database search. It works as follows:

a. The user designates a query point (pixel).

b. The software converts the query point into the spatial index coordinate system ((0,0) to (255,255)).

c. The software determines the smallest cell id.

d. The software tests all features within the smallest cell, if any, to determine if these features qualify for the query response.

e. The software calculates the next larger cell (INT of cell id divided by two).

f. The software repeats the test (if necessary) and continues to increase cell size until cell 1 is reached.

Spatial query using the sample tree:

a. The software points at cell 5 and gets nothing.

b. The software goes to cell 2 and gets faces 8, 9, 16, 17, and 18.

c. The software checks the MBR of faces found to determine if they include the query point.

d. The software goes to cell 1 and gets face 13.

e. The software checks the MBR of face 13 to determine if it includes the query point.

f. The software reports the query result.

Withdrawn/Retirée

C6.2.1 TREE CREATION

Creation of this tree follows a fairly simple algorithm. Basically, the tree is created by storing primitive ids at a node level. If the node fills up to the buffer limit, then the node is split into left and right sons. The primitive ids are then distributed into either son depending on the MBR. If the primitive MBR falls across both nodes, the primitive id remains in the parent node.

The algorithm is fairly straightforward:

a. Read record from primitive table, create bounding rectangle (or read from MBR table). Set NODE to 1. If done, go to f.

b. Go to NODE level.

c. Does the primitive MBR fit into this node's MBR? If not, go to e.

d. Is there room to store it at NODE? If yes, store it and return to a. If not, split the node into left son and right levels. Check the primitive list and store the primitive ids in the respective left son, right son, or parent node. Go to a.

e. Which node should it belong? Increment NODE level and go to b.

f. Tree creation is done. Write out index file as such:

1. Write out header record of number of primitives and bounding rectangle.

2. Create and write out bit array of the tree. Each bit represents the node number of the tree. It is set to 1 if primitive ids exist at a node.

3. Write out each node as a record. The format is an 8-bit integer MBR and a list of primitive ids.

g. Exit; algorithm completed.

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D. DIGITAL GEOGRAPHIC DATA VOLUME TRANSMITTAL FORM

DATA EXCHANGE FORM

Part 1. — National Organizations

1. SENDER: _____ 2. ADDRESSEE: _____

3. SECURITY CLASSIFICATION: T S C R U

4. SPECIAL HANDLING:

Date & Level of Downgrading: _____

Bi or Multilateral agreement(s): _____

Agreement between Country(s): ___

Name / Signature: _____

Creation Date: _____

Part 2. — Data Exchange Specifications

5.a. EXCHANGE MEDIA:

Type:		**Spec:**	
	Mag. Tape: _____	_	Density: _____
	CD-ROM: _____	_ 1	.4MB: _____
	3.5" Floppy: _____	_	1.2MB: _____
	5.25" Floppy: _____		720K: _____
			Other: _____
			4mm: _____
			8mm: _____
	Cartridge _____	_	Other: _____

5.b. FORMATTING / COMPRESSION:

Number of Cylinders: _____

Number of Sectors: _____

Compression: _____ Yes: _____ No:

Technique Used: _____

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6. EXCHANGE SPECIFICATION:

DIGEST Edition: _____ Date: _____
Annex A ISO 8211: _____
Annex B ISO 8824: _____
Annex C VRF: _____
Comments: _____

7. OPERATING SYSTEM:

Unix: _____ System: _____ Version: _____
PC / MS - DOS Version: _____
VAX / VMS Version: _____
Mac O/S Version: _____
Other: Version: _____

8. READ / WRITE STATEMENT: _____
Load _____

9. VOLUME CONTENTS:

File No.	File Name	Area of Coverage	Data Structure	Product Type	Remarks	Size

Part 3. - Additional Information

10. REMARKS: _____

11. ADDITIONAL INFORMATION: _____

Withdrawn/Retirée

E. VECTOR DATA MODEL

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E.1 INTRODUCTION

This annex, which is strictly informative, illustrates the description of the logical data model for the following four levels of vector data in DIGEST:

- Level 3—full topology
- Level 2—planar graph
- Level 1—chain-node
- Level 0—spaghetti

Each level is described by its logical data model and the list of constraints which apply to this level.

E.2 NOTATION

The depiction of the DIGEST vector data model in this annex is based on an extended version of the Structured Systems Analysis & Design (SSADM) Entity-Relationship Modelling.

E.2.1 DEFINITIONS

- A logical **entity type** is one of the following:

  — feature entities:
  - simple point
  - simple line
  - simple area
  - complex

  — topological entities:
  - node
  - edge
  - face

  — topological construct:
  - ring

- An **association** is a logical relationship between two entity types. It has no direction and may be implemented in different ways.

- A **link** is a one-way logical relationship between two entity types, which may be implemented in an encapsulation by using pointers. There are two links (one for each direction) corresponding to each association. (Note that in some cases, the link in only one direction is useful or relevant.) Their logical description is independent of implementation using any encapsulation of DIGEST. Following are abbreviations for the links used in this annex.

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ALT*	"is the **alt**ernative representation of"
BB	"is **b**ounded **b**y"
CF	"has as its **c**ontaining **f**ace"
CMP	"is **comp**osed of"
CPO	"is the **compo**nent of"
SN	"has as its **s**tart **n**ode"
EN	"has as its **e**nd **n**ode"
FE	"is **c**onnected (as its **f**irst **e**dge) to"
LF	"has as its **l**eft **f**ace"
RF	"has as its **r**ight **f**ace"
NEL	"has as the **n**ext **e**dge on the **l**eft"
NER	"has as the **n**ext **e**dge on the **r**ight"
SE	"has as its **s**tart **e**dge"
STK*	"is **st**acked on"
STU*	"is **st**acked **u**nder"

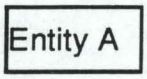
* relation between features only (see 5.1.1.3)

Therefore, the difference between an association and a link is primarily one of direction:

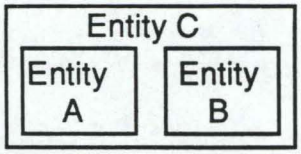
Association (non-directional) = Link 1 (one direction) + Link 2 (opposite direction)

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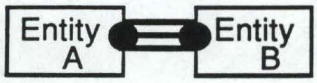
E.2.2 GENERAL NOTATION



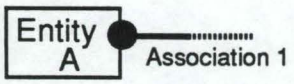
Each entity type is boxed. Note that "A" refers to an arbitrary entity type, and not to a specific entity.



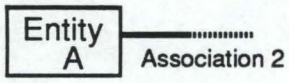
An Entity C may be either an Entity A or an Entity B. It may not be anything else or both.



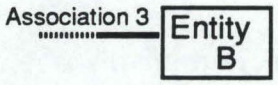
Entity A and Entity B are bounded together and considered as a single entity.



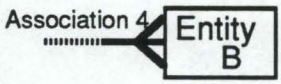
Each Entity A is linked to at least one other entity (through Association 1).



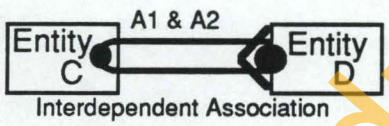
Each Entity A may or may not be linked to another entity (through Association 2).



A given entity may be linked to at most one Entity B (through Association 3).



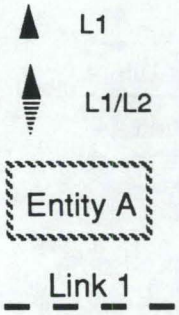
A given entity may be linked to any number of Entities B (through Association 4).



An Entity C must be linked to at least one Entity D through one of the two associations A1 and A2. It may be linked to more Entities D through either of these associations.
An Entity D must be linked to a single Entity C through Association A1 and to a single Entity C through Association A2.

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The following notation is used concerning the logical implementation (as opposed to DIGEST encapsulation) of the data model.



L1 — 1-Way Pointer with Link L1.

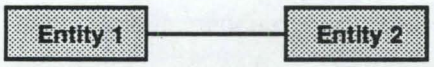
L1/L2 — 2-Way Pointer: mandatory one way (bold arrow), optional one way (dashed arrow). Link L1 is mandatory, Link L2 is optional.

Entity A — The Entity A is optional, i.e. implementation is not mandatory.

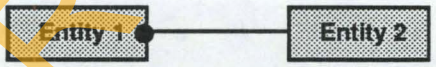
Link 1 — The link 1 is optional, i.e. implementation is not mandatory.

E.2.3 ENTITY-ASSOCIATION EXAMPLES

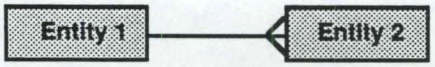
GENERIC EXAMPLES



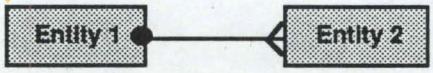
An Entity 1 may, optionally, be linked to a single Entity 2.
An Entity 2 may, optionally, be linked to a single Entity 1.



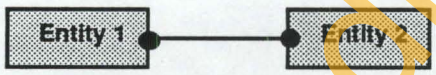
An Entity 1 must be linked to a single Entity 2.
An Entity 2 may, optionally, be linked to a single Entity 1.



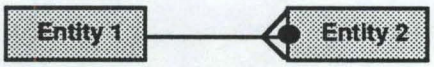
An Entity 1 may, optionally, be linked to any number of Entities 2 (including none).
An Entity 2 may, optionally, be linked to a single Entity 1.



An Entity 1 must be linked to one or more Entities 2.
An Entity 2 may, optionally, be linked to a single Entity 1.



An Entity 1 must be linked to a single Entity 2.
An Entity 2 must be linked to a single Entity 1.



An Entity 1 may, optionally, be linked to any number of Entities 2 (including none).
An Entity 2 must be linked to a single Entity 1.

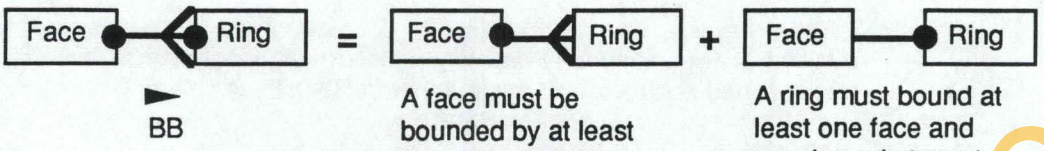


An Entity 1 must be linked to one to more entities 2 of any type.
An Entity 2 may be linked to any number of Entities1 (including none), but an Entity 2A must be linked to at least one Entity 1

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SPECIFIC EXAMPLES

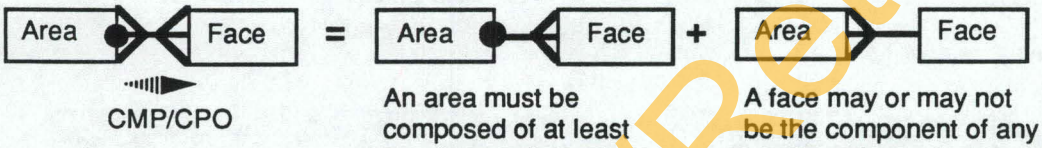
Bounded By



A face must be bounded by at least one ring and may be bounded by any number of rings.

A ring must bound at least one face and may bound at most one face.

Composed of/Component of



An area must be composed of at least one face and may be composed of any number of faces.

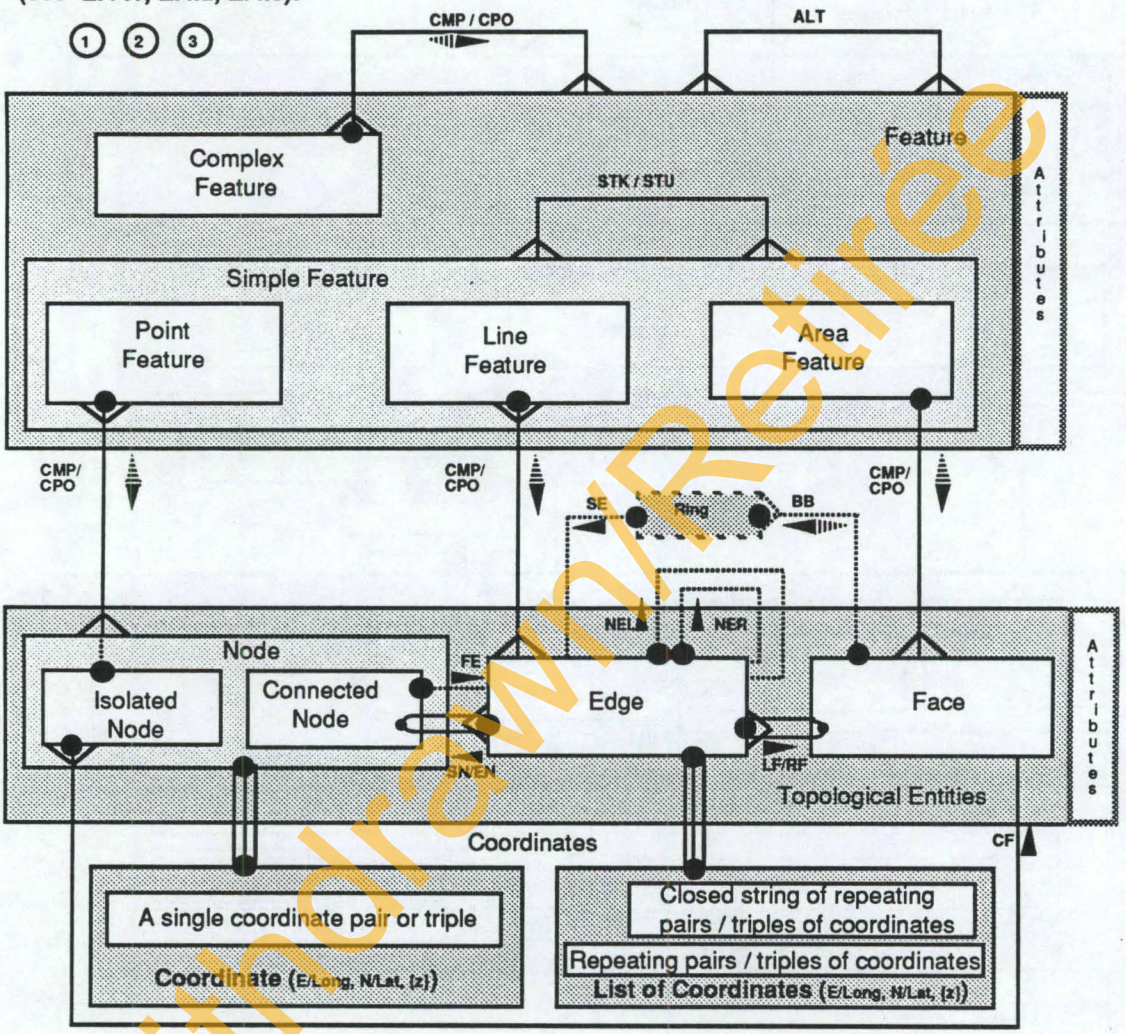
A face may or may not be the component of any number of area features.

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E.3 DATA MODELS

E.3.1 LEVEL 3 — FULL TOPOLOGY

Valid constraints* for this level (see E.4 .1, E.4.2, E.4.3):



Legend

- Mandatory for all
- Optional
- 2 Way Pointer
- 1 Way Mandatory,
- 1 Way Optional.
- 1 Way Pointer
- Relationship switches dependent on level of topology

Legend

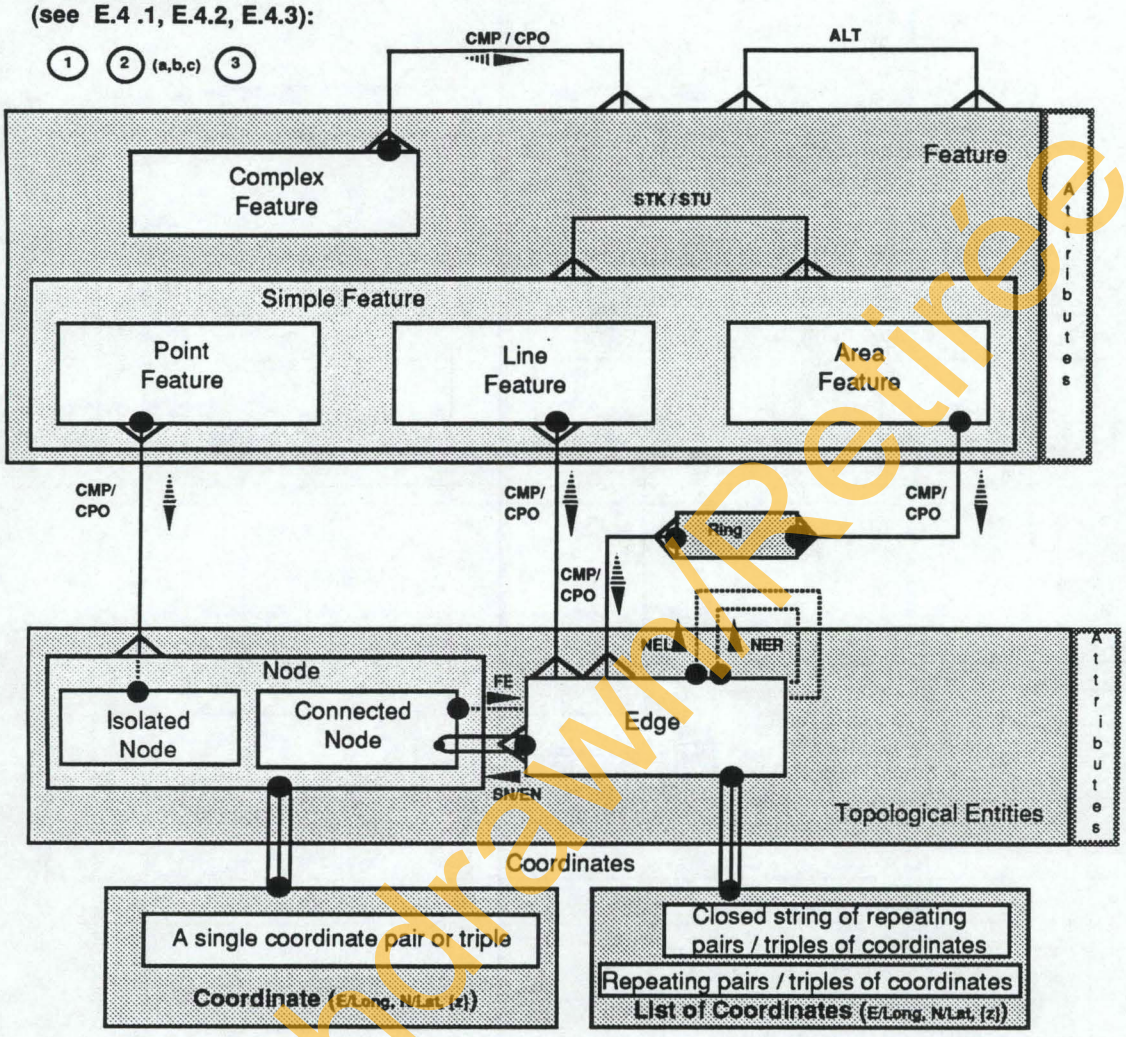
CF = Containing Face
CMP = Component Of
CPO = Composed Of
EN = End Node
EOF = Edge of Face
LF = Left Face
RF = Right Face
SN = Start Node

* Constraints are rules restricting the application of a relationship.

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E.3.2 LEVEL 2 — PLANAR GRAPH

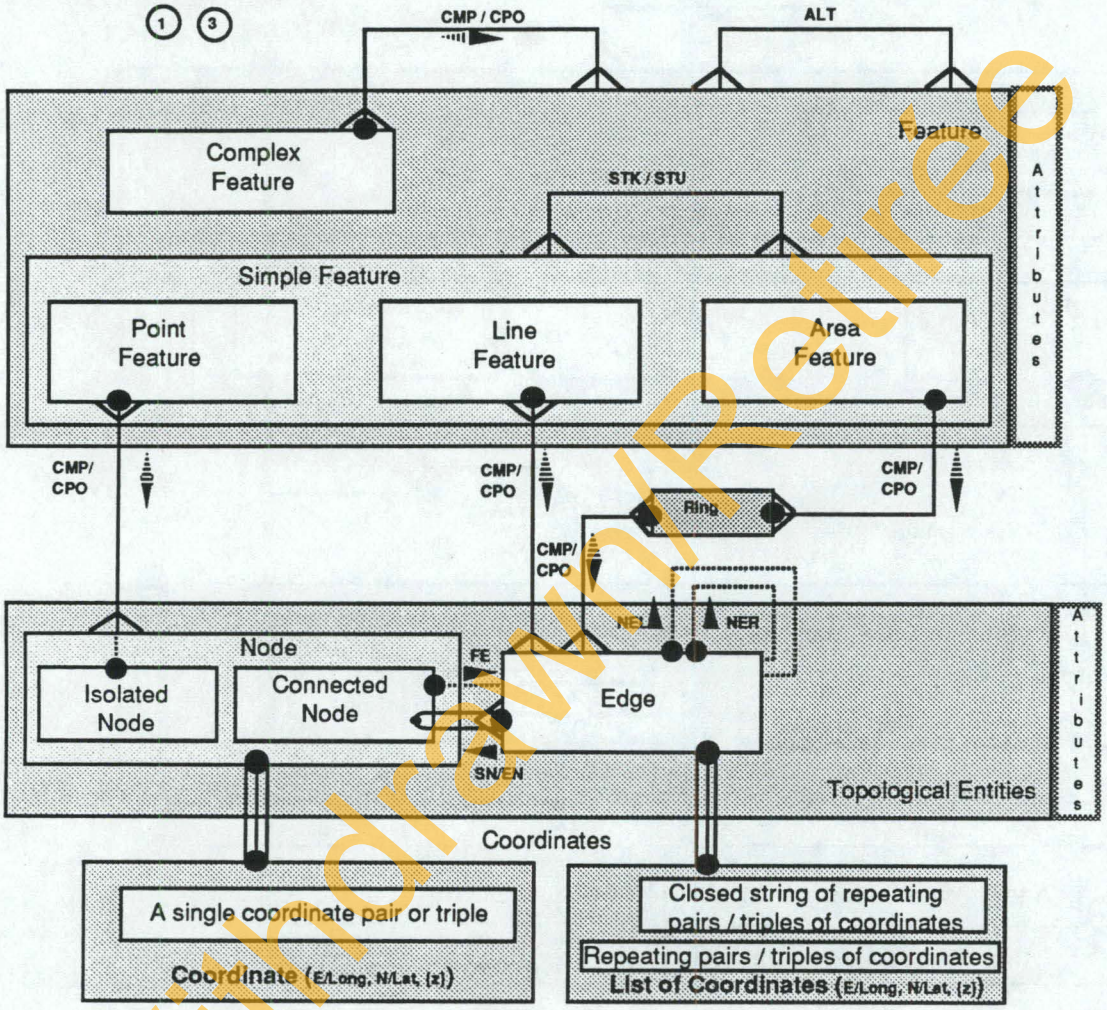
Valid constraints for this level (see E.4 .1, E.4.2, E.4.3):



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E.3.3 LEVEL 1 — CHAIN-NODE

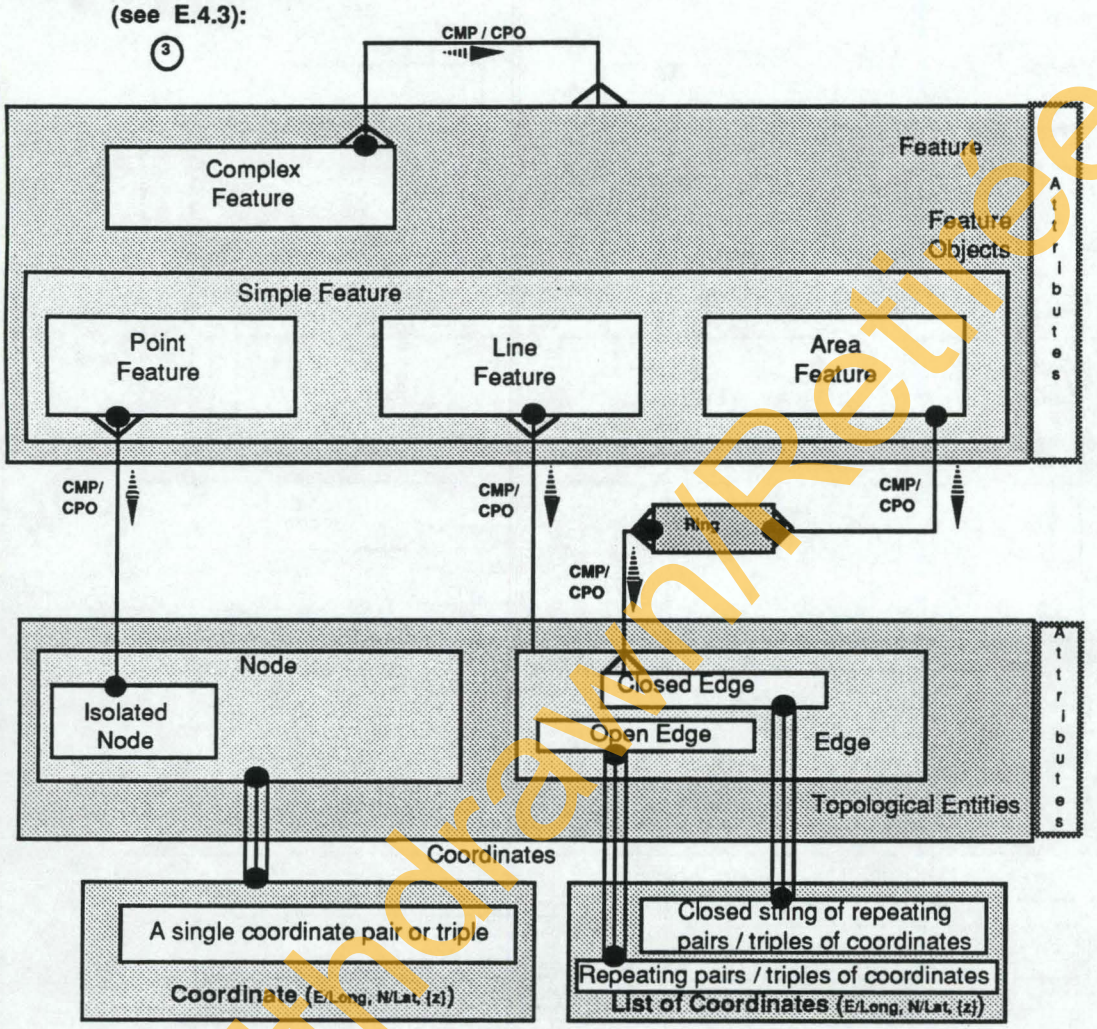
Valid constraints for this level (see E.4 .1, E.4.3):



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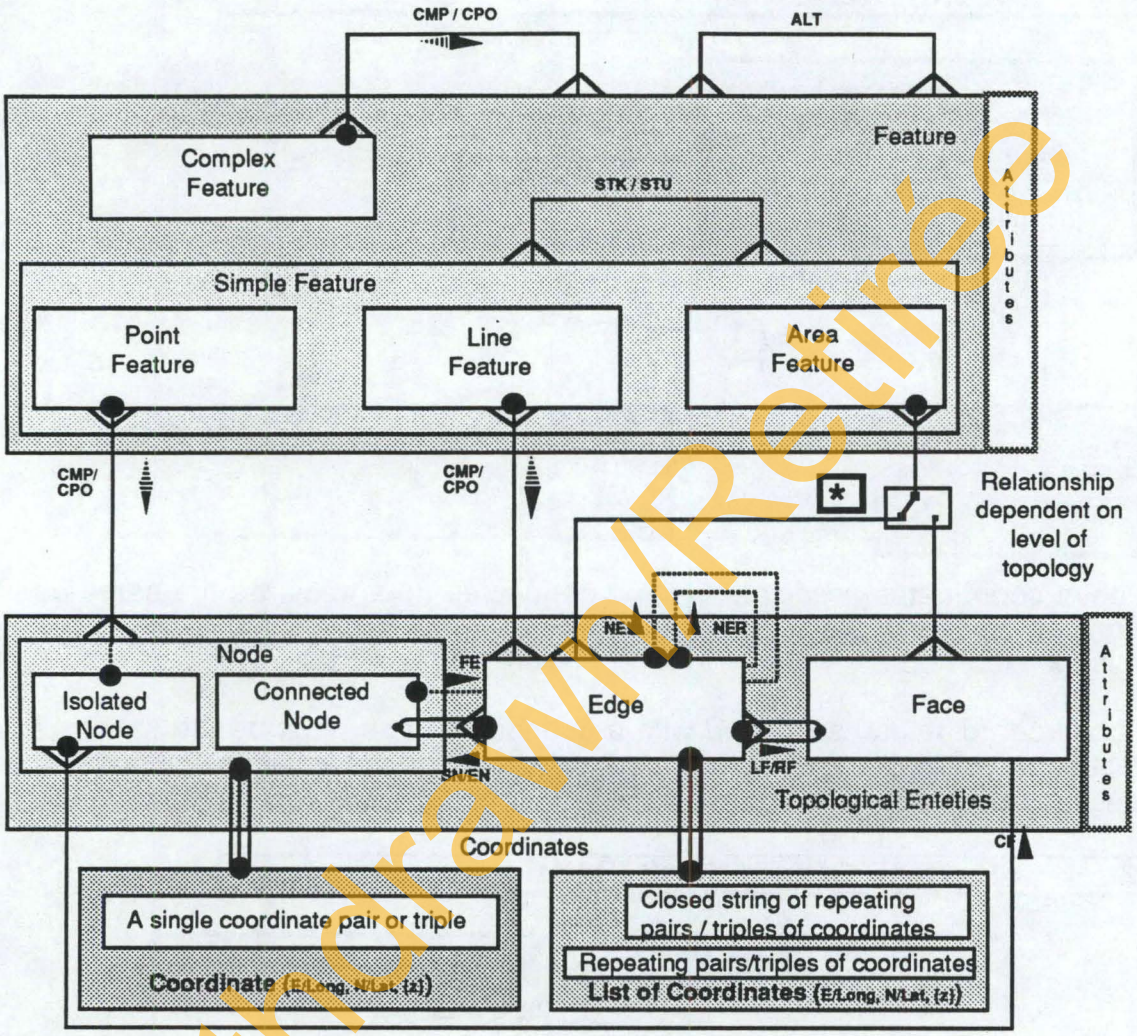
E.3.4 LEVEL 0 — SPAGHETTI

Valid constraint for this level (see E.4.3):

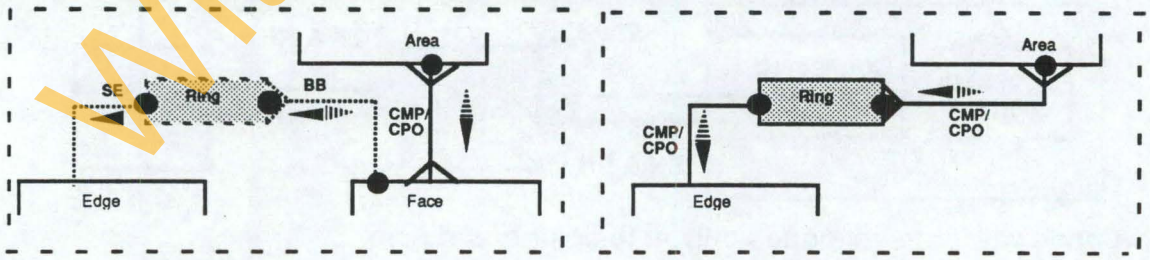


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E.3.5 COMBINED TOPOLOGICAL LEVELS



* The following illustrates the Area-Edge-Face relationships for various levels of topology:



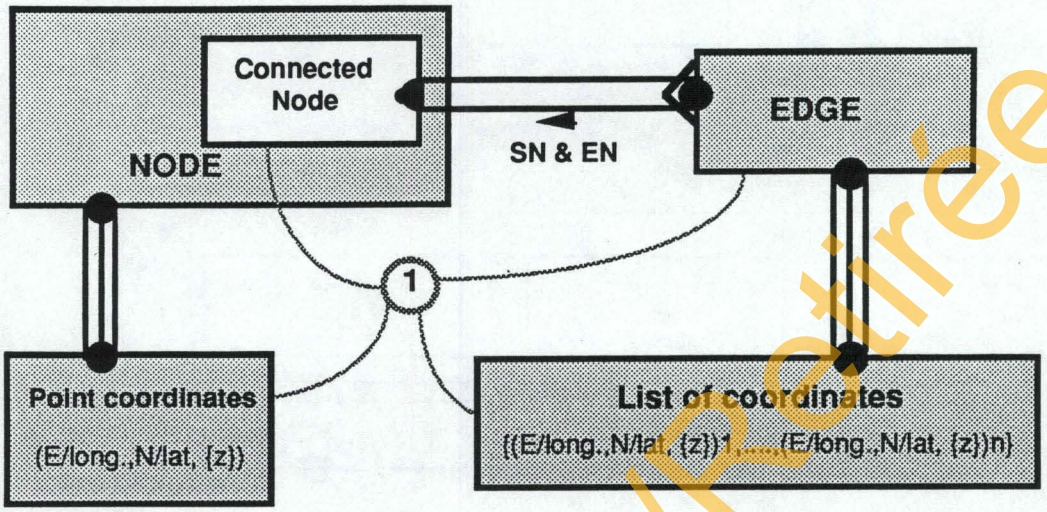
Area-Edge-Face relationship for Level 3

Area-Edge relationship for Levels 2, 1, 0

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E.4 CONSTRAINTS

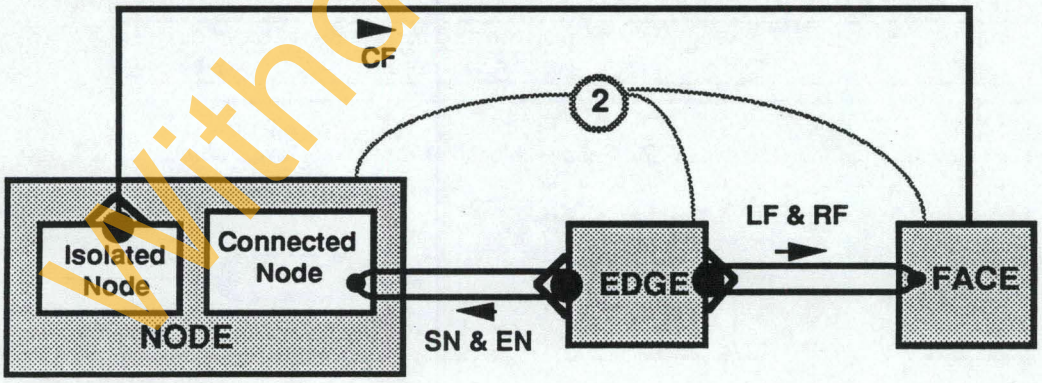
E.4.1 CONNECTED NODE/EDGES COORDINATES CONSISTENCY



The point coordinates associated with a connected node must be the same as the first coordinates of the list associated with any edges of which this connected node is the start node.

The point coordinates associated with a connected node must be the same as the last coordinates of the list associated with any edges of which this connected node is the end node.

E.4.2 PLANAR GRAPH CONSTRAINT



a. A node will intersect edges only at their start/end point.

b. No two nodes may occupy the same (x, y) coordinate point.

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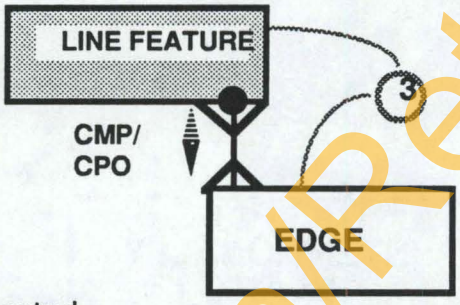
c. No edge will intersect nor overlap any other edge, or itself, except at their start/end point

d. No two faces overlap.

e. Any point on the coordinate surface not on an edge or at a node is in one (and only one) face.

f. Any node not intersecting any edge is contained in a single face.

E.4.3. LINE FEATURE ORIENTATION



Line features may be oriented.

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F. LOGIC FLOW DIAGRAMS

Logic Flow Diagrams, commonly called Railroad Normal Form, have long been used to provide a graphical, definitive method of specifying the syntax of computer languages. Using this methodology each legal combination and sequence of elements is made readily visible by following the "track" in the same sense that a train would be forced to traverse the route. This methodology is pertinent to the specification of the logical flow of datasets, subsets, files, topological features and entities, fields and subfields that occur in a geographic information exchange dataset such as DIGEST.

The following Logical Flow Diagrams are presented as an aid to understanding the structure of a DIGEST transmittal and are derived from the foregoing formal specification; thus, if any discrepancy exists between the formal specification and the Logic Flow Diagrams the formal specification shall govern.

Appendix 1 contains the notation used in the Logic Flow Diagrams;

Appendix 2 contains an overview of a DIGEST transmittal; and

Appendix 3 defines the logical flow at an intermediate level of detail.

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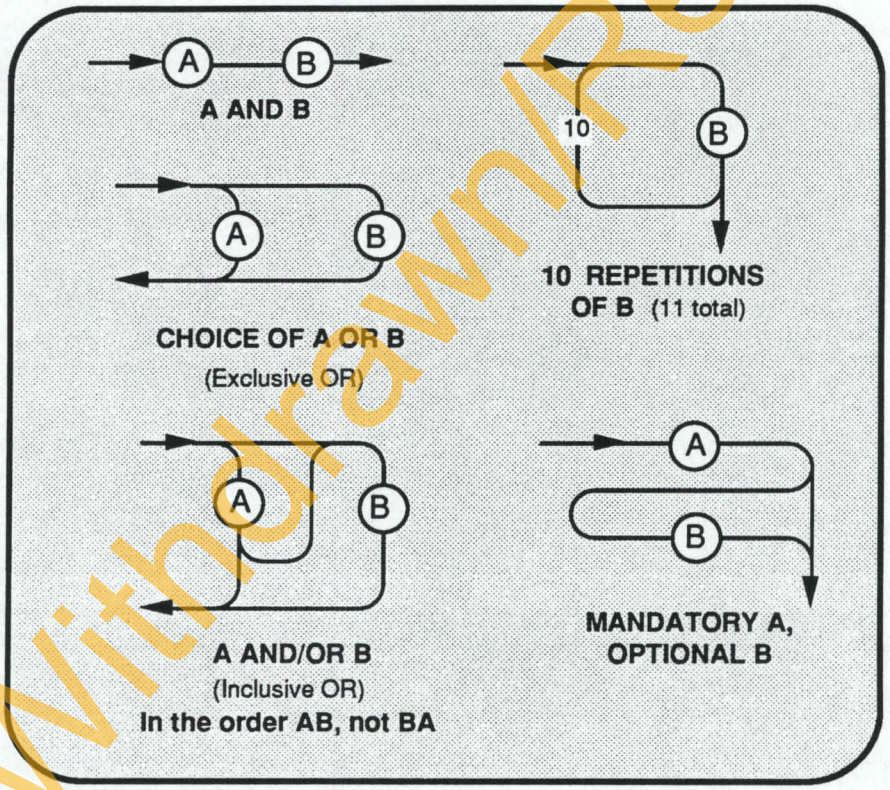
F.1 NOTATION

Rules

- progression is always from upper left to bottom right. Thus arros are not strictly required to define the direction of flow but they are inserted to improve readability.

- the flow must always follow the curved path, in the same way as a locomotive must progress, without backing up and "shunting".

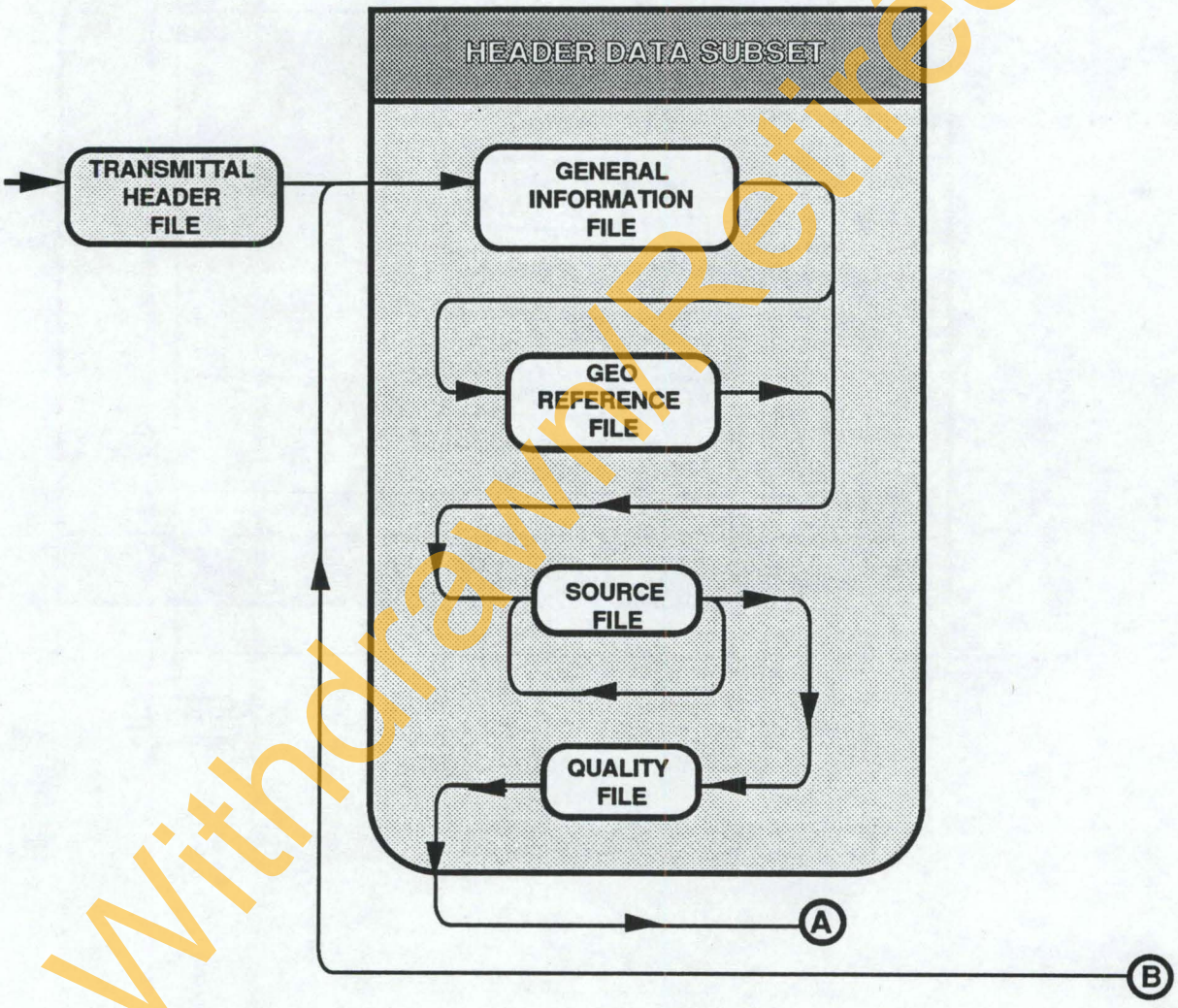
- the logical flow for repetitions is clockwise, i.e. the return path is upward and to the left of the item(s) repeated.



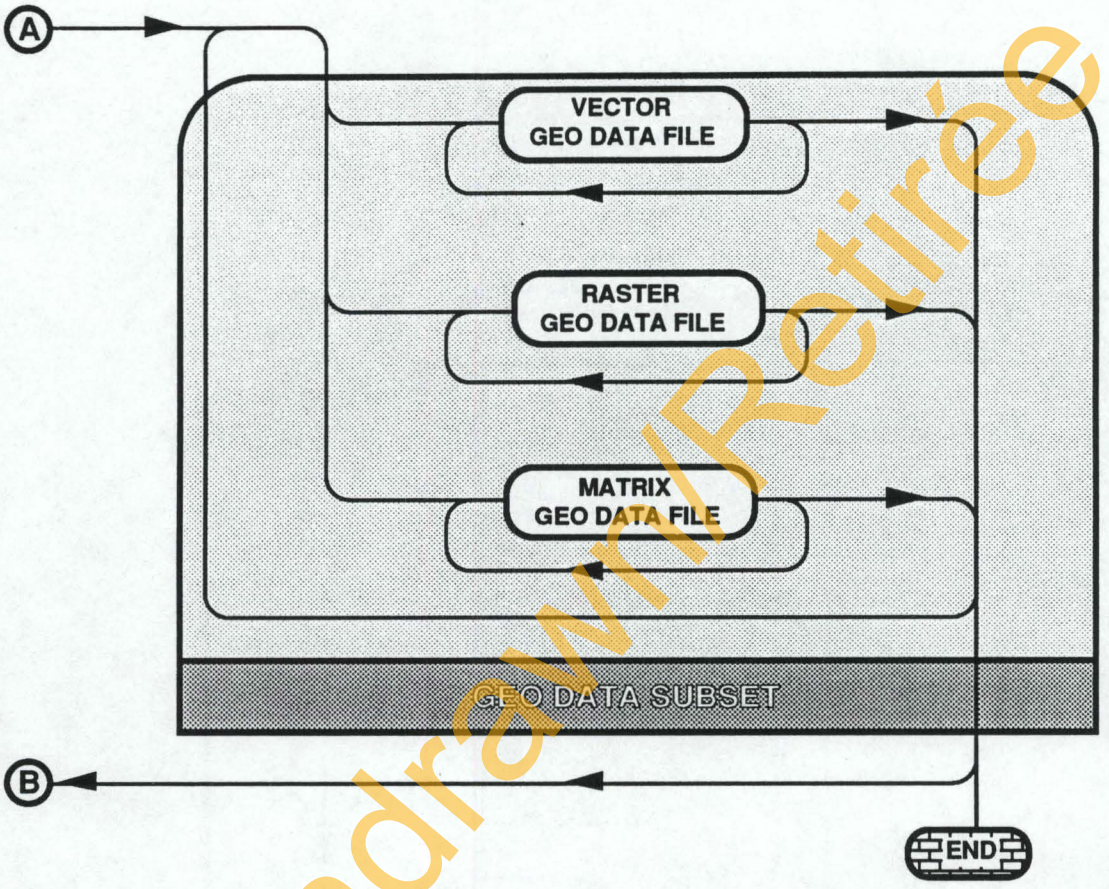
Typical Logical Constructs

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F.2 LOGICAL FLOW OVERVIEW

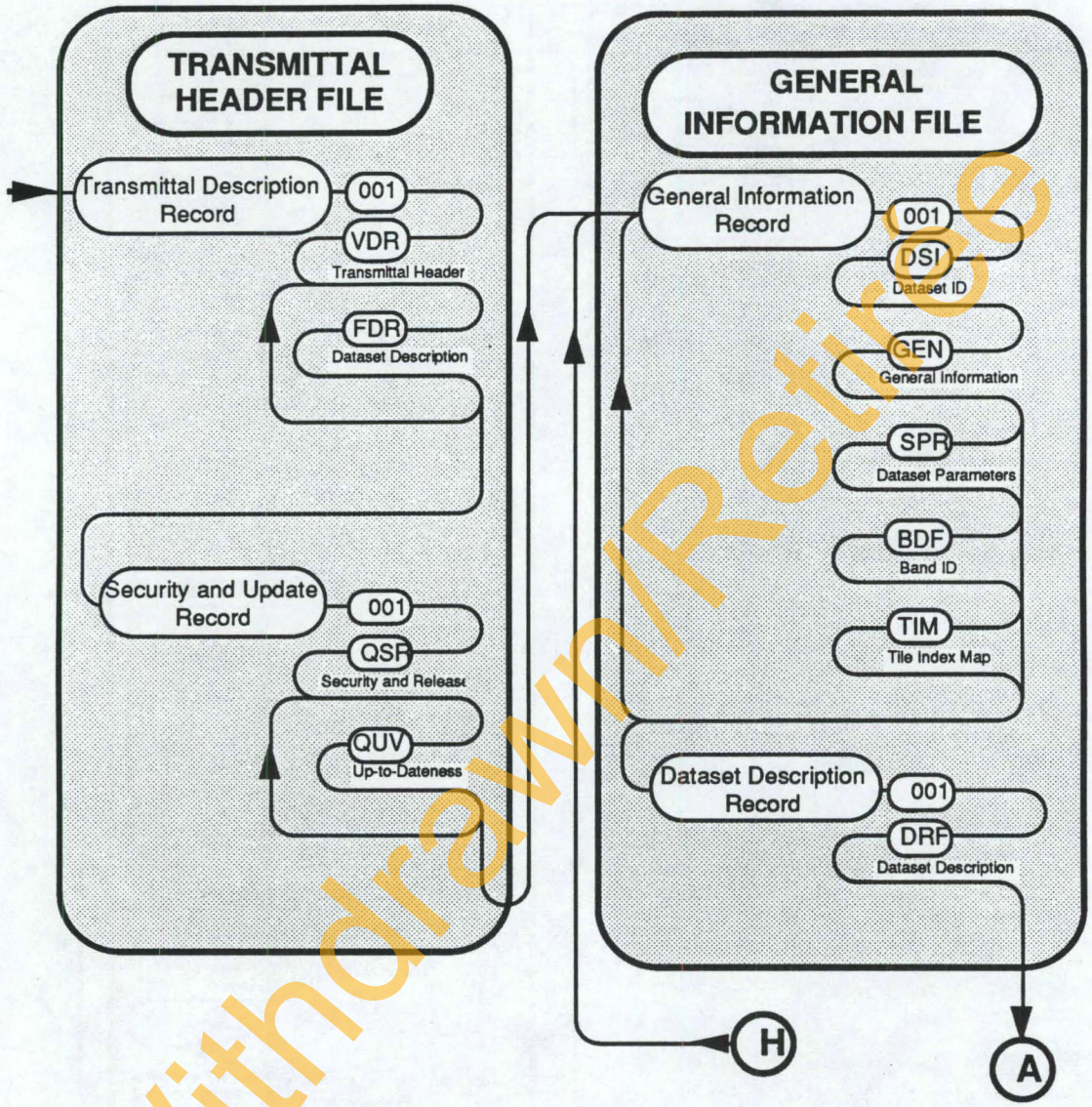


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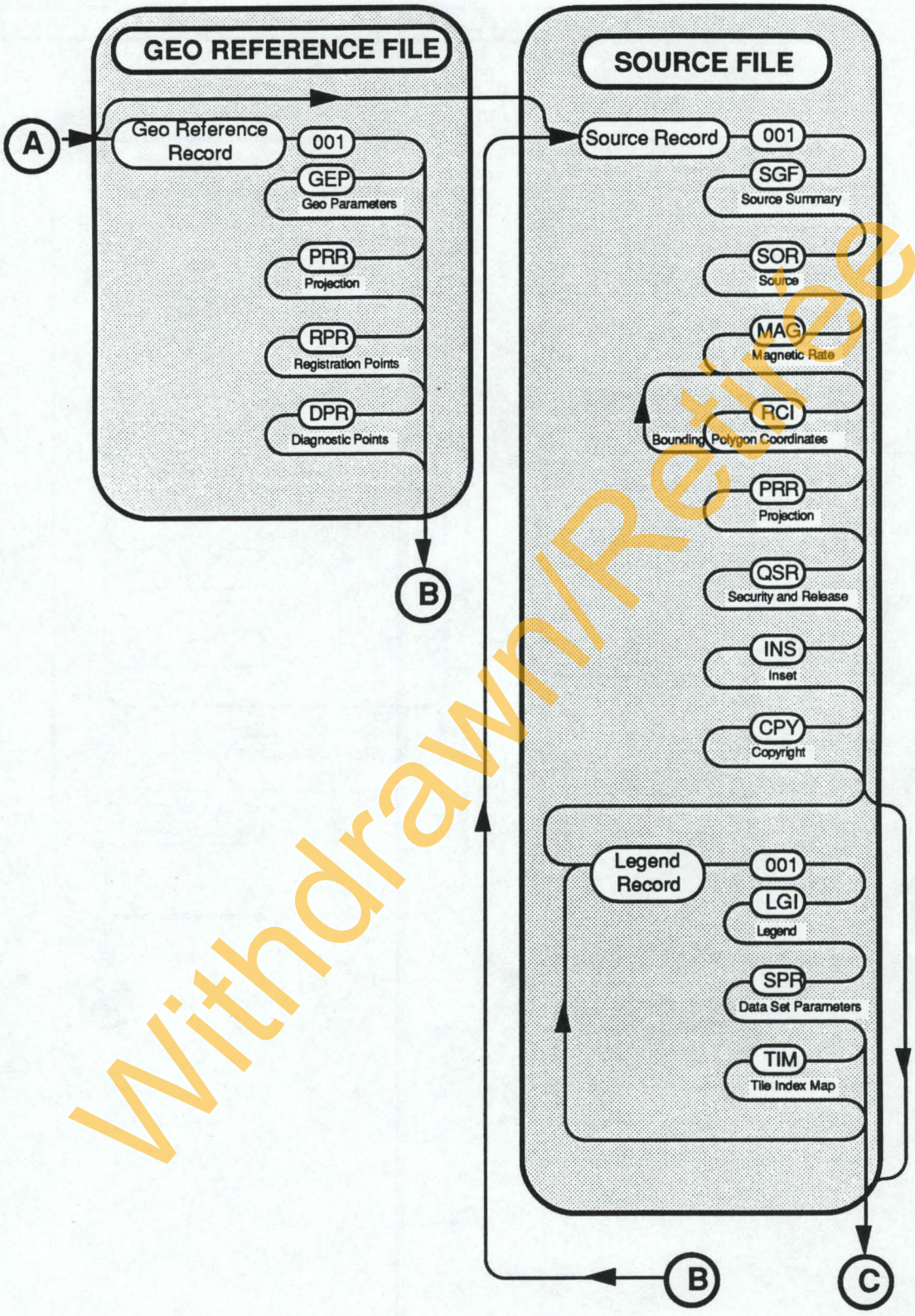


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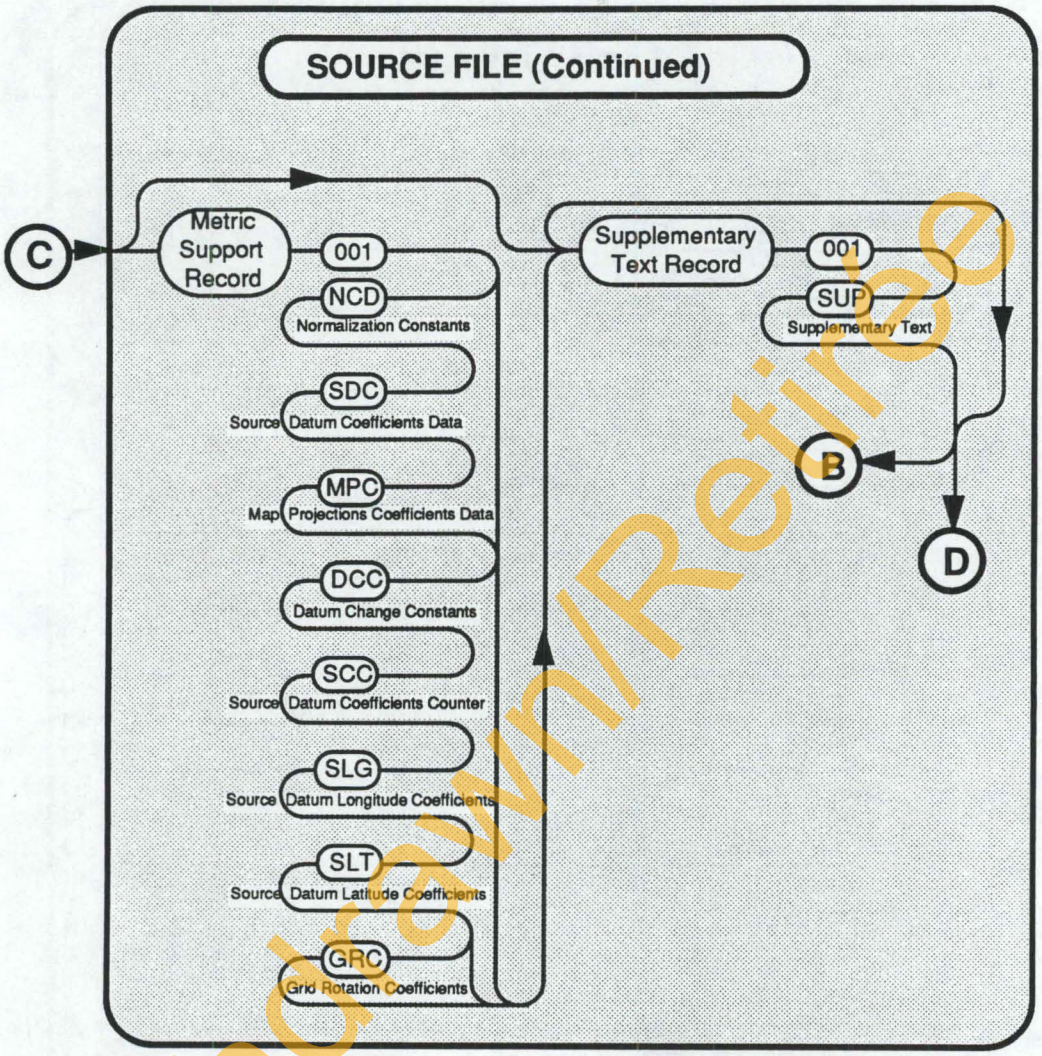
F.3 INTERMEDIATE LOGICAL FLOW



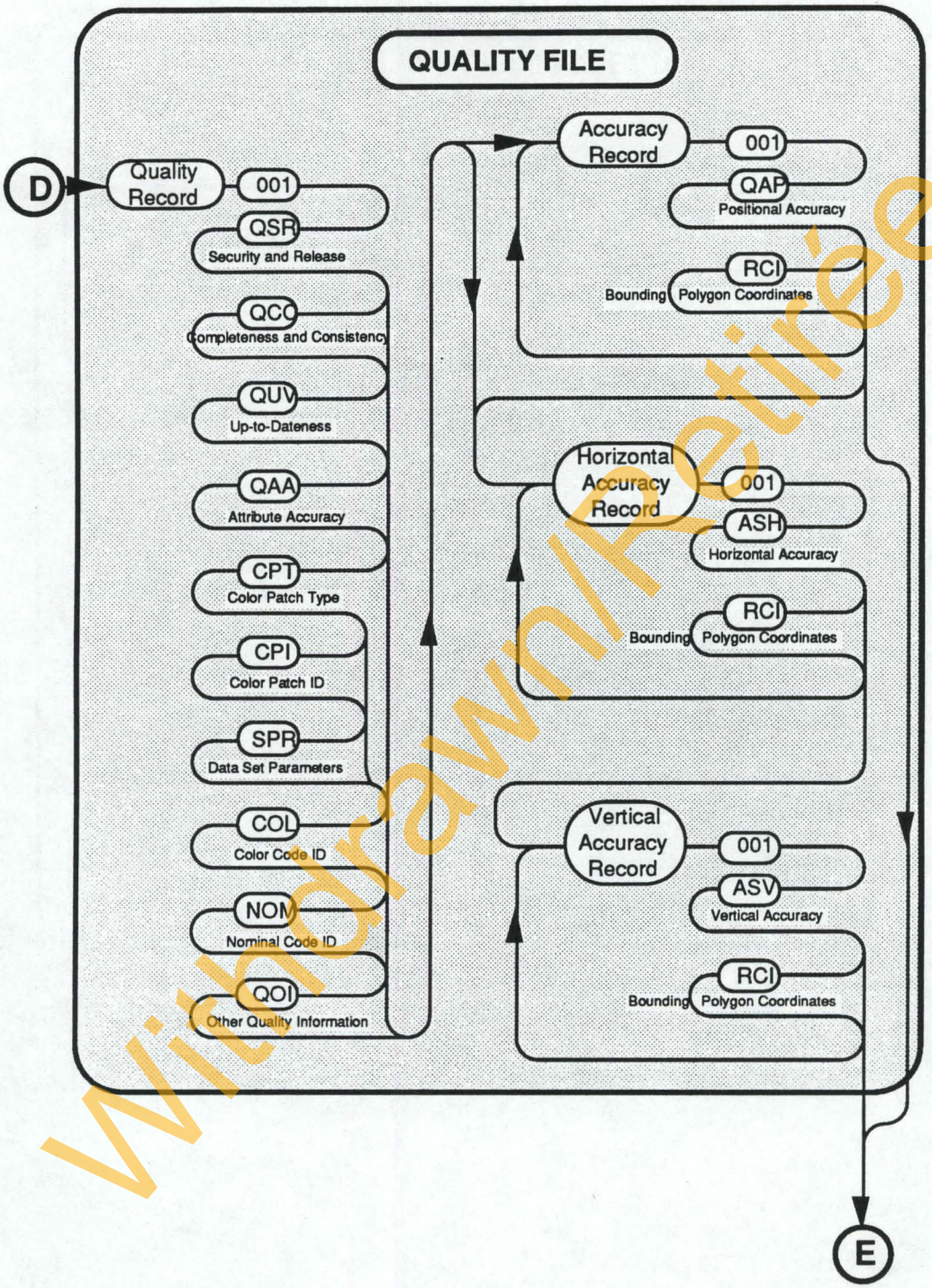
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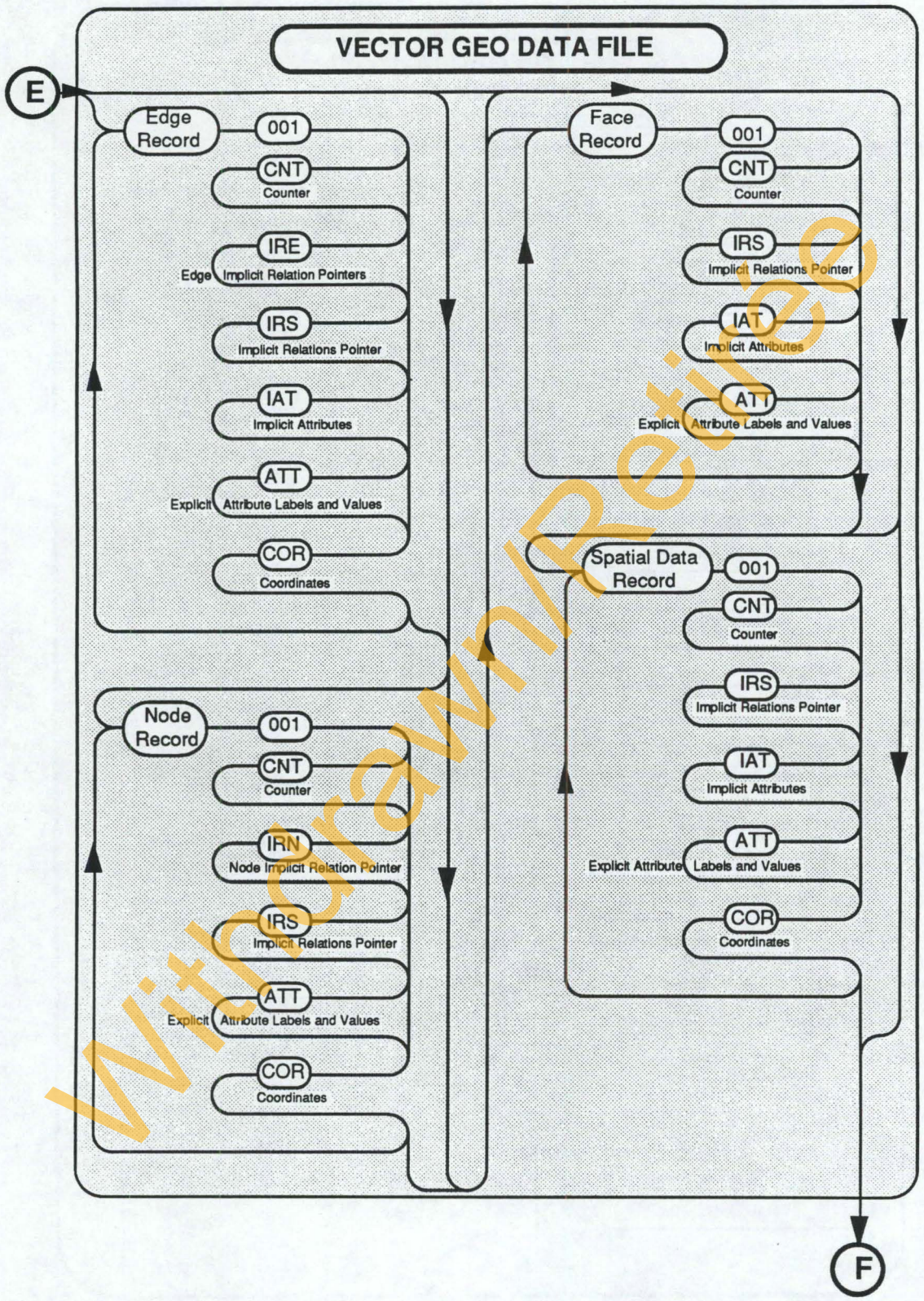
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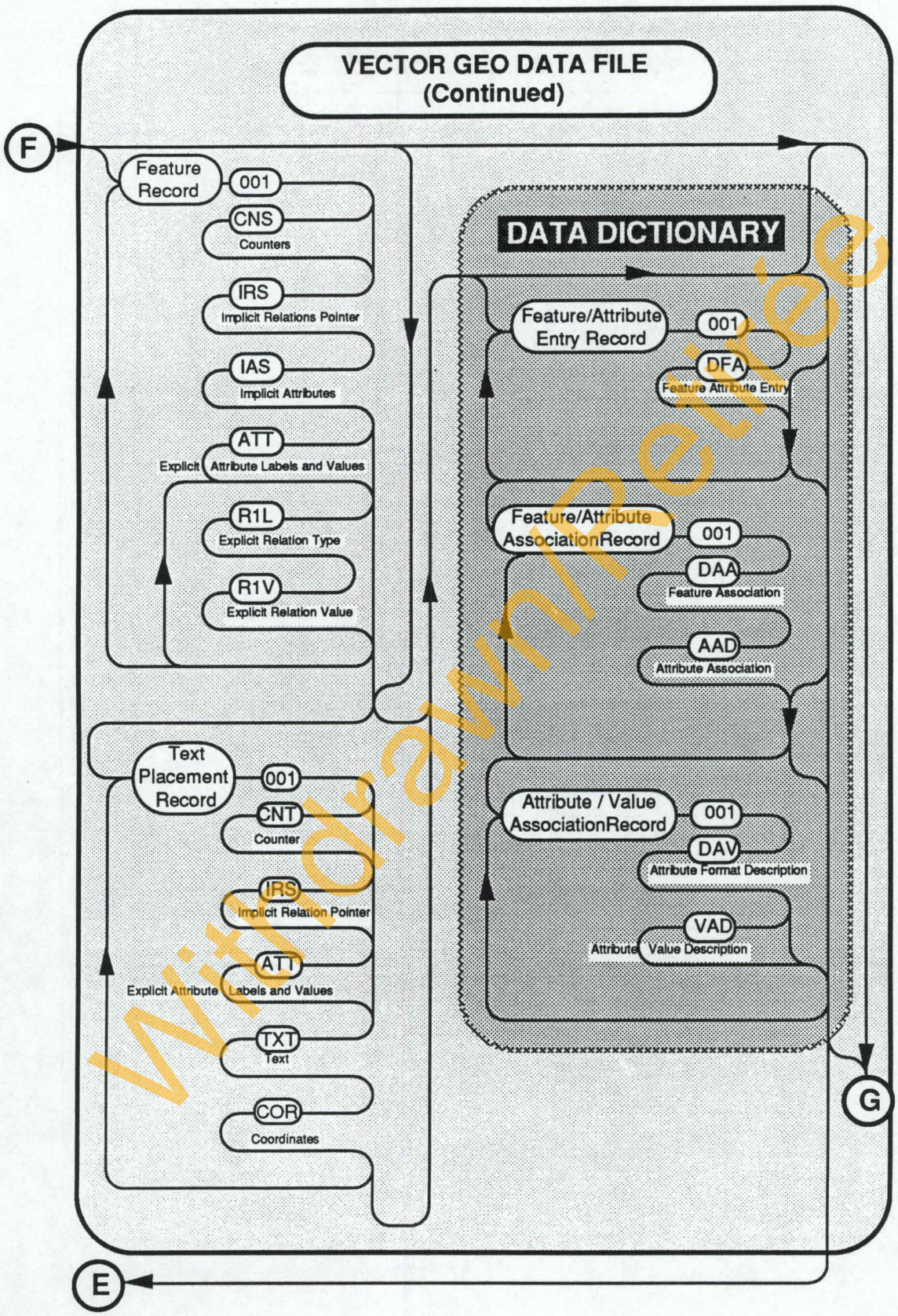
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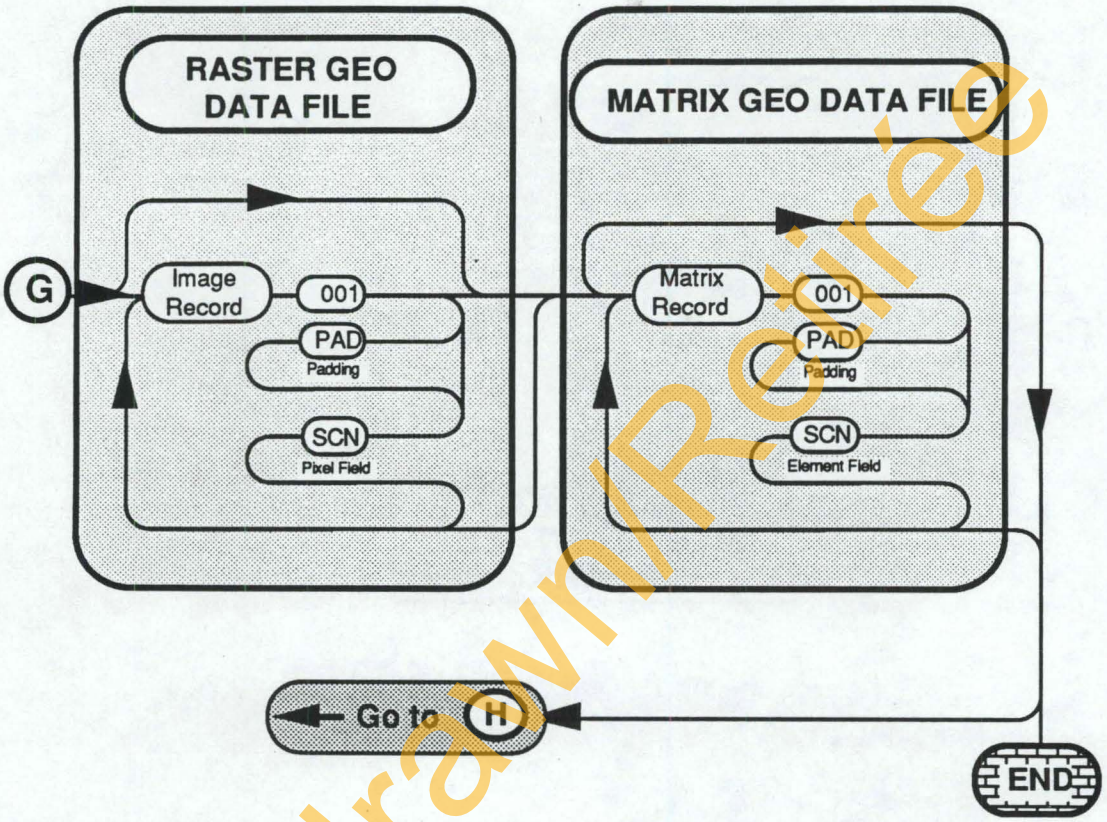
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3. "Product Specifications for Digital Landmass System (DLMS) Data Base", Defense Mapping Agency, 1st Edition - July 1977.

4. NATO STANAG 2215 (Edition 4) - "Evaluation of Land Maps", 19 Dec 1983.

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6. NATO STANAG 3675 (Edition 1, Amendment 12) - "Road Classification", 1 Jun 1992.

7. NATO STANAG 3984 (Edition 1) - "Header Record Format for Exchange of Digital Geographic Information", 18 Nov 1986.

8. NATO STANAG 3985 (Edition 1) - Preferred Magnetic Tape Standards for the Exchange of Digital Geographic Information", 4 June 1987.

9. NATO STANAG 3986 (Edition 1) - "Digital Data File Transmittal Form for Geographic Information", 10 Mar 1987.

10. NATO STANAG 3809 (Edition 2) - "Digital Terrain Elevation Data Exchange (Geographical Format)", 22 April 1987.

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The

DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD

(DIGEST)

Part 3

CODES, PARAMETERS AND TAGS

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Produced and issued under the direction of the Directorate of Geographic Operations,
Department of National Defence, Canada on behalf of the
Digital Geographic Information Working Group.

Edition 1.2 January 1994

DIGEST Part 3

CODES, PARAMETERS AND TAGS

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NOTICE TO USERS

1. This international exchange standard has been designed to enable the transfer of Digital Geographic Information (DGI) between geographic information systems. This documentation now forms a baseline from which both system developers and national survey organizations can plan their development and production activities.

2. Research into all aspects of DGI is continuing within the Digital Geographic Information Working Group (DGIWG) forum and any subsequent potential changes will be subject to formal change control procedures.

3. DGIWG has decided to hold DIGEST Parts 1, 2 and 3 stable for two years from the date of issue in order to allow system developers the opportunity to develop compatible software. Any clarifications or corrections to the standard approved by the committee will be recorded in separate clarification and corrections documents which will be available from the committee. These documents will be incorporated into a future version of DIGEST along with any upward compatible extensions approved at that time.

RECORD OF AMENDMENTS

NUMBER	DATE	ENTERED BY	REMARKS

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FOREWORD

Authority. The **DI**gital **G**eographic Information **E**xchange **ST**andard (DIGEST) was prepared by and issued under the authority of the Digital Geographic Information Working Group (DGIWG).

Security Classification. All parts of DIGEST are unclassified but may be subject to the limitation of use that the copying of the documents is prohibited without the authority of the national point of contact (see Part 1 — 5.2).

Changes from the Last Edition. DIGEST Edition 1.2 cancels and replaces DIGEST Edition 1.1 (October 1992). The major changes have been technical improvements to the theoretical data model, reworking of the encapsulations, and updating of the coding scheme. The significant changes are:

- The separate data structures used to describe Spaghetti, Chain-Node, and Topological data have been combined into a common data model which supports four different levels of implementation corresponding to Level 0 — Spaghetti, Level 1 — Chain-Node, Level 2 — Planar Graph, and Level 3 — Full Topology (including faces on a 2-D manifold). This harmonized a major aspect of the standard with other international standards such as the IHO data interchange standard and with several national standards.

- DIGEST has been revised in order to make the standard consistent across all of its various parts. Additional fields have been added to the various encapsulations so that the same information content can be carried in any of the encapsulations.

- The description of which data fields are optional and which fields are dependent on the existence of other fields has been clarified by introducing a mechanism of identifying the depth of nesting of conditional and repeating fields and sub-fields.

- DIGEST has been revised to align it with the most recent versions of the ISO character set and coding standards. Text, expressed in any recognized alphabet in the world, may be supported in attributes or in specific data sub-fields. Four levels of text are supported ranging from ASCII (ISO 646), through Latin Alphabet 1 for western European Languages (ISO 8859), a comprehensive Latin Alphabet (ISO 6937) and the Universal Character Set standard including all world alphabets (ISO 10646).

- Additional informative descriptive diagrams have been added to the document in the form of annexes in order to assist in the implementation of the standard. These informative annexes consist of data model diagrams and logic flow diagrams.

- The lists of codes for projections, grids, ellipsoids and datums have been extended significantly.

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- FACC has been greatly extended, incorporating many new features and attributes derived from other catalogues. This makes FACC a much more comprehensive catalogue.

Document Structure. DIGEST is published as four parts:

- Part 1: General Description
- Part 2: Theoretical Model, Exchange Structure, and Encapsulation Specifications
- Part 3: Codes, Parameters and Tags
- Part 4: Feature and Attribute Coding Catalogue

This part provides technical information that DIGEST uses including codes, parameters and tags. It is structured as follows.

- The first four clauses provide the scope, purpose and field of application; conformance; references; and terminology (the first three apply to DIGEST as a whole).
- The fifth clause discusses data types and code tables in DIGEST.
- The next seven clauses provide DIGEST codes and parameters for projections, grids, ellipsoids, datums, units of measure, countries, and media recording standards.
- The next clause discusses the use of CIE values in DIGEST.
- The final two clauses list tags for encapsulation using ISO 8211 and ISO 8824.

Document Maintenance. The maintenance of DIGEST is covered in Part 1 — 5, including custodianship, national representatives, procedures for effecting changes to the standard, and distribution of the documents.

Acknowledgements. It is truly remarkable when a group of individuals from 11 different countries spanning two continents can work together on a project as extensive and complex as designing an exchange standard for digital geographic information. The editor would like to acknowledge the efforts and contributions of all DGIWG members—past and present—in the creation and evolution of this standard.

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1 SCOPE, PURPOSE AND FIELD OF APPLICATION

1.1 SCOPE

Digital geographic information (DGI) has evolved into an essential element in the planning and conduct of civil and military operations. The required data volume, demands and data complexity dictates that multi-national agreements for digital data standards be established to assure compatibility. In support of this aim these standards define those aspects necessary to the exchange of DGI. They are as follows:

- the data structures to be supported;
- format;
- feature and attribute coding scheme;
- exchange media; and
- administrative procedures.

The type of data to be exchanged using these standards includes the digital representation of the following:

- elevation and depth information;
- geographic feature geometry and feature attribute information;
- information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum, e.g. radar, infra-red; and
- other geographic information.

The data will all be available on a common worldwide reference datum of World Geodetic System 1984 (WGS 84).

1.2 PURPOSE

These standards will enable interoperability and compatibility among national and multi-national systems and users. They will also support the increasing use of joint development programs. In fact it is essential that geographic staffs involved in the development of national Geographic Information Systems are advised of the advantages of making their data structures and feature and attribute coding schemes compatible with these standards.

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1.3 FIELD OF APPLICATION

The application of the agreed standards being dealt with hereafter has several aspects, including organizational; geo-scientific; and regional and thematic.

1.3.1 ORGANIZATIONAL APPLICABILITY

This document applies to the topographic, hydrographic and aeronautical institutions of the participating nations. The standards have been built to support exchange of DGI between the central agencies operating in this geo-scientific field. This does not preclude the use by other institutions; on the contrary, all users are requested to widen the field of applications even to their contractors on the commercial side by making these standards part of relevant contracts. This will help to avoid redundant developments and cut costs by using common approaches.

1.3.2 GEO-SCIENTIFIC APPLICABILITY

These standards apply to geodetic, geographic, geological and geophysical data of interest. Since the present, and even more importantly the future area of interest for research, development, planning, and execution of operations is hard to define, the term has to be interpreted in a wide sense. Positioning, navigation, simulation, targeting, map and chart automated production, display and manipulation of data are some applications. All the data in this document are covered by the terms "geo data" and DGI. Geo data will be turned into applications-specific user-oriented "product data" out of the original "non-product oriented data".

1.3.3 REGIONAL AND THEMATIC APPLICABILITY

The contents of databases are mainly a national responsibility, but authorities may wish to state points of interest referring to the regional extension and the thematic subjects held in these databases. An integrated multi-national database is not foreseen. Should it come into existence, the standards of this document can easily be applied, since international agreements (ISO standards and NATO STANAGs) have been considered as far as published and known to DGIWG. For bi- or multi-national system developments this document should apply.

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2 CONFORMANCE

This standard is applicable to all member nations of DGIWG. Information processing systems which have the capability of exchanging DGI shall have the capability of reading and writing data in conformance with this standard. This standard shall be used for the exchange of DGI unless the interchanging parties have agreed on an alternative exchange format.

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3 REFERENCES

Following are the normative references which are used in the application of DIGEST. References which are informative or which merely assisted in the preparation of the standard are included in the bibliography (Annex G to Part 2).

International/Multinational

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2 ISO 1000 — *SI units and recommendations for the use of their multiples and of certain other units*, Third Edition 1992-11-01

3. ISO 1001 — *Information Processing — File Structure and Labelling of Magnetic Tapes for Information Interchange*, Ed. 2, 1986. Common with references 16 and 24.

4. ISO 2022 — *Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques*, Ed. 3, 1986.

5. ISO 2375 — *Data Processing — Procedure for registration of escape sequences*, Ed. 3, 1985.

6. ISO 3788 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information Interchange recorded at 63 cpmm (1600 cpi), Phase Encoded.* Ed. 1, 1976. Common with references 17 and 22.

7. ISO 5652 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information interchange formats and recording, using group coding 246 cpmm (6,250 cpi).* Common with references 19 and 23.

8. ISO 6937 — *Information Processing — Coded character sets for text communication*, Ed. 1, 1983.

9. ISO 8211 — *Information Processing — Specification for a data descriptive file for information interchange*, 1985.

10. ISO 8601 — *Data Elements and Interchange Format; Information Interchange Representation of Dates and Time*, 1988. (Replaces ISO 4031)

11. ISO 8824 — *Information processing systems — Open Systems Interconnection — Specifications of Abstract Syntax Notation One (ASN.1)*, 1987. (CCITT X.208)

12. ISO 8825 — *Information processing systems — Open Systems Interconnection — Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*, Ed. 1, 1987.

13. ISO 9660 — *Information Processing — Volume and File Structure of CD-ROM for Information Interchange*, Ed. 1, 1988.

14. ISO 8859 -1— *Information processing — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*, First Edition 1987-02-15

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15. ISO/IEC/10646 -1 — *Information technology - Universal Multiple-Octet Coded Character Set (UCS), Part 1: Architecture and Basic Multilingual Plane,* First edition 1993-05-01

16. CCITT Recommendation, 1992, Geneva:
T50 — *International Reference Alphabet* (IA5),
T51 — *Latin Alphabet Coded Character Sets for Telematic Services,*
T52 — *Non Latin Alphabet Coded Character Sets for Telematic Services.*

17. DLMS Accuracy Working Group. (*Accuracy Determination Method.*)

18. European Computer Manufacturer's Associates (ECMA), *Standard for Data Interchange on Read Only 120 mm Optical Data Disks (CD-ROM).* ECMA/TTC31/87/47, September 1987. (DRAFT).

National

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20. ANSI X3.39—1973, *Recorded Magnetic Tape for Information Interchange (1,600 cpi, PE),* 1973. Common with references 5 and 22.

21. ANSI X3.4—1977, *Code for Information Interchange,* 1977.

22. ANSI X3.54—1976, *Recorded Magnetic Tape for Information Interchange (6,250 CPI, Group-Coded Recording),* 1976. Common with references 7 and 23.

23. ANSI/IEEE - 754—1986, *IEEE Standard for Binary Floating Point Arithmetic.*

24. FIPS PUB 1-1 — *Code for Information Interchange,* 24 Dec 1980.

25. FIPS PUB 10-3 — *Countries, Dependencies, Areas of Special Sovereignty, and their Principal Administrative Divisions,* 9 Feb 1984.

26. FIPS PUB 25 — *Recorded Magnetic Tape for Information Interchange (1,600 CPI, Phase Encoded),* 30 Jun 1973. Common with references 5 and 17.

27. FIPS PUB 50 — *Recorded Magnetic Tape for Information Interchange, 6,250 cpi (246 cpmm), Group-Coded Recording,* 1 Feb 1978. Common with references 7 and 19.

28. FIPS PUB 79 — *Magnetic Tape Labels and File Structure for Information Interchange,* 17 Oct 1980. Common with references 2 and 16.

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30. DoD (US Department of Defense) *Operators Manual for the MC&G Standard Printing Color Identification System.*

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4 TERMINOLOGY

4.1 TERMS AND DEFINITIONS

A list of terms and their definitions as used in DIGEST can be found in Part 2 — 4.1.

4.2 ACRONYMS AND ABBREVIATIONS

Although most acronyms and abbreviations are defined the first time they are used, the following list is provided as a quick reference for all the acronyms and abbreviations appearing in this part of DIGEST.

ANSI	**A**merican **N**ational **S**tandards **I**nstitute
ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
ASN	**A**bstract **S**yntax **N**otation
CCITT	**C**omité **C**onsultatif **I**nternational **T**élégraphique et **T**éléphonique
CD-ROM	**C**ompact **D**isk — **R**ead **O**nly **M**emory
cpi	**c**haracters **p**er **i**nch
cpmm	**c**haracters **p**er **m**illimetre
DCC	**D**ocument **C**hange **C**ontrol
DDR	**D**ata **D**escriptive **R**ecord
Dept	**Dep**artment
DIA	(US) **D**efense **I**ntelligence **A**gency
DG	**D**irector **G**eneral
DGI	**D**igital **G**eographic **I**nformation
DGIWG	**D**igital **G**eographic **I**nformation **W**orking **G**roup
DIGEST	**D**igital **G**eographic **I**nformation **E**xchange **S**tandard
DLMS	**D**igital **L**andmass **S**ystem
DoD	U.S. **D**epartment **o**f **D**efense
ECMA	**E**uropean **C**omputer **M**anufacturer's **A**ssociates
FACC	**F**eature and **A**ttribute **C**oding **C**atalogue
FIPS PUB	(U.S.) **F**ederal **I**nformation **P**rocessing **S**tandards **Pub**lication
GDS	**G**eo **D**ata **S**ubset
Geo	**Geo**graphic
GCR	**G**roup **C**oding **R**ecording
HDS	**H**eader **D**ata **S**ubset
HQ	**H**eadquarters
IA5	**I**nternational **R**eference **A**lphabet-5
ID	**Id**entification
IEEE	**I**nstitute of **E**lectrical and **E**lectronic **E**ngineers
ITU	**I**nternational **T**elegraphic **U**nion
IGMI	**I**stituto **G**eografico **M**ilitare **I**taliano
IGN	**I**nstitut **G**éographique **N**ational
in	**in**ch
IHO	**I**nternational **H**ydrographic **O**rganization
IRV	**I**nternational **R**eference **V**ersion

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ISO	International Organization for Standardization ("iso" = Greek for "same")
MC&G	**M**apping, **C**harting and **G**eodesy
mm	**mm**illimetre
NATO	**N**orth **A**tlantic **T**reaty **O**rganization
OSI	**O**pen **S**ystems **I**nterconnection
PE	**P**hase **E**ncoded
RGB	**r**ed, **g**reen, **b**lue
STANAG	**Stan**dardization **Ag**reement
SQL	**S**tructured **Q**uery **L**anguage
THF	**T**ransmittal **H**eader **F**ile
UN	**U**nited **N**ations
UTF	**U**niversal **T**ransfer **F**orm
VA	**V**irginia
VRF	**V**ector **R**elational **F**ormat
WGS	**W**orld **G**eodetic **S**ystem

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5 DATA TYPES AND CODE TABLES

5.1 SPECIFICATION OF DATA TYPES

The fundamental building blocks out of which all forms of DIGEST data exchange are composed are primitive data elements consisting of numbers, coordinate pairs or triplets, text strings and special items such as a date. Although each of the encapsulations of DIGEST encode these data elements in different ways, the basic elements remain constant. That is, the range of values for numeric entities and repertoire of valid text characters are common to the various encapsulations of DIGEST. Different encoding techniques are appropriate to the various encapsulations of DIGEST for efficiency and structural reasons as well as for alignment with the underlying encapsulation specifications.

The specification below defines each of the data items as primitive elements for the ISO 8211, ISO 8824/5 (ASN.1) and VRF representations of DIGEST (Annexes A, B and C of Part 2 respectively[1]). These items can be classified into four main groups: single items; coordinate strings; other items such as Triplet ID, Date, etc.; and text. Single items consist of individual occurrences of items of particular types, whereas coordinate strings consist of multiple occurrences of coordinates.

Two types of text strings are required. These are a Basic Text String text (used to encode labels, etc.) and a generalized text format to handle place names and other information including accents and special characters to support information written in any language in the world. The "Basic Text String" data element type would include any string of characters from the ASCII (International Reference version - IRV alphabet of the ISO 646 standard). The "General Text String" encompasses any characters including accents, diacritical marks, special characters, and any other ISO standardized alphabet. This permits the handling of place names to be described in any language. There exist a number of different world standards for the handling of general text. A graduated common repertoire supporting both direct (multi-byte) and composite (telecommunication oriented) coding is described.

The following table illustrates the various data types and the encoding used in each of the DIGEST encapsulations:

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[1] All references to Annexes A,B, or C in this clause refer to DIGEST Part 2.

Table 5-1 Data Types

Type	Short Description	ISO 8211	ISO 8824/25	VRF
Single Entities				
Integer Number	a signed Integer Number, the length of the Integer Number is encapsulation and usage dependent. Some encapsulations provide both short (2-byte)(16-bit) and long 4(byte) (32-bit) integer numbers, arbitrary whereas others provide length integers or integer numbers of a specific number of digits.	I format (arbitrary length integer) I n [where n is number of digits] (specific length of digits)	IMPLICIT INTEGER (arbitrary length integer)	S,1 (Short Integer) 2 byte I,1 (Long Integer) 4 byte
Real Number	a signed real (floating point) number consisting of a mantissa and an exponent, the length of the real number is encapsulation and usage dependent. Some encapsulations provide both short (4-byte)(32-bit) and long (8-byte)(64-bit) real numbers, whereas others provide arbitrary length real numbers.	R format (arbitrary length real)	Real-Number composed of 2 Integers one for mantissa & one for exponent.	F,1 (Short Real) 4 byte R,1 (Long Real) 8 byte
Fraction Number	the fraction part of a real number, a number ranging between 0.0 (inclusive) and 1.0 (exclusive) used to represent real numbers normalized to a unity range. Normalized numbers are used for efficiency in some situations.	R format (arbitrary length real)	Fraction-Number represented as an Integer data field	F,1 (Short Real) 4 byte R,1 (Long Real) 8 byte
Bit-Value	a set of bits representing a single bit coded value such as a pixel value	B format (string of bits in a bit-field)	OCTETSTRING (string of bits grouped as octets)	(Not Applicable)
X,Y Coordinate	a pair of numbers representing an X, Y coordinate pair.	R format (pair of R format elements)	two fraction numbers encoded as an OCTETSTRING or an element of a packed differential coordinate string	C,* (two coordinate, short floating point) 8n+4 bytes or B,* (two coordinate, long floating point) 16n+4 bytes
X,Y,Z Coordinate	a triplet of numbers representing an X, Y,Z coordinate value.	R-format (triplet of R-format elements)	three fraction numbers encoded as an OCTETSTRING or an element of a packed differential coordinate string	Z,* (three coordinate, short floating point) 12n+4 bytes or Y,* (three coordinate, long floating point) 24n+4 bytes

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Strings				
Abs-Coordinate-String	an arbitrary length string of absolute coordinates	Repeating set of R format	SEQUENCE of Abs-Coord [where Abs-Coord is defined as an X,Y or X,Y,Z Coordinate built out of fraction numbers]	Relational table columns of short or long real (floating point) numbers. in C, B, Z or Y format.
Rel-Coordinate-String	an arbitrary length string consisting of an initial absolute coordinate followed by a sub-string length indicator and a string of relative coords.	(not applicable)	SEQUENCE (Abs-Coord, INTEGER, OCTETSTRING)	(not applicable)
Dif-Coordinate-String	an arbitrary length string consisting of an initial absolute coordinate followed by a differential factor, a sub-string length indicator and a string of relative coordinates.	(not applicable)	SEQUENCE (Abs-Coord, INTEGER, INTEGER, OCTETSTRING)	(not applicable)
Bit String	an arbitrary length string of Bit coded values	Repeating set of B format	SEQUENCE (Bit-Value)	(not applicable)
Other				
Triplet ID	ID Triplet. Used in edge and face primitive tables to provide cross-tile topology and seamless databases	(not applicable)	(not applicable)	K,1 (Triplet ID) 1 to 13 bytes
Date	defines the local calendar date and time	A(8)	IMPLICIT GENERALIZED TIME	D,1 (Date and time) 20 bytes
Null Field	a place holder element of null value (null fields are required in some encapsulations)	(not applicable)	IMPLICIT NULL	X,1 null values are available for single numeric data entities

Withdrawn/Retired

Text String				
Basic-Text	an arbitrary length string of ASCII data (ASCII is defined by ISO 646)	A format	IMPLICIT-GRAPHIC-STRING	T, n (fixed length text) n byte fixed table column width T,* (variable length text) *+4 byte text string indirectly referenced
General-Text	an arbitrary length string of text data including accents and special characters from one of four levels of repertoire: Level 0 - Basic ASCII text , (IRV of ISO 646) Level 1 - Extended ASCII (including accents for Western European Latin alphabet based languages, ISO 8859 part 1 Latin Alphabet 1 repertoire) (ASCII+ all Latin alphabet accents) Level 2 - Full Latin alphabet repertoire (all accents, diacritical marks and special characters for Latin alphabet based languages (ISO 6937 repertoire)) Level 3 - Universal Character Set repertoire UCS-2 implementation level 2 (Base Multilingual plane of ISO 10646) (i.e. including Latin , alphabet, Greek, Cyrillic, Arabic, Chinese, etc.))	A format	MPLICIT-GRAPHIC-STRING	T, n (fixed length text) n byte fixed table column width T,* (variable length text) *+4 byte text string indirectly referenced

Each of the three encapsulations, in ISO 8211, ISO 8824/5 and VRF relational tables, make use of different techniques to identify the data type being used in any particular section of the data set.

The ISO 8211 standard makes use of a data descriptive technique which facilitates the exchange of files containing data records between systems in a media independent manner. It defines a generalized structure for a wide variety of data types and structures in terms of a Data Descriptive Record (DDR) which specifies the size and position of each data element within a data file. It also provides the means within the DDR for the description of use for the contents of the data fields.

In the ISO 8824/5 implementation the type of an item is determined from the context (Tag Structure) of the syntactic description in ASN.1. Note that the term

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"IMPLICIT" in the equivalence statements below ensures that double tags are not assigned to these elements. All direct data types (coordinates, topological pointers, etc.) make use of the Integer-Number data type, whereas structural data about the interchange format, such as counters, etc. are expressed in the INTEGER primitive directly.

In the relational table implementation data is encapsulated in terms of tables contained in separate files. Each table contains a header which defines the data type of each column of the table.

The following sections identify each of the data types as used in the various encapsulations. Certain data types are unique to specific encapsulations. For example the ISO 8824 encapsulation supports a fraction number data type. This is the mantissa part of a real number, and it can be carried efficiently in the equivalent of an integer data field. It is particularly useful for carrying normalized coordinate data. It is used in the ISO 8824 telecommunications oriented encapsulation in order to improve efficiency in telecommunications systems.

Null values for specific data entities are defined along with the data entities.

5.1.1 SINGLE DATA ENTITIES

ISO 8211 -

Integer (I)

ISO 8211 "I" format
- a signed Integer Number (Implicit point number) of arbitrary size encoded as a string of text characters. The null value is a zero field width.

Integer (I n)

ISO 8211 "I" format
- a signed Integer Number (Implicit point number) of "n" characters encoded as a string of text characters. The null value is the maximum negative value possible (e.g. -9999 for an I5 Integer format).

Real (R)

ISO 8211 "R" format
- a signed Real Number (Explicit point number) of arbitrary size encoded as a string of text characters. The null value is a zero field width.

Real (R n)

ISO 8211 "R" format
- a signed Real Number (Explicit point number) of "n" characters encoded as a string of text characters. The null value is the maximum negative value possible (e.g. -9999. for an R6 Real format).

Real (R n.m)

- ISO 8211 "R" format.
a signed Real Number (Explicit point number) of "n" characters with "m" characters after the decimal point. The

Withdrawn/Retired

null value is the maximum negative value possible (e.g. -9999.99. for an R6.2 Real format).

Fraction Number

(This number form is currently not used in Annex A. Fraction number values will in the future be handled in Integer number fields, as stated above, to handle normalized offset coordinate units.)

Bit (B 8)

ISO 8211 "B" format

– a set of 8 bits in an ISO 8211 fixed bit field. A string of bits of arbitrary length corresponding to a pixel value, are padded to fill an integer number of octets. There is no null value.

X,Y Coordinate

(There is no specific X,Y coordinate format in Annex A. Coordinates are handled as a pair of " R " format numbers.)

– a pair of real numbers representing an X,Y coordinate pair.

X,Y,Z Coordinate

(There is no specific X,Y,Z coordinate format in Annex A. Coordinates are handled as a triplet of " R " format numbers.)

– a triplet of real numbers representing an X,Y,Z coordinate value.

ISO 8824/5

(Note: the following is ISO 8824 ANS.1 code for the identified items)

Integer-Number ::= IMPLICIT INTEGER

– a signed Integer Number of arbitrary length. The null value is a zero field width.

Real-Number ::= IMPLICIT OCTETSTRING

– a signed Real Number is composed of an octet-string of arbitrary length, in compliance with the ANSI/IEEE 754 floating point number standard. The precision of the number is determined from the length. Both 32 and 64 bit precision are used. The null value is the "Not A Number" value defined in ANSI/IEEE 754.

Fraction-Number

```
MACRO           ::= BEGIN
TYPENOTATION    ::=     IMPLICIT INTEGER   --fraction--
VALUENOTATION   ::=     ".", INTEGER
                END
```

– a signed normalized fraction represented in an integer field of arbitrary length. The Most Significant Bit represents the sign (using the two's complement convention). This is followed by an implied fractional point (decimal/binary point) followed by a representation of the fraction. The null value is a zero field width.

Bit-Value ::= OCTETSTRING

– a string of bits of arbitrary length corresponding to a bit value, carried in a string of octets, padded to fill an integer number of octets. The null value is a zero field width.

Withdrawn/Retired

X,Y Coordinate

(There is no specific X,Y coordinate entity in Annex B. Coordinates are handled in absolute, relative or differential coordinate strings. A single coordinate can be handled as a string containing only one coordinate entity.)

- a pair of real numbers representing an X,Y coordinate pair.

X,Y,Z Coordinate

(There is no specific X,Y,Z coordinate entity in Annex B. X,Y,Z Coordinate triplets are handled as absolute coordinate strings containing triplet values. A single coordinate may be handled as a string containing only one coordinate entity)

- a triplet of real numbers representing an X,Y,Z coordinate.

VRF Relational Tables

In the relational table form of DIGEST the format of each column of data is given in the first row of the table. Certain data elements can be expressed in either short or long format. Which headers are used in particular tables are given in Annex C. Allowable field types are given in Table C-47 in section C.10.1.6. Since tables are of fixed column width it is necessary to make a distinction between an empty column entry and one of zero value. For each type of data there is a defined null/no value which is used to indicate an empty field. The column headers for each data type are given below:

Integer Number (Short) S,1

- a signed Integer Number of 2 byte (16-bit) length. The null value is defined to be the bit pattern 10000000 00000000, which is equivalent to the maximum negative number in "two's complement number format".

Integer Number (Long) I,1

- a signed Integer Number of 4 byte (32-bit) length. The null value is defined to be the bit pattern 10000000 00000000 00000000 00000000.

Real-Number (Short) F,1

- a signed Real Number of 4 byte (32-bit) length in compliance with the ANSI/IEEE 754 floating point number standard. For table entries of this type that are "empty" the "Not-a-Number form" defined in IEEE 754 is used.

Real-Number (Long) R,1

- a signed Real Number of 8 byte (64-bit) length in compliance with the ANSI/IEEE 754 floating point number standard. For table entries of this type that are "empty" the "Not-a-Number form" defined in IEEE 754 is used.

Fraction-Number

(This number form is currently not used in Annex C. Fraction number values will in the future be handled in Integer number fields, as stated above, to handle normalized offset coordinate units.)

Withdrawn/Retired

Bit-Value (This number form is currently not used in Annex C.)

X,Y Coordinate C,n or C,* or B,n or B,*

– a pair of numbers representing an X,Y coordinate pair. "C,n" corresponds to a 2-coordinate array of short Real (F,1) numbers with the null value equal to both coordinates being "Not-a-Number (NAN)". "C,*" corresponds to a 2-coordinate string, with the null value equal to a string length of 0. "B,n" corresponds to a 2-coordinate array of long Real (R,1) numbers with the null value equal to both coordinates being "Not-a-Number (NAN)". "B,*" corresponds to a 2-coordinate string, with the null value equal to a string length of 0.

X,Y,Z Coordinate Z,n or Z,* or Y,n or Y,*

– a triplet of numbers representing an X,Y,Z coordinate value. "Z,n" corresponds to a 3-coordinate array of short Real (F,1) numbers with the null value equal to both coordinates being "Not-a-Number (NAN)". "Z,*" corresponds to a 3-coordinate string, with the null value equal to a string length of 0. "Y,n" corresponds to a 3-coordinate array of long Real (R,1) numbers with the null value equal to both coordinates being "Not-a-Number (NAN)". "Y,*" corresponds to a 3-coordinate string, with the null value equal to a string length of 0.

5.1.2 COORDINATE STRINGS

ISO 8211 -

Strings

– Strings of data elements, such as strings of coordinates, strings of bit values etc., are carried in ISO 8211 as repeating fields of single elements or sets of single elements; for example a repeating string of coordinates would be carried as a repetition of the set of two real number fields corresponding to X and Y. There is no special structure for strings of data in the ISO 8211 encapsulation.

ISO 8824/5

(Note: the following is ISO 8824 ANS.1 code for the identified items)

Abs-Coordinate-String ::= SEQUENCE OF Abs-Coord

– an arbitrary length string of absolute coordinates.

Rel-Coordinate-String ::= SEQUENCE {Abs-Coord, INTEGER, OCTETSTRING}

– an arbitrary length string consisting of an initial absolute coordinate followed by a sub-string length indicator and a string of relative coordinates. The sub-string length indicator specifies the bit length of each coordinate element. Each coordinate consists of a pair of elements corresponding to binary fraction numbers representing dX, dY coordinates relative to the current coordinate position.

Withdrawn/Expired

Dif-Coordinate-String ::= SEQUENCE {Abs-Coord, INTEGER, INTEGER, OCTETSTRING}

– an arbitrary length string consisting of an initial absolute coordinate followed by a differential factor, a sub-string length indicator and a string of differential coordinates. The differential factor is common to all differential coordinates in the string and the coordinate length indicator specifies the bit length of each coordinate element. Each coordinate consists of a pair of elements corresponding to binary fraction numbers representing a $dX*2^F$, $dY*2^F$ coordinate relative to the current coordinate position, where F is a differential factor.

Bit-String ::= SEQUENCE {Bit-Value}

– an arbitrary length string of Bit Values.

Abs-Coord ::= CHOICE { [0] OCTETSTRING, –X,Y
[1] OCTETSTRING, –X,Y,Z
}

– a pair or triplet of binary fraction numbers representing an X, Y or X, Y, Z coordinate where the octet string is divided into two or three equal length pieces which correspond to the two or three fraction numbers.

VRF Relational Tables

Strings

– Strings of data elements, such as strings of coordinates, strings of pixel values etc., are carried in Annex C as columns in relational tables in C, B, Z or Y format.

5.1.3 OTHER DATA ENTITIES

ISO 8211 -

ID Triplet (The ID triplet field type is not used in Annex A.)

Date

A coding of date in an ASCII data field.

– an item defining calendar date in accordance with ISO 8601 . A specific A type data field is constructed to carry date information. The null value is all SPACE characters in the field.

Null Field (The use of Null data elements in not applicable for Annex A.)

ISO 8824/5

(Note: the following is ISO 8824 ANS.1 code for the identified items)

ID Triplet (The ID triplet field type is not used in Annex B.)

Date ::= IMPLICIT GENERALIZEDTIME

Withdrawn/Retired

– an item defining the local calendar date and time, in accordance with ISO 8601 for the specification of a calendar date. The null value is a zero field width.

Null Field ::= IMPLICIT NULL
– A place holder element of null value.

Further-Study ::= IMPLICIT NULL
– An equivalent to "Null Field" Items which are for further study in the interchange format in Annex B are identified within the syntactic structure by a null element.

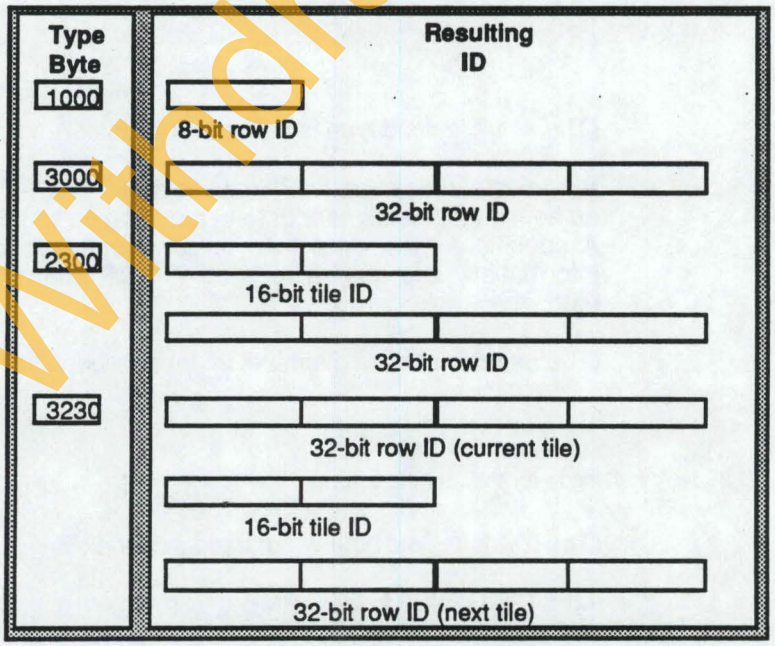
VRF Relational Tables

ID Triplet K,1

- The ID triplet field type is used in edge and face primitive tables to provide cross-tile topology and seamless databases. This field type replaces the integer foreign key used in untiled coverages. The triplet is composed of an 8-bit type byte, followed by 1-4 subfields. The type byte is broken down into four 2-bit pieces that describe the subfields (Table 5-1). Figure 5-1 is an example of the ID triplet field.

Table 5-2 Type Byte Definitions

Bit Count	Number Bits in Subfield
0	0
1	8
2	16
3	32



Withdrawn/Retirée

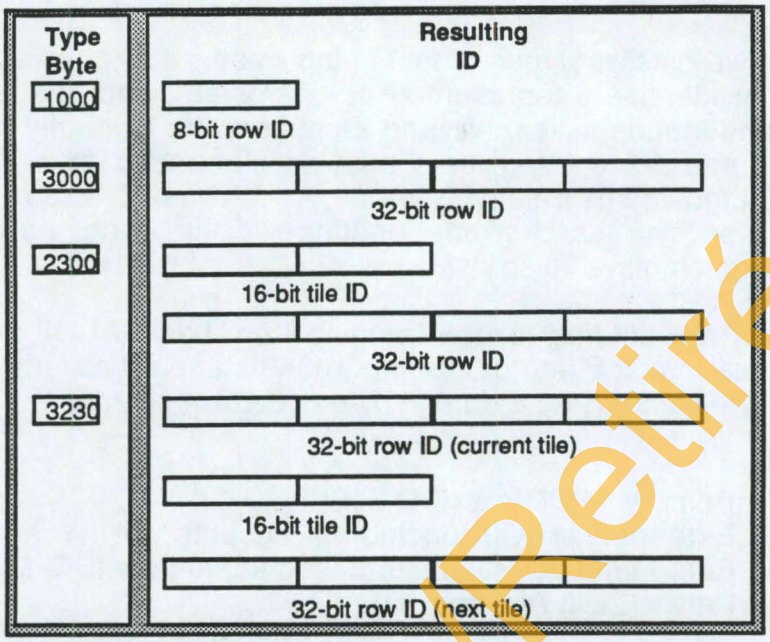


Figure 5-1 Example of ID Triplet

This design allows optional references to the next tile, in addition to internal references, without the necessity for having them stored exhaustively through the database. It also saves storage space when used with typical IDs (a sequence of IDs that runs from 1 up to 100,000 requires 92% of the space required by 32-bit integers).

Date

D,1

– an item defining the local calendar date and time, in accordance with ISO 8601 for the specification of a calendar date in 20 bytes. Generally only the first 8 bytes are used. The null value is all SPACE characters.

Null Field

X,1

– A place holder element of null value.

Withdrawn/Retirée

5.1.4 TEXTUAL INFORMATION

DIGEST supports two different types of text string - basic and general text, one for labels and other identifiers represented as characters, and one for human readable text in any language. Labels and identifiers are primarily meant for computer systems and are nothing more than an alphabetic code. Therefore they can be restricted to the relatively small ASCII character set. Human readable text may be expressed in any language of the world. As such it is necessary to have much more flexibility.

Four Lexical Levels are defined for text ranging from basic ASCII text to the generality of the Multilingual Plane of the ISO 10646 standard covering virtually every language in the world using a double byte code. These are:

Lexical Level	
0 -	Primary ASCII text (ISO 646)
1 -	Extended ASCII (including accents for Western European Latin alphabet based languages ISO 8859 Part 1 (Latin Alphabet 1))
2 -	Full Latin alphabet text ASCII (all accents, diacritical marks and special characters for Latin alphabet based languages (ISO 6937 repertoire))
3 -	Universal Character Set (Base Multilingual plane of ISO 10646) (note: 2 bytes per character)

Basic Text

Basic Text is used for all text subfields which are alphanumeric identifiers, labels etc. and must be in ASCII only. (Lexical Level 0)

General Text

General Text is used to handle text subfields which potentially would contain information in any language. General Text has four levels of alphabetic repertoire Lexical Level 0-3.

Only a small number of text fields throughout the standard may take on General Text. These General Text fields are identified in Table 5-7 below. An identifier associated with each general text field identifies the Lexical Level of that particular field. This is done in an implementation dependent manner dependent upon the encapsulation.

The details of the method of identifying which general text fields are at which Lexical Level differs among the various encapsulations, as described in Annexes A, B, and C.

Withdrawn/Retirée

In Annex A an optional "L" format is defined for any General Text sub-field. This is a constructed text format which is implemented using ISO 8211 "A" format with the Lexical Level for that field defined in the Data Descriptive Record (DDR) of the data field in the data set.

In Annex B General Text is implemented by specifying a special General Text production which contains a tag identifying the Lexical level.

In Annex C the header for a table contains an indication of the Lexical Level of the text data in the table for a particular column.

General Text may also be used in text attributes. The Lexical Level of the attributes is done in an implementation dependent manner dependent upon the encapsulation. For Annex A the value format sub-field of the Explicit Attribute Labels and Values Field specifies which attributes may contain general text and the ISO 8211 Data Descriptive Record for a data field specifies the Lexical Level for that field. For Annexes B and C it is implemented in the same manner as for text fields within the standard.

Text is handled in the international character set standards in terms of two concepts: repertoire and coding. The repertoire is the list of possible characters which are permitted. The coding is the assignment of computer bit patterns to identify each character. Both the repertoire and coding of the various character sets are described below. The repertoires remain the same between different encapsulations. The coding used may differ for efficiency or to accommodate restrictions such as relational form.

5.1.5 TEXT SYNTAX

ISO 8211 -

Basic-Text (A)

ISO 8211 "A" format
- an arbitrary length string of text characters taken from the International Reference Version (IRV) primary character code table (ASCII) as defined in ISO Standard 646 including both the graphic G set and control C set as well as the SPACE character. The null value is a zero field width.

Basic-Text (A n)

ISO 8211 "A" format
- a string of "n" text characters taken from the International Reference Version (IRV) primary character code table (ASCII) as defined in ISO Standard 646 including both the graphic G set and control C set as well as the SPACE character. The null value is a field filled with the DEL character.

Withdrawn/Retirée

General-Text (L)

"L" format text

– an arbitrary length string of text taken from one of four repertoires.
  0 - basic ASCII text (ISO 646)
  1 - Extended ASCII (including accents for Western European Latin alphabet based languages ISO 8859 Part 1 (Latin Alphabet 1))
  2 - Full Latin alphabet text ASCII (all accents, diacritical marks and special characters for Latin alphabet based languages (ISO 6937 repertoire))
  3 - Universal Character Set (Base Multilingual plane of ISO 10646) UCS-2 implementation level 2 (note: 2 bytes per character)

The null value is a zero field width. The distinction between which repertoire and coding is used is defined by the Lexical Level.

"L" format is a constructed format for ISO 8211; that is, the identifier "L" is used in the description of DIGEST in Annex A to identify those text fields which may take general text. "L" format is actually implemented as ISO 8211 "A" format, where the repertoire and coding is specified in accordance with the LEX flag or attribute.

When other than the default ASCII character set (Lexical Level 0) is used in an entire data set, ISO 8211 requires that the character sets used for each field be described in the Data Descriptive Record in the field controls which precede the field name for each field. In addition DDR in Relative Position RP 17 to 19 should contain (2/0) (2/1) (2/0) to indicate that individual fields may contain extended (non-ASCII) character sets. DDR RP 10 and 11 should contain "09" indicating that there are 9 bytes containing field controls - the last three of which are escape sequences identifying extended character sets. If lexical level 2 or 3 is used anywhere throughout the data set then DDR RP 7 should contain "E" (rather than "SPACE") to indicate that inline code extension may be encountered in the data file. The character repertoires used in DIGEST are progressive supersets. This means that the highest level of character set used in any sub-fields in a field should be described in the DDR field controls for that field.

The following indicates the character set code identifier which should be put in DDR field controls for each Lexical Level:

Lexical Level 0	(ASCII - ISO 646 IRV)	- (2/0)	(2/0) (2/0)
Lexical Level 1	(Latin 1 - ISO 8859)	- (2/13)	(4/1) (2/0)
Lexical Level 2	(Full Latin - ISO 6937)	- (2/14)	(4/10) (2/0)
Lexical Level 3	(Multilingual - ISO 10646)	- (2/5)	(2/15) (4/3)

ISO 8824/5

Basic-Text-String

::= IMPLICIT GRAPHICSTRING
  - - {iso standard 2022 abstract syntaxes (1) 1 6}

– an arbitrary length string of data taken from the International Reference Version (IRV) primary character code table (ASCII) as defined in ISO Standard 646 including both the graphic G set and control C set as well as the SPACE character. These are registered under ISO 2375 with registration numbers 6

Withdrawn / Retired

and 1 respectively, and standardized under CCITT recommendation T.50. The null value is a zero field width.

General-Text-String ::= CHOICE{ -- an arbitrary length string of text
-- taken from one of four repertoires.
[0] GRAPHICSTRING -- basic ASCII text (ISO 646 IRV)
-- {iso standard 2022 abstract syntaxes (1) 1 6}}
[1] GRAPHICSTRING -- Extended ASCII (including
-- accents for Western European Latin alphabet based
-- languages ISO 8859 Part 1 (Latin Alphabet 1))
-- {iso standard 2022 abstract syntaxes (1) 1 6 142}
[2] GRAPHICSTRING -- Full Latin alphabet text ASCII (all
-- accents, diacritical marks and special characters for Latin
-- alphabet based languages (ISO 6937 repertoire))
-- {iso standard 2022 abstract syntaxes (1) 1 6 100}
[3] GRAPHICSTRING -- Universal Character Set (Base
-- Multilingual plane of ISO 10646) (note: 2 bytes per
-- character)
-- {iso standard 10646 transfer-syntaxes (0) two-octet-BMP--
-- form (2)}
}

The null value is a zero field width. The sub-fields which may use a General-Text-String are described in Table 5-7.

VRF Relational Tables

Textual information can be either variable length or fixed length in Annex C. The null state of a variable length text string is of zero length. The null state of a fixed length text string requires that a specific code be selected. The character DEL (code table position 7/15) should be used as the padding character. The character code NUL (code table position 0/0) and a number of other C0 control characters (see 5.2 below) may have special meaning on some computer systems and should not appear in any text strings. A NUL or a SUB (^Z) in a file is an "end of file" mark on some computers and should not be used in DIGEST text strings. Only those characters specified in the identified repertoire should be used at each lexical level.

Annex C does not make an explicit distinction between Basic Text and General Text. Certain data fields can only be expressed in Basic Text (ASCII). Others may be expressed in Lexical Level 0 to 3 (default level 0 ASCII). These fields are identified in Table 5-7 below.

Basic Text T,n or T,*

– a fixed length (T,n) or an arbitrary length (T,*) string of text characters taken from the International Reference Version (IRV) primary character code table (ASCII) as defined in ISO Standard 646 including both the graphic G set and control C set as well as the SPACE character. The null value is a zero field width for a variable width text field or blank filled for a fixed width text field.

Withdrawn/Reserved

General Text

T,n or T,* or L,n or L,* or N,n or N,* or M,n or M,*

– an arbitrary length string of text taken from one of four repertoires.
  0 - basic ASCII text (ISO 646)
  1 - Extended ASCII (including accents for Western European Latin alphabet based languages ISO 8859 Part 1 (Latin Alphabet 1))
  2 - Full Latin alphabet text ASCII (all accents, diacritical marks and special characters for Latin alphabet based languages (ISO 6937 repertoire))
  3 - Universal Character Set (Base Multilingual plane of ISO 10646) UCS-2 implementation level 2 (note: 2 bytes per character)

The null value is a zero field width for a variable width text field or blank filled for a fixed width text field.
The distinction between which repertoire and coding is used is identified by the Field Type in each table header row.
The following list indicates the Field Type code for each Lexical Level:

T,n or T,*	Level 0 (ASCII - ISO 646 IRV)
L,n or L,*	Level 1 (Latin 1 - ISO 8859)
N,n or N,*	Level 2 (Full Latin - ISO 6937)
M,n or M,*	Level 3 (Multilingual - ISO10646)

The asterisk (*) indicates variable -length string. The "n" indicates a fixed-length.

5.2 CODE TABLES

All text is defined in terms of character set code tables. Particular character codes are identified by a code table arranged into rows and columns in which 94 (or 96) character codes are assigned. A number of different character code tables are in use internationally and these code tables are registered with ISO under ISO Standard 2375. The basic international code table is the International Reference Version alphabet ISO 646 IRV which is equivalent to ASCII (American Standard Code for Information Interchange ANSI X3.4).

The alphabetic code table is termed the Graphic or "G" set. Another specialized code table, the Control or "C0" set, is also defined. Some of the C0 control characters are reserved for specialized use, such as transmission control in an asynchronous communications system or application level delimiting. The only Format Effector C0 characters required by DIGEST are: Carriage Return (CR), Line Feed (LF), Back Space (BS), Horizontal Tab (HT), Vertical Tab (VT) and Form Feed (FF). Since DIGEST operates in an 8-bit coding environment with four defined character repertoires corresponding to ISO standards, there is no need for the code extension characters Escape (ESC), Shift In (SI), or Shift Out (SO). Other C0 characters are not used in DIGEST text and have a null meaning.

Withdrawn Retirée

The ASCII (ISO 646 IRV) code table caters largely to the needs of the English language. It defines 94 characters within a single 7-bit code table (with bit 8 zero in an 8-bit implementation). For other Latin languages where accented letters are used extensively, and for other alphabets, the International Organization for Standardization (ISO) has defined other standards. There are several different standards defined by ISO dependent on the size of the repertoire of characters which must be addressed. The ISO 8859 standard uses bit 8 of an 8-bit character field to switch between two code tables, the ASCII code table on the left and a supplementary code table on the right containing 94 additional characters. Each character has a single code. The ISO 6937 standard expands the repertoire to over 300 possible Latin alphabet characters by constructing accented characters out of the combination of a basic character and a non-spacing accent or diacritical mark. A different supplementary code table on the right containing 94 additional characters is also defined. In this supplementary code table column 12 contains non-spacing characters which may be used in combination with specific other base characters. The repertoire defines which of these characters are valid. The ISO 10646 standard defines a "Universal Character Set" for virtually all languages in the world. To do this it must use 16-bits or more to identify each character. DIGEST makes use of the Base Multilingual plane of ISO 10646 which uses 16-bits per character, handling ASCII, virtually all Latin alphabet languages, Greek, Hebrew, Cyrillic, Arabic, Chinese (Han - including Japanese Kanji and Korean Hangul), Japanese Katakana, etc. Virtually every modern alphabet is specified. Excluded are such character sets as ancient Egyptian hieroglyphics which require 32 bits per character.

The specific characters available under a given character set standard are called the repertoire of that standard. Different character set coding standards may be used as long as the character repertoires are identical. It doesn't matter whether the ISO 8211 encapsulation uses one bit combination (code) to represent a given character and ISO 8824 uses a different code, as long as the character identified is the same. Coding is an encapsulation issue, but, some of the ISO standards provide far richer repertoires of characters than do others, and therefore it is necessary in DIGEST to define several different levels of standard character repertoires. The defined repertoire of available characters is what is of principle importance for compatibility.

Four levels of repertoire are defined for DIGEST ranging from basic ASCII text to the support of any alphabet registered nationally or internationally. This range is broken into two broad levels: Basic Text and General Text. Basic text (Level 0) is simply ASCII data and is used throughout the standard for various purposes. The repertoire is simply the 94 characters defined in the ASCII character set plus the SPACE character plus specific C0 control characters (Carriage Return (CR) and Line Feed (LF), etc.). Other C0 characters are not used in basic text. General text includes the Latin alphabet accents and special

Withdrawn/Retired

characters and other alphabets. General text is normally used to specify attributes such as place names which can be defined in any world alphabet or for free text sub-fields or attributes. Four levels of general text repertoire are defined. These levels have been defined to be efficient in various encodings and at different levels of usage. For example Level 1 general text makes use of the Latin Alphabet 1 repertoire (commonly called 8-bit ASCII) which is directly compatible with virtually all computer systems. Level 1 general text addresses the needs of Western European languages. Level 2 general text addresses the needs of virtually all Latin Alphabet based languages. Level 3 general text addresses the needs of almost all world languages, but it is less efficient in coding. DIGEST may be extended to a fifth level of general text which addresses the needs of all languages using the full capabilities of ISO 10646 UCS-4 requiring 4-bytes per character. However this approach can be very complex and inefficient and is reserved for further study at this time.

5.2.1 ALPHABETS AND REPERTOIRE

The basic alphabet used in DIGEST is the International Reference Version alphabet of ISO Standard 646, which is equivalent to ASCII. This alphabet is also standardized for Telematic interchange by the UN International Telegraphic Union (ITU), International Telephone and Telegraph Consultative Committee (CCITT). The International Reference Alphabet of CCITT recommendation T.50 is equivalent ASCII

Level 0 Text Repertoire

The following code table presents the DIGEST Level 0 text repertoire, the Latin Alphabet Primary Code Table (ASCII). Both the G0 graphic and C0 control code tables are shown. Only the C0 Format Effector characters are illustrated. All other C0 control codes are not used. The code extension characters from the C0 set (ESC, SI, and SO) are not used in DIGEST. The 7 bit code table is shown. Bit 8 in an 8 bit field is set to 0.

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Table 5-3 Latin Alphabet Primary Code Table (ASCII)

row b4 b3 b2 b1	column b8 b7 b6 b5	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1
		0	1	2	3	4	5	6	7
0 0 0 0	0			Space	0	@	P	'	p
0 0 0 1	1			!	1	A	Q	a	q
0 0 1 0	2			"	2	B	R	b	r
0 0 1 1	3			#	3	C	S	c	s
0 1 0 0	4			$	4	D	T	d	t
0 1 0 1	5			%	5	E	U	e	u
0 1 1 0	6			&	6	F	V	f	v
0 1 1 1	7			´	7	G	W	g	w
1 0 0 0	8	BS		(	8	H	X	h	x
1 0 0 1	9	HT		)	9	I	Y	i	y
1 0 1 0	10	LF		*	:	J	Z	j	z
1 0 1 1	11	VT		+	;	K	[	k	{
1 1 0 0	12	FF		,	<	L	\	l	|
1 1 0 1	13	CR		-	=	M	]	m	}
1 1 1 0	14			.	>	N	^	n	~
1 1 1 1	15			/	?	O	_	o	
		C0		G0					

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Level 1 Text Repertoire

The following code table presents the DIGEST Level 1 text repertoire, which is the 8-bit code table from ISO 8859 part 1. The G0 graphic portion is equivalent to ASCII (used in DIGEST Level 1 text). The same C0 code table is also used with the same restriction to only Format Effector characters. All other C0 control codes are not used. The right hand side of the 8-bit coding environment contains the ISO 8859 supplementary code table and a blank C1 table. The supplementary characters are direct characters; that is, individual character codes are assigned for each accented character in the repertoire. In DIGEST Lexical Level 0 and 1 each character is coded using a single character. There are no constructed characters. This simplifies processing of such data.

Table 5-4 Latin Alphabet 1 Code Table ISO 8859 -1

row b4 b3 b2 b1	column b8 b7 b6 b5	0 0 0 0	1 0 0 0	2 0 0 1	3 0 0 1	4 0 1 0	5 0 1 1	6 0 1 0	7 0 1 1	8 1 0 0	9 1 0 1	10 1 1 0	11 1 1 1	12 1 1 0	13 1 1 1	14 1 1 0	15 1 1 1
0 0 0 0	0			Space	0	@	P	'	p			NBSP	°	À	Ð	à	ð
0 0 0 1	1			!	1	A	Q	a	q			¡	±	Á	Ñ	á	ñ
0 0 1 0	2			"	2	B	R	b	r			¢	²	Â	Ò	â	ò
0 0 1 1	3			#	3	C	S	c	s			£	³	Ã	Ó	ã	ó
0 1 0 0	4			$	4	D	T	d	t			¤	´	Ä	Ô	ä	ô
0 1 0 1	5			%	5	E	U	e	u			¥	µ	Å	Õ	å	õ
0 1 1 0	6			&	6	F	V	f	v			¦	¶	Æ	Ö	æ	ö
0 1 1 1	7			´	7	G	W	g	w			§	·	Ç	×	ç	÷
1 0 0 0	8	BS		(	8	H	X	h	x			¨	¸	È	Ø	è	ø
1 0 0 1	9	HT		)	9	I	Y	i	y			©	¹	É	Ù	é	ù
1 0 1 0	10	LF		*	:	J	Z	j	z			ª	º	Ê	Ú	ê	ú
1 0 1 1	11	VT		+	;	K	[	k	{			«	»	Ë	Û	ë	û
1 1 0 0	12	FF		,	<	L	\	l	|			¬	¼	Ì	Ü	ì	ü
1 1 0 1	13	CR		-	=	M	]	m	}			SHY	½	Í	Ý	í	ý
1 1 1 0	14			.	>	N	^	n	~			®	¾	Î	Þ	î	þ
1 1 1 1	15			/	?	O	_	o				¯	¿	Ï	ß	ï	ÿ
		C0		G0						C1		G1					

Level 2 Text Repertoire

The DIGEST Level 2 text repertoire supports virtually all letters required in Latin Alphabet based languages in accordance with standard ISO 6937 part 1. This is accomplished by a combination technique in which a non-spacing accent is combined with a base character. For example the letter " é " is composed of the non-spacing accent and the base character as illustrated below.

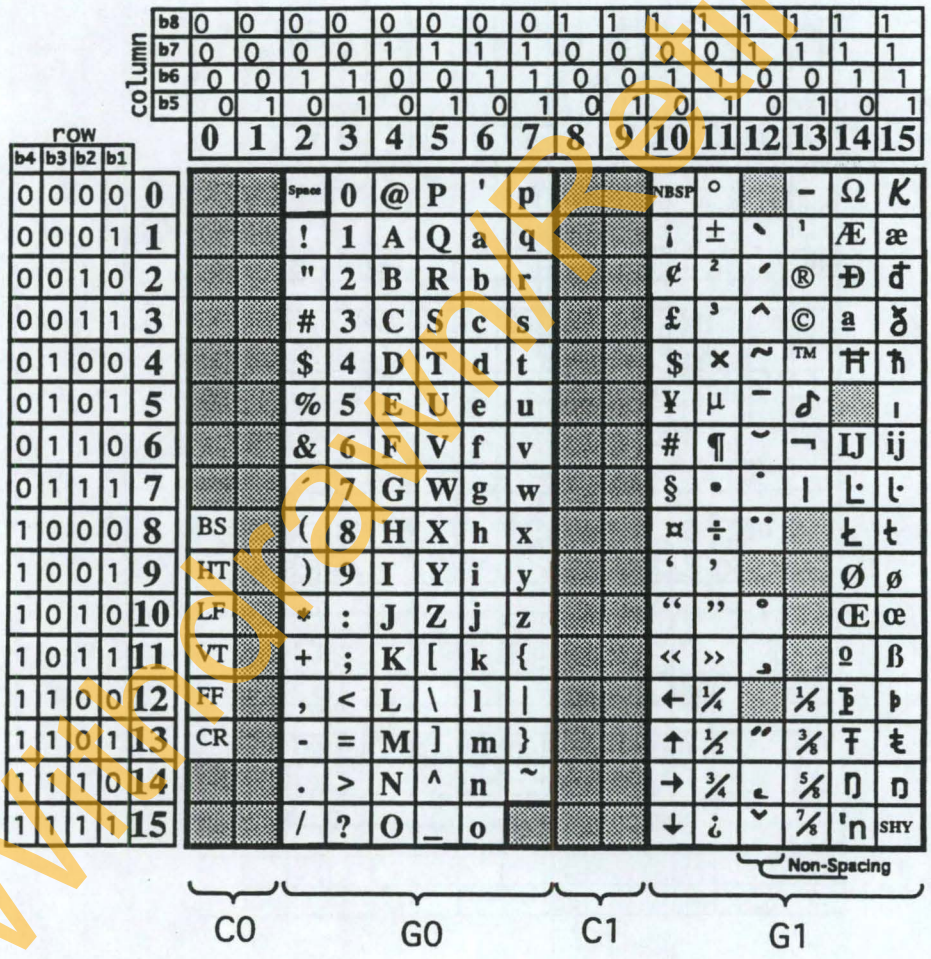
´ + e = é

ISO standard 6937 part 1 defines a supplementary code table which is used with the primary Latin alphabet (ASCII). One column of this code table contains non-spacing characters.

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In an 8-bit environment, as used in DIGEST, this is implemented as illustrated below. The G0 graphic portion of the 8-bit coding environment is equivalent to ASCII (used in DIGEST Level 1 text). The same C0 code table is also used with the same restriction to only Format Effector characters. All other C0 control codes are not used. The right hand side of the 8-bit coding environment contains the ISO 6937 supplementary code table and a blank C1 table. Column 12 contains non-spacing accents and diacritical marks.

Table 5-5 Composite Latin Alphabet Code Table ISO 6937 -1



Not all combinations of non-spacing accents or diacritical marks from column 12, with base characters are valid. The repertoire for Level 3 text consists of those individual characters in the code tables, plus specific combinations which exist in Latin alphabet based languages. This simplifies the implementation since only meaningful combinations need be handled. There are over 300 valid

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characters in the repertoire at this level. The following table indicates the combinations of accents and base characters allowed according to ISO 6937.

Table 5-6 Combinations of Accents and Diacritical Marks with base characters per ISO 6937 - 1

Basic Letter	Acute Accent	Grave Accent	Circumflex Accent	Diaeresis or Umlaut	Tilde	Caron	Breve	Double Acute Accent	Ring	Dot	Macron	Umlaut Mark	Cedilla	Ogonek
aA	áÁ	àÀ	âÂ	äÄ	ãÃ		ăĂ		åÅ		āĀ	äÄ		ąĄ
bB														
cC	ćĆ		ĉĈ			čČ				ċĊ			çÇ	
dD						ďĎ								
eE	éÉ	èÈ	êÊ	ëË		ěĚ				ėĖ	ēĒ	ëË		ęĘ
fF														
gG	ǵǴ		ĝĜ				ğĞ			ġĠ			ģĢ	
hH			ĥĤ											
iI	íÍ	ìÌ	îÎ	ïÏ	ĩĨ					İ	īĪ			įĮ
jJ			ĵĴ											
kK													ķĶ	
lL	ĺĹ					ľĽ							ļĻ	
mM														
nN	ńŃ				ñÑ	ňŇ							ņŅ	
oO	óÓ	òÒ	ôÔ	öÖ	õÕ			őŐ			ōŌ	öÖ		
pP														
qQ														
rR	ŕŔ					řŘ							ŗŖ	
sS	śŚ		ŝŜ			šŠ							şŞ	
tT						ťŤ							ţŢ	
uU	úÚ	ùÙ	ûÛ	üÜ	ũŨ		ŭŬ	űŰ	ůŮ		ūŪ	üÜ		ųŲ
vV														
wW			ŵŴ											
xX														
yY	ýÝ		ŷŶ	ÿŸ								ÿŸ		
zZ	źŹ					žŽ				żŻ				

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Level 3 Text Repertoire

The Level 3 text repertoire supports all characters in the Base Multilingual Plane of ISO 10646, which is known as Universal Character Set -2 (for 2-byte coding). This character set is also known as "Unicode". It covers almost all languages in the world including the large iconographic character sets such as Chinese, Japanese and Korean. It is based on a 2-byte (16-bit) coding scheme.

There are several levels of sub-repertoire defined in ISO 10646 UCS-2. For DIGEST, UCS-2 level 2 is used because it permits the widest selection of characters including the combination accents used in Arabic and some other languages, but it is restricted only to unique character combinations that exist in real languages. Many computer systems only implement UCS-2 level 1, which is rigidly defined as one character per code. DIGEST data using UCS-2 level 2 would make use of default representations of any combined characters according to the rules of ISO 10646.

The two byte coding scheme of UCS-2 makes use of two character codes (16-bits) to address into a very large code table (or plane). UCS-4 uses four 8-bit codes (32 bits) to index into an enormous code space. The base plane of the UCS-4 code space, called the base multi-lingual plane, is equivalent to the UCS-2 code plane. The other planes support less frequently needed codes such as extended Chinese, Ancient Egyptian, etc. The first eight bits of the address space of both UCS-2 and UCS-4 match the ISO 8859 character set, and the first seven bits match ASCII. To the user of a database UCS codes are just 16 or 32 bit character codes. Direct support for ISO 10646 is provided in this manner by many computer vendors.

The entire repertoire of ISO 10646 is much too large to reproduce in this standard. Reference should be made to ISO 10646-1913. In brief the alphabets supported are:

Table 5-7 Character Set Repertoire of ISO 10646 Base Multilingual Plane

Collection Number	Name	Code Positions
1	Basic Latin	0020 - 007E
2	Latin-1 Supplement	00A0 - 00FF
3	Latin Extended-A	0100 - 017F
4	Latin Extended-B	0180 - 024F
5	IPA Extensions	0250 - 02AF
6	Spacing Modifier Letters	02B0 - 02FF
7	Combining Diacritical Marks	0300 - 036F
8	Basic Greek	0370 - 03CF
9	Greek Symbols and Coptic	03D0 - 03FF

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10	Cyrillic	0400 - 04FF
11	Armenian	0530 - 058F
12	Basic Hebrew	05D0 - 05EA
13	Hebrew Extended	0590 - 05CF, 05EB - 05FF
14	Basic Arabic	0600 - 0652
15	Arabic Extended	0653 - 06FF
16	Devanagari	0900 - 097F, 200C, 200D
17	Bengali	0980 - 09FF, 200C, 200D
18	Gurmukhi	0A00 - 0A7F, 200C, 200D
19	Gujarati	0A80 - 0AFF, 200C, 200D
20	Oriya	0B00 - 0B7F, 200C, 200D
21	Tamil	0B80 - 0BFF, 200C, 200D
22	Telugu	0C00 - 0C7F, 200C, 200D
23	Kannada	0C80 - 0CFF, 200C, 200D
24	Malayalam	0D00 - 0D7F, 200C, 200D
25	Thai	0E00 - 0E7F
26	Lao	0E80 - 0EFF
27	Basic Georgian	10D0 - 10FF
28	Georgian Extended	10A0 - 10CF
29	Hangul Jamo	1100 - 11FF
30	Latin Extended Additional	1E00 - 1EFF
31	Greek Extended	1F00 - 1FFF
32	General Punctuation	2000 - 206F
33	Superscripts and Subscripts	2070 - 209F
34	Currency Symbols	20A0 - 20CF
35	Combining Diacritical Marks for Symbols	20D0 - 20FF
36	Letter Like Symbols	2100 - 214F
37	Number Forms	2150 - 218F
38	Arrows	2190 - 21FF
39	Mathematical Operators	2200 - 22FF
40	Miscellaneous Technical	2300 - 23FF
41	Control Pictures	2400 - 243F
42	Optical Character recognition	2440 - 245F
43	Enclosed Alphanumerics	2460 - 24FF
44	Box Drawing	2500 - 257F
45	Block Elements	2580 - 259F
46	Geometric Shapes	25A0 - 25FF
47	Miscellaneous Symbols	2600 - 26FF
48	Dingbats	2700 - 27BF
49	CJK Symbols and Punctuation	3000 - 303F
50	Hiragana	3040 - 309F
51	Katakana	30A0 - 30FF
52	Bopomofo	3100 - 312F
53	Hangul Compatibility Jamo	3130 - 318F
54	CJK Miscellaneous	3190 - 319F
55	Enclosed CJK Letters and Months	3200 - 32FF
56	CJK Compatibility	3300 - 33FF
57	Hangul	3400 - 3D2D
58	Hangul Supplementary-A	3D2E - 44B7
59	Hangul Supplementary-B	44B8 - 4DFF
60	CJK Unified Ideograms	4E00 - 9FFF
61	Private Use Area	E000 - F8FF
62	CJK Compatibility Ideograms	F900 - FAFF
63	Alphabetic Presentation Forms	FB00 - FB4F
64	Arabic Presentation Forms-A	FB50 - FDFF

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65	Combining Half Marks	FE20 - FE2F
66	CJK Compatibility Forms	FE30 - FE4F
67	Small Form Variants	FE50 - FE6F
68	Arabic Presentation Forms-B	FE70 - FEFE
69	Halfwidth and Fullwidth Forms	FF00 - FFEF
70	Specials	FFF0 - FFFD

5.2.2 CODING OF CHARACTER SETS

The coding used for DIGEST Text Level 0 and 1 is simply 8-bit character codes. One character code corresponds directly to one character. Control characters used as delimiters in ISO 8211 and on some telecommunications lines are avoided. This coding is supported by all encapsulations (ISO 8211, ISO 8824/5 and VRF) in the same manner.

The coding used for Text Level 2 is also 8-bit character codes. However, there is not a direct correspondence between characters and 8-bit codes since some characters may be constructed out of the combination of a non-spacing accent and a basic character. Control characters used as delimiters in ISO 8211 and on some telecommunications lines are avoided. This coding is supported by all encapsulations (ISO 8211, ISO 8824/5 and VRF) in the same manner. However certain Structured Query Language (SQL) functions on relational tables may not be supported in some implementations because of the non-direct relationship between characters and 8-bit codes.

The coding for Text Level 3 can be one of two variations. First of all, in the simplest encoding double bytes of two 8-bit octets would be used as a 16-bit index into the character code space; that is, as 16-bit character codes. This approach is supported directly in the relational table encapsulation and in the ISO 8824 encapsulation. ISO 10646 also defines a coding format called UTF-1 (Universal Transfer Form). This coding is a transformation of the 16-bit index into a variable length code, which can be one to five octets dependent upon the priority of the characters as defined in ISO 10646. Primary text characters remain as one byte and are bit equivalent to ASCII. The UTF algorithm can be summarized as follows:

1. A UCS (UCS-2 or UCS-4) character from 0000 0000_{Hex} to 0000 $009F_{Hex}$ is mapped to the corresponding octet from 00_{Hex} to $9F_{Hex}$.

2. A UCS character from 0000 $00A0_{Hex}$ to 0000 4015_{Hex} is mapped to a sequence of two octets, with the first octet in the range $A1_{Hex}$ to $F5_{Hex}$, and the second octet having 190 values in the 21_{Hex} to $7E_{Hex}$ or the range $A0_{Hex}$ to FF_{Hex}.

3 A USC character from 0000 4016_{Hex} to 0003 $8E2D_{Hex}$ is mapped to a sequence of three octets, with the first octet in the range from $F6_{Hex}$ to FB_{Hex},

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and the other octets in the range from 21_{Hex} to $7E_{Hex}$ or the range $A0_{Hex}$ to FF_{Hex}.

4. A UCS character in the range 003 $8E2E_{Hex}$ or larger is mapped to a sequence of five octets, with the first octet in the range from FC_{Hex} to FF_{Hex}, and the other octets in the range 21_{Hex} to $7E_{Hex}$ or the range $A0_{Hex}$ to FF_{Hex}.

Note that the four-octet sequences are not used, since this maximizes the number of characters that can use the three-octet form.

Note that all codes described in the above algorithm were expressed in hexadecimal numbers.

The UTF-1 coding transforms UCS characters into a form that does not use octet values specified in ISO 2022 as coded representations of C0, Space, DEL or C1 characters, and can thus be used for transmitting text data through systems that are sensitive to these octet values.

ISO 8211 makes use of the Unit Seperator (US) (C0 character 1/15) code as a sub-field delimiter for fields not specified by a format. In general this makes ISO 8211 sensitive to a specific 8-bit octet value. That is to say in a 16-bit character code for a UCS character, the 8-bit combination corresponding to the US character might occur. This could cause a false sub-field terminator to be detected. Therefore, the UTF-1 coding for DIGEST Level 3 text must be used in an ISO 8211 encapsulation[2].

5.2.3 LEXICAL FIELDS

The following is a table of text sub-fields which may carry general text. These text fields may have a Lexical Level of 0, 1, 2 or 3.

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2 In a future version of DIGEST, it may be possible to arrange formats so that the use of UTF-1 can be avoided. Since ISO 8211 is an archival format, it is preferable that the direct 16-bit coding be used for UCS-2 in the future.

Table 5-8 Table of General-Text Fields Defined in DIGEST

Record	Field Name	Field Tag (see note 1)	Sub-Field Name	Sub-Field Label (see note 1)
GENERAL INFORMATION	GENERAL_INFORMATION (see note 2)	GEN	Free Text (e.g. description of digitizing equipment)	
SOURCE	COPYRIGHT	CPY	Copyright statement	CPZ
SUPPLEMENTARY TEXT	SUPPLEMENTARY_TEXT (see note 2)	SUP	(Free text (supplementary text)	TXT
QUALITY	OTHER_QUALITY_INFORMATION	QOI	Free text	OQI
TEXT REPLACEMENT	TEXT	TXT	Text (Text associated with identified feature)	FTX

Notes:

1. The Annex A Field Tags and Sub-Field Labels have been used for clarity.

2. Due to a limitation in ISO 8211-1985 there is no capability of specifying the character set (Lexical Level) being used at the sub-field level. Therefore, an entire field must be of the same Lexical Level. This affects only two fields: the GENERAL_INFORMATION field and the SUPPLEMENTARY_TEXT field. In both of these fields there exists an "A" format sub-field which takes on specific values. In the GENERAL_INFORMATION field the IMR (Image Rectification Field) can take on the value "Y" or "N". In the SUPPLEMENTARY_TEXT field the TRY(Supplementary text record type) can take on the values "CONV", "CPYZ", "DATM", "MISC", "NOTE", "XXXX". Since these are specific text strings composed of only ASCII characters, and because these characters take on the same bit patterns at all Lexical Levels, there is no actual difficulty. Because the ISO 10646 UTF coding must be used for Lexical Level 3, in this case the bit patterns for the character codes happen to match, even for level 3. Until this restriction is corrected in a future version of ISO 8211, care must be taken when maintaining DIGEST so that no additional "A" sub-fields are added to records that contain "L" format sub-fields.

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6 PROJECTION CODES AND PARAMETERS

Table 6-1 provides the allowable projections and their codes and parameters for the Dataset Map Projection Group. These codes and parameters are necessary for conversion of digitized map coordinates to geographic coordinates.

Table 6-1 Projection Codes and Parameters

NAME	CODE	PARAMETERS			
		1	2	3	4
Albers Equal Area	AC	Central Meridian	Std. Parallel Nearer to Equator	Std. Parallel Farther from Equator	Parallel of Origin
Azimuthal Equal Area	AK	Longitude of Tangency	Latitude of Tangency	-	-
Azimuthal Equal Distant	AL	Longitude of Tangency	Latitude of Tangency	-	-
Gnomonic	GN	Longitude of Tangency	Latitude of Tangency	-	-
Hotine Oblique Mercator (Rectified Skew Orthomorphic)	RB	Longitude of Proj. Origin	Latitude of Proj. Origin	Azimuth of Skew X-Axis at Proj. Origin	ScaleFactor at Proj. Origin
Lambert Conformal Conic	LE	Central Meridian	Std. Parallel Nearer to Equator	Std Parallel Farther from Equator	Parallel of Origin
Lambert Equal Area	LJ	Central Meridian	-	-	-
Mercator	MC	Central Meridian	Latitude of True Scale	Parallel of Origin	-
Oblique Mercator	OC	Longitude of Reference Point on Great Circle	Latitude of Reference Point on Great Circle	Azimuth of Great Circle at Reference Point	-
Orthographic	OD	Longitude of Tangency	Latitude of Tangency	-	-
Polar Stereo-graphic	PG	Central Meridian	Latitude of True Scale	-	-
Polyconic	PH	Central Meridian	-	-	-
Transverse Mercator	TC	Central Meridian	Central Scale Factor	Parallel of Origin	-
Oblique Stereographic	SD	Longitude of Origin	Latitude of Origin	Scale factor at Origin	-
Relative Coordinates	RC	X-Scale Factor	Y-Scale Factor		

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7 GRID CODES

Table 7-1 provides the allowable grids and their codes for the Grid System field.

Table 7-1 Grid Codes

	Grid Description	Code
1	Aden Zone	AD
2	Afghanistan Gauss-Kruger Grid	AF
3	Air Defense Grid	AG
4	Air Support Grid	AI
5	Alabama Coordinate System	AJ
6	Alaska Coordinate System	AK
7	Algeria Zone	AL
8	Albania Bonne Grid	AM
9	Alpha-Numeric (Atlas) Grid	AN
10	Arbitrary Grid	AO
11	American Samoa Coordinate System	AP
12	Argentine Gauss-Kruger Conformal Grid	AQ
13	Artillery Referencing System	AR
14	Arizona Coordinate System	AS
15	Australia Belt	AU
16	Arkansas Coordinate System	AV
17	Australian Map Grid	AW
18	Azores Gauss Conformal Grid	AX
19	Azores Zone	AZ
20	Baku 1927 Coordinate System	BA
21	Bavaria Solder Coordinate System	BB
22	Belgium Lambert Grid	BC
23	Belgium Bonne Grid	BE
24	Brazil Gauss Conformal Grid	BF
25	Borneo Rectified Skew Orthomorphic Grid	BO
26	British West Indies Grid	BW
27	California Coordinate System	CB
28	Canada British Modified Grid	CD
29	Ceylon Belt (Transverse Mercator)	CE
30	Canary Islands (Spanish~ Lambert Grid)	CF
31	Chile Gauss Conformal Grid	CG
32	China Belt	CH
33	Canary Islands Zone	CI
34	China Lambert Zone	CJ
35	Colorado Coordinate Zone	CK
36	Connecticut Coordinate System	CM
37	Caspian Zone	CN
38	Costa Rica Lambert Grid	CO
39	Crimea Grid	CQ
40	Crete Zone	CR

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41	Cuba Lambert Grid	CT
42	Caucasus Zone	CU
43	Cape Verde Islands Zone	CV
44	British Cassini Grid	CW
45	Czechoslovak Uniform Cadastral Coordinate System	CX
46	Cyprus Grid	CY
47	Czechoslovak Military Grid	CZ
48	Danube Zone	DA
49	Dahomey Belt	DB
50	Denmark General Staff Grid	DC
51	Delaware Coordinate System	DD
52	Dominican Lambert Grid	DE
53	Denmark Geodetic Institute System 1924	DJ
54	Cape Verde Peninsula Grid	DK
55	East Africa Belt	EA
56	English Belt	EB
57	Eqypt Gauss Conformal Grid	ED
58	El Salvador Lambert Grid	EE
59	Estonian Grid	EF
60	Egypt Purple Belt	EP
61	Egypt Red Belt	ER
62	Egypt 35 Degree Belt	ET
63	Fernando Poo Gauss Grid	FA
64	Fiji Grid	FB
65	Florida Coordinate System	FC
66	French Bonne Grid	FD
67	French Guiana Gauss Grid	FE
68	French Somaliland Gauss-LaBorde Grid	FF
69	French Indochina Grid	FI
70	Franz Josef Land Zone	FJ
71	French Lambert Grid	FL
72	Formosa (Taiwan) Gauss-Schreiber Coordinate System	FO
73	French Equatorial Africa Grid	FS
74	Gabon Belt	GA
75	Gauss-Boaga Grid (Transverse Mercator)	GB
76	Gabon Gauss Conformal Grid	GC
77	Geodetic	GD
78	Guadeloupe Gauss-LaBorde Grid	GF
79	Colombia Gause Conformal Grid	GG
80	Sweden Gauss-Hannover Grid	GH
81	Georgia Coordinate System	GI
82	Gauss-Kruger Grid (Transverse Mercator)	GK
83	Greece Azimuthal Grid	GL
84	German Army Grid (DHG)	GN
85	Ghana National Grid	GO
86	Greece Bonne Grid	GP

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87	Greece Conical Mecklenburg Coordinates	GQ
88	Geographic Reference System (GEOREF)	GR
89	Greece Conical Mecklenburg Coordinate (New Numbering)	GM
90	Greenland Lambert Grid	GT
91	Guinea Zone	GU
92	Guam Coordinate System	GV
93	Guatemala Lambert Grid	GW
94	Guyana Transverse Mercator Grid	GY
95	Haiti Lambert Grid	HB
96	Hawaii Coordinate System	HC
97	Hawaii Grid	HD
98	Honduras Lambert Grid	HE
99	Hong Kong New System Cassini Grid	HF
100	Hungary Stereographic Grid	HG
101	Hong Kong Colony Grid	HR
102	Idaho Coordinate System	IA
103	Illinois Coordinate System	IB
104	Indiana Coordinate System	IC
105	Indonesia Mercator Grid	ID
106	Indonesia Polyhedric Grid	IE
107	Iowa Coordinate System	IF
108	Ivory Coast Azimuthal Grid	IG
109	Irish Cassini Grid	IH
110	Ivory Coast Belt	IJ
111	Irish Transverse Mercator Grid	IK
112	Iceland New Lambert Zone	IL
113	India Zone	IN
114	Iberian Peninsula Zone	IP
115	Iraq Zone	IQ
116	Iraq National Grid	IR
117	Italy Zone	IT
118	Ivy - Found on an HA in Marshall Islands	IY
119	Iceland Zone	IZ
120	Jamaica Foot Grid	JA
121	Japan Plane-Rectangular Coordinate System	JB
122	Japan Gauss-Schreiber Grid	JC
123	Johore Grid	JO
124	Austria Gauss-Kruger Grid	KA
125	Bulgaria Gauss-Kruger Grid	KB
126	Katanga Grid	KC
127	Kansas Coordinate System	KD
128	Kentucky Coordinate System	KE
129	Finland Gauss-Kruger Grid	KF
130	German Gauss-Kruger Grid	KG
131	Kenya Colony Grid	KH

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132	Korea Gauss-Schreiber Coordinate System	KJ
133	Louisiana Coordinate System	KK
134	Lithuania Gauss-Kruger Grid	KL
135	Kwantung Province Grid	KN
136	Turkey Gauss-Kruger Grid	KT
137	Kwangsi Province Grid	KW
138	Luxembourg Gauss-Kruger Grid	KX
139	Lambert Conformal Conic Grid	LC
140	Latvia Coordinate System	LD
141	Levant Zone	LE
142	Levant Stereographic Grid	LF
143	Liberia Rectified Skew Orthomorphic Grid	LG
144	Libya Zone	LI
145	Sirte (Libya) Lambert Grid	LL
146	Malaya Grid	MA
147	Malta Belt	MB
148	Maldive-Chagos Belt	MC
149	Madiera Zone	MD
150	Mediterranean Zone	ME
151	Maine Coordinate System	MF
152	Malaya Rectified Skew Orthomorphic Grid	MG
153	Military Grid Referense System	MGRS
154	Martinique Gauss Grid	MH
155	Maryland Coordinate System	MI
156	Mexican Lambert Grid	MK
157	Michigan Coordinate System	ML
158	Mecca-Muscat Zone	MM
159	Minnesota Coordinate System	MN
160	Madagascar Grid (Laborde)	MO
161	Mississippi Coordinate System	MP
162	Morocco Zone	MQ
163	Missouri Coordinate System	MT
164	Mauritius Zone	MU
165	Montana Coordinate System	MV
166	Mozambique Lambert Grid	MW
167	Mozambique Polyconic Grid	MX
168	Massachusetts Coordinate System	MJ
169	Northwest Africa Zone	NA
170	Nigeria Colony Belt	NC
171	National Grid of Great Britain	ND
172	Northern European Zone	NE
173	Nebraska Coordinate System	NF
174	Numeric Grid	NG
175	Niger Zone	NI
176	Netherlands Stereographic Grid (Old Numbering)	NJ
177	North Korea Gauss-Kruger Grid	NK

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178	Netherlands Stereographic Grid (New Numbering)	NL
179	Netherlands East Indies Equatorial Zone British Metric Grid (Lambert)	NM
180	Nord de Guerre Zone	NO
181	Nevada Coordinate System	NP
182	New Sierra Leone Colony Grid	NQ
183	New York Coordinate System	NR
184	Netherlands East Indies Southern Zone	NS
185	New Zealand National Grid	NT
186	Nicaragua Lambert Grid	NU
187	Niger Belt	NV
188	North Carolina Coordinate System	NW
189	North Dakota Coordinate System	NX
190	Netherlands East Indies Equatorial Zone U.S. Yard Grid	NY
191	New Zealand Belt	NZ
192	Northern Malaya Grid	OA
193	Norway Gauss-Kruger Grid	OB
194	Ohio Coordinate System	OD
195	Oklahoma Coordinate System	OE
196	Orange Report Net	OR
197	Oregon Coordinate System	OS
198	Palestine Belt	PA
199	Panama Lambert Grid	PB
200	Palestine Civil Grid (Cassini)	PC
201	Paraguay Gauss-Kruger Grid	PD
202	Peiping Coordinate System of 1954	PE
203	Pennsylvania Coordinate System	PF
204	Peru Polyconic Grid	PI
205	Philippine Plane Coordinate System	PJ
206	Poland Gauss-Kruger Grid	PK
207	Poland Quasi-Stereographic Grid	PL
208	Philippine Polyconic Grid	PP
209	Portugal Bonne Grid, Old	PQ
210	Portugal Bonne Grid, New	PR
211	Portugal Gauss Grid	PS
212	Puerto Rico Coordinate System	PT
213	Puerto Rico Lambert Grid	PU
214	Qatar Grid	QA
215	Qatar Peninsula Grid	QU
216	Russian Belt	RB
217	Reunion Gauss Grid	RC
218	Rhode Island Coordinate System	RD
219	Rumania Bonne Grid	RE
220	Soviet Coordinate System of 1942	RF
221	Rumania Lambert-Cholesky Grid	RH

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222	Rumania Stereographic Grid	RI
223	Pulkovo Coordinate System of 1932	RT
224	South Africa Belt	SA
225	Senegal Gauss Conformal Grid (Belt)	SB
226	South Africa Coordinate System (Republic of South Africa)	SD
227	Senegal Belt	SE
228	South Carolina Coordinate System	SF
229	Sahara Zone	SH
230	South Dakota Coordinate System	SI
231	South Libya Zone	SJ
232	Sarawak Grid	SK
233	Spain Lambert Grid	SL
234	Southern New Guinea Grid	SN
235	South Georgia Lambert Grid	SQ
236	South Syria Lambert Grid	SR
237	Spanish North-Morocco Lambert Grid	SS
238	Svalbard Gauss-Kruger Grid	SV
239	Svobodny 1935 Coordinate System	SX
240	Seychelles Belt	SY
241	Spitzbergen Zone	SZ
242	Tanganyika Territorial Grid	TA
243	Tashkent 1875 Coordinate System	TB
244	Tennessee Coordinate System	TC
245	Texas Coordinate System	TD
246	Tobago Grid	TE
247	Trinidad Grid	TF
248	Trucial Coast Cassini Grid	TG
249	Trucial Coast Transverse Mercator Grid	TH
250	Turkey Bonne Grid	TI
251	Tunisia Zone	TN
252	Uganda Cassini Coordinate System	UA
253	Unidentified Grid	UB
254	Uruguay Gauss-Kruger Grid	UC
255	Utah Coordinate System	UD
256	Universal Polar Stereographic System	UP
257	U.S. Polyconic Grid System	US
258	Universal Transverse Mercator	UT
259	Vermont Coordinate System	VA
260	Virginia Coordinate System	VB
261	Venezuela Modified Lambert Grid	VE
262	Viet Nam Azimuthal Grid	VI
263	West Malaysia Rectified Skew Orthomorphic(Metric)Grid	WA
264	Switzerland Bonne Grid	WB
265	Switzerland Conformal Oblique Cylindrical Grid	WC
266	West Virginia Coordinate System	WD
267	Wisconsin Coordinate System	WE

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268	Wyoming Coordinate System	WF
269	World Polyconic System	WP
270	Yugoslavia Gauss-Kruger Grid (Not Reduced)	YA
271	Yugoslavia Reduced Gauss-Kruger Grid	YG
272	Yunnan Province Grid	YU

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8 ELLIPSOID CODES

Table 8-1 provides the allowable ellipsoids and their codes for the Ellipsoid field.

Table 8-1 Ellipsoid Codes

	Ellipsoid	Code
1	Modified Airy	AAM
2	Airy	AAY
3	Australian National	AUN
4	Bessel 1841	BES
5	Clarke 1858	CLE
6	Clarke 1880	CLJ
7	Clarke 1866	CLK
8	Everest	EVE
9	Modified Everest	EVM
10	Modified Fischer 1960	FAM
11	Fischer	FIS
12	Geodetic Reference System 1967	GRE
13	Geodetic Reference System 1980	GRS
14	Helmert 1906	HEL
15	Hough	HOU
16	Indonesian 1974	IDN
17	International	INT
18	Krassovsky	KRA
19	South American 1969	SAM
20	Walbeck	WAL
21	World Geodetic System 1960	WGA
22	World Geodetic System 1966	WGB
23	World Geodetic System 1972	WGC
24	World Geodetic System 1984	WGE

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9 DATUM CODES

Table 9-1 provides the allowable datums and their codes for the Geodetic Datum fields. Sounding Datum and the Vertical Reference System field usage are also covered in the Feature and Attribute Coding Catalogue (Part 4).

Table 9-1 Datum Codes

	Geodetic Datums	Code
1	Adindan	ADI
2	Adindan (Ethiopia)	ADIA
3	Adindan (Sudan)	ADIB
4	Adindan (Mali)	ADIC
5	Adindan (Senegal)	ADID
6	Adindan (Mean value: Ethiopia and Sudan)	ADIM
7	Afgooye (Somalia)	AFG
8	Ain el Abd 1970 (Bahrain Island)	AIN
9	Anna 1 Astro (Cocos Islands)	ANO
10	Arc 1950	ARF
11	Arc 1950 (Botswana)	ARFA
12	Arc 1950 (Lesotho)	ARFB
13	Arc 1950 (Malawi)	ARFC
14	Arc 1950 (Swaziland)	ARFD
15	Arc 1950 (Zaire)	ARFE
16	Arc 1950 (Zambia)	ARFF
17	Arc 1950 (Zimbabwe)	ARFG
18	Arc 1950 (Mean value: Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, and Zimbabwe)	ARFM
19	Arc 1960 (Kenya)	ARSA
20	Arc 1960 (Tanzania)	ARSB
21	Arc 1960 (Mean value: Kenya, Tanzania)	ARSM
22	Ascension Island 1958 (Ascension Island)	ASC
23	Astro Station 1952 (Marcus Island)	ASQ
24	Astro Beacon "E" (Iwo Jima Island)	ATF
25	Average Terrestrial System (Atlantic Datum) 1997	ATS
26	Australian Geod. 1966 (Australia and Tasmania Is.)	AUA
27	Australian Geod. 1984 (Australia and Tasmania Is.)	AUG
28	Djakarta (Batavia) (Sumatra Island, Indonesia)	BAT
29	Bermuda 1957 (Bermuda Islands)	BER
30	Bogota Observatory (Colombia)	BOO
31	Bukit Rimpah (Bangka & Belitum Islands, Indonesia)	BOR
32	Bukit Rimpah	BUR
33	Canton Astro 1966 (Phoenix Islands)	CA0

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34	Cape Canaveral (Mean value: Florida and Bahama Islands)	CAC
35	Campo Inchauspe (Argentina)	CAI
36	Cape (South Africa)	CAP
37	Camp Area Astro (Camp McMurdo Area, Antartica)	CAZ
38	Carthage (Tunisia)	CGE
39	Chua Astro (Paraguay)	CHG
40	Chatham 1971 (Chatham Island, New Zealand)	CHI
41	Chua Astro	CHU
42	Corrego Alegre (Brazil)	COA
43	Guyana CSG67	CSG
44	GUX 1 Astro (Guadacanal Island)	DOB
45	Easter Island 1967 (Easter Island)	EAS
46	European 79	ENB
47	Wake-Eniwetok 1960 (Marshall Islands)	ENW
48	European 1979 (Mean value: Austria, Finland, Netherlands, Norway, Spain, Sweden, and Switzerland)	EUQ
49	European 1950 (Mean value)	EUR
50	European 1950 (Western Europe: Austria, Denmark, France, Federal Republic of Germany , Netherlands, and Switzerland)	EURA
51	European 1950 (Greece)	EURB
52	European 1950 (Norway and Finland)	EURC
53	European 1950 (Portugal and Spain)	EURD
54	European 1950 (Cyprus)	EURE
55	European 1950 (Egypt)	EURF
56	European 1950 (Iran)	EURH
57	European 1950 (Sardinia)	EURI
58	European 1950 (Sicily)	EURJ
59	European 1950 (England, Channel Islands, Ireland, Northern Ireland, Scotland, Shetland Islands, and Wales)	EURK
60	European 1950 (Mean value: Austria, Belgium, Denmark, Finland, France, Federal Republic of Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, & Switzerland)	EURM
61	Oman (Oman)	FAH
62	Observatorio 1966 (Corvo and Flores Islands, Azores)	FLO
63	GAN Datum (Addu Atoll, Republic of Maldives)	GAA
64	German	GDA
65	Geodetic Datum 1949 (New Zealand)	GEO
66	Ghana	GHA

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67	DOS 1968 0230 (Gizo Island, New Georgia Islands)	GIZ
68	SW Base (Faial, Graciosa, Pico, Sao Jorge, and Terceira Island, Azores)	GRA
69	Genung Segara (Kalimantan Island, Indonesia)	GSE
70	G. Serindung	GSF
71	Guam 1963	GUA
72	Guadeloupe Ste. Anne	GUD
73	Herat North (Afganistan)	HEN
74	Hermannskogel	HER
75	Prov. S. Chilea.i (S. Chile, 53 S.)	HIT
76	Hjorsey 1955 (Iceland)	HJO
77	Hong Kong 1963 (Hong Kong)	HKD
78	Hu-tzu-shan	HTN
79	Bellevue (IGN) (Efate and Erromango Islands)	IBE
80	Italian	IDA
81	Indian	IND
82	Indian (Thailand and Vietnam)	INDA
83	Indian (Bangladesh, India, and Nepal)	INDB
84	Ireland 1965	IRE
85	Ireland 1965 (Ireland and Northern Ireland)	IRL
86	ISTS 073 Astro 1969 (Diego Garcia)	IST
87	Johnston Island 1961 (Johnston Island)	JOH
88	Kandawala (Sri Lanka)	KAN
89	Kertau 1948 (West Malaysia and Singapore)	KEA
90	Kerguelen Island 1949 (Kerguelen Island)	KEG
91	L.C. 5 Astro 1961 (Cayman Brac Island)	LCF
92	Liberia 1964 (Liberia)	LIB
93	Local Astro.	LOC
94	Luzon	LUZ
95	Luzon (Philipines except Mindanao Island)	LUZA
96	Luzon (Mindanao Island)	LUZB
97	Martinique Fort-Desaix	MAR
98	Marco Astro (Salvage Islands)	MAA
99	Massawa (Eritrea, Ethiopia)	MAS
100	Mayotte Combani	MAY
101	Merchich	MER
102	Merchich (Morocco)	MER
103	Midway Astro 1961 (Midway Island)	MID
104	Mahe 1971 (Mahe Island)	MIK
105	Minna (Nigeria)	MIN
106	Rome 1940 (Sardinia Island)	MOD
107	Montjong Lowe	MOL

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108	Viti Levu 1916 (Viti Levu Island, Fiji Islands)	MVS
109	Nahrwan (Masirah Island, Oman)	NAHA
110	Nahrwan (United Arab Emirates)	NAHB
111	Nahrwan (Saudi Arabia)	NAHC
112	Naparima (BWI Trinidad and Tobago)	NAP
113	North American 1983 (Mean Value: Alaska, Canada, CONUS, Mexico, and Central America)	NAR
114	North American 1927 (Mean value)	NAS
115	North American 1927 (Eastern US)	NASA
116	North American 1927 (Western US)	NASB
117	North American 1927 (Mean value: CONUS)	NASC
118	North American 1927 (Alaska)	NASD
119	North American 1927 (Mean value: Canada)	NASE
120	North American 1927 (Alberta and British Columbia)	NASF
121	North American 1927 (Newfoundland, New Brunswick, Nova Scotia and Quebec)	NASG
122	North American 1927 (Manitoba and Ontario)	NASH
123	North American 1927 (Northwest Territories and Saskatchewan)	NASI
124	North American 1927 (Yukon)	NASJ
125	North American 1927 (Mexico)	NASL
126	North American 1927 (Central America - Belize, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua)	NASN
127	North American 1927 (Canal Zone)	NASO
128	North American 1927 (Caribbean, Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, and Turks Islands)	NASP
129	North American 1927 (Bahamas, except San Salvador Island)	NASQ
130	North American 1927 (San Salvador Island)	NASR
131	North American 1927 (Cuba)	NAST
132	North American 1927 (Hayes Peninsula, Greenland)	NASU
133	North American 1983	NAX
134	Nigeria	NIG
135	Old Egyptian (Egypt)	OEG
136	Ordnance Survey of Great Britain	OGB
137	Ord. Survey G.B. 1936 (England)	OGBA
138	Ord. Survey G.B. 1936 (England, Isle of Man, and Wales)	OGBB
139	Ord. Survey G.B. 1936 (Scotland and Shetland Islands)	OGBC
140	Ord. Survey G.B. 1936 (Wales)	OGBD
141	Ord. Survey G.B. 1936 (Mean value: England, Isle of Man, Scotland, Shetland, and Wales)	OGBM

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142	Old Hawaiian	OHA
143	Old Hawaiian (Hawaii)	OHAA
144	Old Hawaiian (Kauai)	OHAB
145	Old Hawaiian (Maui)	OHAC
146	Old Hawaiian (Oahu)	OHAD
147	Old Hawaiian (Mean value)	OHAM
148	Pitcairn Astro 1967 (Pitcairn Island)	PIT
149	Pico de las Nieves (Canary Islands)	PLN
150	SE Base (Porto Santo) (Porto Santo & Madeira Islands)	POS
151	Provisional South American 1956	PRP
152	Prov. S. Amer. 1956 (Northern Chile near 19 degrees south)	PRPA
153	Prov. S. Amer. 1956 (Southern Chile near 43 degrees south)	PRPC
154	Prov. S. Amer. 1956 (Columbia)	PRPD
155	Prov. S. Amer. 1956 (Ecuador)	PRPE
156	Prov. S. Amer. 1956 (Guyana)	PRPF
157	Prov. S. Amer. 1956 (Peru)	PRPG
158	Prov. S. Amer. 1956 (Venezuela)	PRPH
159	Prov. S. Amer. 1956 (Mean value: Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, & Venezuela)	PRPM
160	Puerto Rico (Puerto Rico and Virgin Islands)	PUR
161	Qatar National (Qatar)	QAT
162	Qornoq (South Greenland)	QUO
163	Reunion 1947	REU
164	Santo (DOS) 1965 (Espirito Santo Island)	SAE
165	South American 1969 (Argentina)	SANA
166	South American 1969 (Bolivia)	SANB
167	South American 1969 (Brazil)	SANC
168	South American 1969 (Chile)	SAND
169	South American 1969 (Columbia)	SANE
170	South American 1969 (Ecuador)	SANF
171	South American 1969 (Guyana)	SANG
172	South American 1969 (Paraguay)	SANH
173	South American 1969 (Peru)	SANI
174	South American 1969 (Trinidad and Tobago)	SANK
175	South American 1969 (Venezuela)	SANL
176	South American 1969 (Mean value: Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, and Venezuela)	SANM
177	Sao Braz (Sao Miguel, Santa Maria Islands, Azores)	SAO
178	Sapper Hill 1943 (East Falkland Islands)	SAP
179	Schwarzeck (Namibia)	SCK

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180	Astro Dos 71/4 (St. Helena Island)	SHB
181	Sierra Leone 1960	SIB
182	South Asia (Southeast Asia, Singapore)	SOA
183	St. Pierre et Miquelon 50	STP
184	Tananarive Obsv. 1925	TAN
185	Tristan Astro 1968 (Tristan da Cunha)	TDC
186	Timbali 1948 (Brunei and East Malaysia - Sarawak and Sabah)	TIL
187	Tokyo (Mean value)	TOK
188	Tokyo (Japan)	TOYA
189	Tokyo (Korea)	TOYB
190	Tokyo (Okinawa)	TOYC
191	Tokyo (Mean value: Japan, Korea, and Okinawa)	TOYM
192	Astro Tern Is. 1961 (Tern Island, Hawaii)	TRN
193	Undetermined (processed as if WGS 84)	UND
194	Voirol	VOI
195	World Geodetic System 1960	WGA
196	World Geodetic System 1966	WGB
197	World Geodetic System 1972	WGC
198	World Geodetic System 1984	WGE
199	Yacare (Uruguay)	YAC
200	Zanderij (Surinam)	ZAN

	Sounding Datum	Code
1	Mean Higher High Water	MHHW
2	Mean High Water	MHW
3	Mean High Water Neaps	MHWN
4	Mean High Water Springs	MHWS
5	Mean Lower Low Water	MLLW
6	Mean Low Water	MLW
7	Mean Low Water Neaps	MLWN
8	Mean Low Water Springs	MLWS

	Vertical Reference	Code
1	Geodetic (All elevations in the data set are referenced to the ellipsoid of the specified datum.)	GEOD
2	Mean Sea Level (All elevations in the data set are referenced to the geoid of the specified datum.)	MSL

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10 UNITS OF MEASURE CODES

DIGEST defines units of measurement as referenced by ISO 1000 "SI units and recommendations for the use of their multiples and of certain other units." However, there are certain units outside the SI (Système internationale), some of which are recognized by International Committee for Weights and Measures (CIPM), which need to be included in DIGEST because of their practical importance, i.e. occurrence in DGI datasets. These units have their codes enclosed by parentheses ( ).

When a compound unit is formed by multiplication of two or more units, it can be indicated in one of the following ways:

N · m or N m

DIGEST preference is "N · m" to avoid misinterpretation of the blank space.

When a compound unit is formed by dividing one unit by another, it can be indicated in one of the following ways:

$\frac{m}{s}$ or m/s or $m\ s^{-1}$

DIGEST preference is "m/s".

Table 10-1 lists the SI, and commonly recognized (shown in parentheses), units of measure which are most likely to occur within a DIGEST dataset, and their codes (abbreviations) for the various Units of Measure fields of the Data Set Parameter Group. They also are referenced in Part 4 — Annex B (Attribute and Value Codes).

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Table 10-1 Units of Measure Codes

	Unit	Code
	LENGTH	
1.	Micrometres	UM
2.	Millimetres	MM
3.	Centimetres	CM
4.	Decimetres	DM
5.	Metres	M
6.	Kilometres	KM
7.	Inches	(IN)
8.	Feet	(FT)
9.	Yards	(YD)
10.	Fathoms	(FM)
11.	Fathoms and Feet	(FF)
12.	Statute Miles	(MI)
13.	Nautical miles	(NM)
	TIME	
14.	Seconds	S
15.	Minutes	MIN
16.	Hours	H
17.	Days	D
	SPEED	
18.	Metres per Second	M/S
19.	Kilometres per Hour	KM/H
20.	Miles per Hour	(MPH)
21.	Knots	(KNOT)
	AREA	
22.	Square metres	(M2)
23.	Square kilometres	(KM2)
24.	Hectares	(HA)
	ANGULAR MEASUREMENT	
25.	Mils	ML
26.	Seconds (of arc)	(SEC)
27.	Minutes (of arc)	(MA)
28.	Degrees (of arc)	(DEG)

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	WEIGHT (MASS)	
29.	Kilograms	KG
30.	Kips	(KIP)
	PRESSURE	
31.	Millibars	MBAR
32.	Hectopascals	HPA
	ELECTRICITY	
33.	Volts	V
34.	Kilovolts	KV
35.	Watts	W
36.	Megawatts	MW
37.	Gigawatts	GW
38.	Amperes	A
39.	Hertz	HZ
40.	Kilohertz	KHZ
41.	Megahertz	MHZ
	MISCELLANEOUS	
42.	Beds	(BED)
43.	Features	(FEATURE)
44.	Lanes/Tracks	(LANE/TRACK)
45.	Levels	(LEVEL)
46	Lines	(LINE)
47.	Occults	(OCCULT)
48.	Percent	(%)
49.	Persons	(PERSON)
50.	Qualifiers	(QUALIFIER)
51.	Structures	(STRUCTURE)
52.	Vehicles	(VEHICLE)

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Note: Codes enclosed in parentheses indicate non-ISO 1000 units. The parentheses themselves do not form part of the code.

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11 COUNTRY CODES

Use US FIPS PUB 10-3 for country codes.

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12 CODES FOR MEDIA RECORDING STANDARDS

Table 12-1 lists the codes for the various media recording standards.

Table 12-1 Codes for Media Recording Standards

Media Recording Standard	Code
Magnetic Tape	
• ISO 3788 (1600 PE)	1
• ISO 5652 (6250 GCR)	2
• ANSI X3.202 (8mm tape)	3
CD-ROM	
• ISO 9660	4

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13 USE OF CIE VALUES

CIE is an international colour system for defining colour produced by the "Commission Internationale de l'Eclairage". A number of systems for identifying colours, and the difference between colours, have been promulgated by the CIE. These are all based on measuring the Tristimulus values (Red, Green and Blue intensities) of a colour relative to a standard white. The method chosen by the DGIWG is to use the coordinates to the CIE chromaticity chart (see Figure 13-1). This is also the method used in the DoD Standard Printing Color Catalog (Reference 29). Of the other two systems, the CIELUV system is more applicable to the TV industry, and the CIELAB system, while providing finer discrimination between similar colours, is unnecessarily complex for the requirements of raster images. It is only necessary to uniquely identify what a colour should be; any difference in hue from the colour printed or captured by the scanner is irrelevant.

Defining accurately and consistently the colours that should appear in the raster image of a map, irrespective of any changes in colour introduced by both the printing and scanning processes, should not be difficult. In most cases the map specification defines what the various colours used in its production should be by reference to a standard colour chart or catalogue. An example of this is Reference 29, which as well as printing sample colours also gives the CIE Values for that colour. Where the standard colour catalogue referenced by a map specification does not give the CIE Values, then these may be obtained by:

- identifying the CIE Values for the catalogue in accordance with Reference 30 which defines the standard white to be used and the method to be adopted; or

- identifying the closest approximation to each colour in Reference 29 and assigning those CIE Values to the local standard colour catalogue. This method should only be used where the precise definition of a colour is not critical (i.e. the map series is only produced and/or scanned by one agency).

Defining what a map colour should be according to a recognized standard will ensure that:

- the colour can be readily identified by the receiving agency or user;

- precise consistency of colour can be achieved between samples of the same raster product produced not only by the same agency, but by different agencies; and

- users of applications will not be distracted by changes in colour and luminosity (which is worse) when traversing map boundaries.

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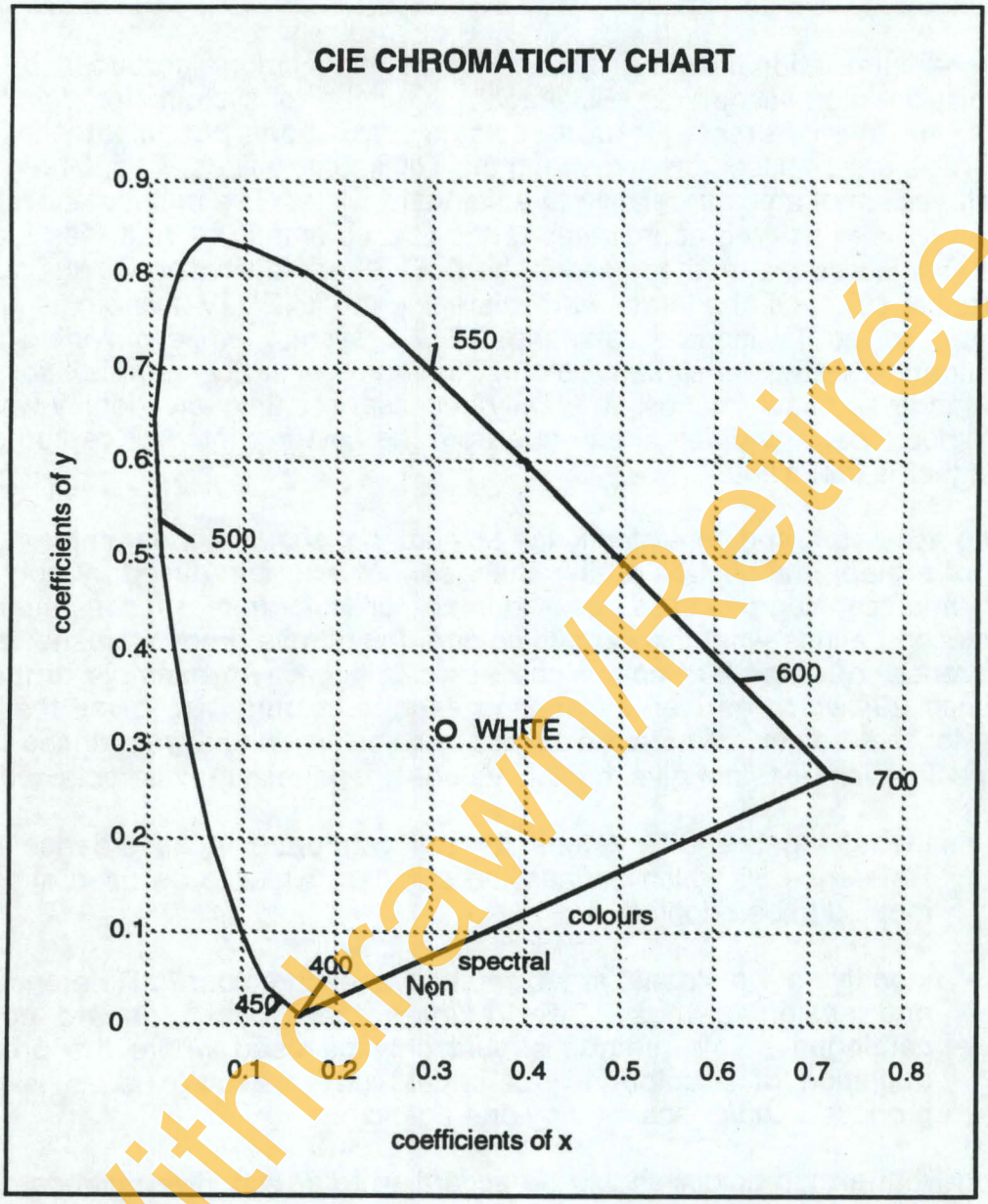


Figure 13-1 CIE Chromaticity Chart

Notes:

1. The colour coordinates are given as x,y,Y where Y is the reflectance.
2. The numbers round the rim of the graph are the dominant wavelength in nanometres.

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14 DGIWG DATASET CODES

Table 14-1 lists the DGIWG dataset names which may be used, and the codes (abbreviations) which may appear in the PRT fields.

Table 14-1 Dataset Codes

	Dataset Names	Code
0.	Unspecified	NULL
1.	Background Display Dataset	BDD
2.	Background Display-Vector Smart Map Dataset	BDD/VMap
3.	Transportation and Logistics Dataset	TLD
4.	Terrain Analysis Dataset	TAD
5.	Aeronautical Information Dataset	AID
6.	Toponymic Dataset	TND
7.	UTM/UPS Standard Raster Product	USRP
8.	ARC Standard Raster Product	ASRP
9.	Standard Raster Graphics	SRG
10.	Digital Matrix Elevation Dataset	DMED
11.	Simulator Dataset	SIMD

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15 ISO 8211 TAGS

The file abbreviations in the FILE/RECORD/TAG NAME fields are listed in Tables 15-1, 15-2 and 15-3 respectively.

Table 15-1 ISO 8211 FILE Field Abbreviations

VGF	for the	VECTOR_GEO_DATA_FILE	
MGF	for the	MATRIX_GEO_DATA_FILE	
RGF	for the	RASTER_GEO_DATA_FILE	
GIF	for the	GENERAL_INFORMATION_FILE	
GRF	for the	GEO_REFERENCE_FILE	
QF	for the	QUALITY_FILE	
SF	for the	SOURCE_FILE	
THF	for the	TRANSMITTAL_HEADER_FILE	

Table 15-2 ISO 8211 RECORD Field Abbreviations

AAR	for the	ATTRIBUTE/VALUE ASSOCIATION RECORD	
AFR	for the	AREA FEATURE RECORD	
AR	for the	ACCURACY RECORD	
CFR	for the	COMPLEX FEATURE RECORD	
DDR	for the	DATASET DESCRIPTION RECORD	
ER	for the	EDGE RECORD	
FAA	for the	FEATURE/ATTRIBUTE ASSOCIATION RECORD	
FER	for the	FEATURE/ATTRIBUTE ENTRY RECORD	
FR	for the	FACE RECORD	
GIR	for the	GENERAL INFORMATION RECORD	
GRR	for the	GEOGRAPHIC REFERENCE RECORD	
HAR	for the	HORIZONTAL ACCURACY RECORD	
IR	for the	IMAGE-RECORD	
LFR	for the	LINEAR FEATURE RECORD	
LR	for the	LEGEND RECORD	
MSR	for the	METRIC SUPPORT RECORD	
NR	for the	NODE RECORD	
PFR	for the	POINT FEATURE RECORD	
QR	for the	QUALITY RECORD	
SDR	for the	SPATIAL DATA RECORD	
SR	for the	SOURCE RECORD	
STR	for the	SUPPLEMENTARY TEXT RECORD	
SUR	for the	SECURITY AND UPDATE RECORD	
TDR	for the	TRANSMITTAL DESCRIPTION RECORD	
TPR	for the	TEXT PLACEMENT RECORD	
VAR	for the	VERTICAL ACCURACY RECORD	

Withdrawn/Retiree

Table 15-3 ISO 8211 TAG NAME Field/Subfield Abbreviations

Tag	Format	Name	Data Type (Location)
001	TAG	RECORD_ID_FIELD	V (in VGF/AFR)
001	TAG	RECORD_ID_FIELD	V (in VGF/CFR)
001	TAG	RECORD_ID_FIELD	V (in VGF/FER)
001	TAG	RECORD_ID_FIELD	V (in VFF/FAA)
001	TAG	RECORD_ID_FIELD	V (in VGF/AAR)
001	TAG	RECORD_ID_FIELD	V (in VGF/ER)
001	TAG	RECORD_ID_FIELD	V3 (in VGF/FR)
001	TAG	RECORD_ID_FIELD	R (in VGF/IR)
001	TAG	RECORD_ID_FIELD	V (in VGF/LFR)
001	TAG	RECORD_ID_FIELD	V (in VGF/NR)
001	TAG	RECORD_ID_FIELD	V (in VGF/PFR)
001	TAG	RECORD_ID_FIELD	V3 (in VGF/SDR)
001	TAG	RECORD_ID_FIELD	V (in GIF/DDR)
001	TAG	RECORD_ID_FIELD	C (in GIF/GIR)
001	TAG	RECORD_ID_FIELD	C (in GRF/GRR)
001	TAG	RECORD_ID_FIELD	C (in QF/AR)
001	TAG	RECORD_ID_FIELD	C (in QF/HAR)
001	TAG	RECORD_ID_FIELD	C (in QF/QR)
001	TAG	RECORD_ID_FIELD	C (in QF/VAR)
001	TAG	RECORD_ID_FIELD	R (in SF/LR)
001	TAG	RECORD_ID_FIELD	A (in MGF/MR)
001	TAG	RECORD_ID_FIELD	C (in SF/SR)
001	TAG	RECORD_ID_FIELD	C (in SF/STR)
001	TAG	RECORD_ID_FIELD	C (in THF/SUR)
001	TAG	RECORD_ID_FIELD	C (in THF/TDR)
AAD	TAG	ATTRIBUTE_ASSOCIATION_FIELD	V(in VGF/FAA)
AAH	I	Accuracy Absolute Horizontal	C (in QF/AR/QAP)
AAH	I	Absolute Horizontal Accuracy	C (in QF/HAR/ASH)
AAV	I	Absolute Vertical Accuracy	C (in QF/VAR/ASV)
AAV	I	Accuracy Absolute Vertical	C (in QF/AR/QAP)
ACT	I	Number of latitude coefficients	R/A (in SF/MSR/SCC)
ADR	A	Free text,title and address of addressee (/used as a line separator)(null for CD-ROM)	C (in THF/TDR/VDR)
ALB	A (3)	Attribute Label	V (in VGF/FAA/AAD)
ALB	I	Attribute Value	V (in VGF/AAR/VAD)
ALC	I	Area Feature Count	V (in GIF/GIR/GEN)
AOR	R	Angle of orientation from source datum grid to WGS UTM grid	R/A (in SF/MSR/GRC)
APH	I	Relative Horizontal Accuracy	C (in QF/HAR/ASH)
APH	I	Accuracy point to point horizontal	C (in QF/AR/QAP)
APV	I	Accuracy point to point Vertical	C (in QF/AR/QAP)
APV	I	Relative Vertical Accuracy	C (in QF/VAR/ASV)
ARV	I	NUMBER OF PIXELS IN 360 degrees (E-W)	R/A (in GIF/GIR/GEN)
ASH	TAG	HORIZONTAL_ACCURACY_FIELD	C (in QF/HAR)
ASV	TAG	VERTICAL_ACCURACY_FIELD	C (in QF/VAR)
ATC	A	Attribute Label	V (in VGF/ER/ATT)
ATC	A	Attribute Label	V (in VGF/NR/ATT)
ATC	A	Attribute Label	V3 (in VGF/FR/ATT)
ATC	A	Attribute Label	V (in VGF/LFR/ATT)
ATC	A	Attribute-Label	V (in VGF/SPR/ATT)
ATC	A	Attribute Label	V (in VGF/PFR/ATT)

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ATC	A	Attribute Label	V (in VGF/CFR/ATT)
ATC	A	Attribute Label	V (in VGF/AFR/ATT)
ATC	A	Attribute Label	V (in VGF/TPR/ATT)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/ER)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/NR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V3 (in VGF/FR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/LFR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/PFR)
ATT	TAG	EXPLICIT_ATTRIBUTE_LABELS_AND-VALUES_FIELD	V0 (in VGF/SDR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/AFR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/CFR)
ATT	TAG	EXPLICT_ATTRIBUTE_LABELS_AND_VALUES_FIELD	V (in VGF/TPR)
AVD	A	Attribute value definition	V (in VGF/AAR/VAD)
AVF	A	Attribute value format	V (in VGF/AAR/DAV)
AVT	A (2)	Enumerated "EN" or actual value "AV"	V (in VGF/FAA/DAV)
AVU	A	Attribute (default) measurement unit	V (in VGF/AAR/DAV)
AX1	R	Latitude Coefficient 1	R/A (in SF/MSR/SDC)
AX2	R	Latitude Coefficient 2	R/A (in SF/MSR/SDC)
AX3	R	Latitude Coefficient 3	R/A (in SF/MSR/SDC)
AX4	R	Latitude Coefficient 4	R/A (in SF/MSR/SDC)
AX5	R	Latitude Coefficient 5	R/A (in SF/MSR/SDC)
AX6	R	Latitude Coefficient 6	R/A (in SF/MSR/SDC)
AX7	R	Latitude Coefficient 7	R/A (in SF/MSR/SDC)

BAD	A	Layer name (ISO Media file label name)	C (in GIF/GIR/SPR)
BAD	A	Name of derived layer (ISO Media file label name)	C (in SF/SR/SGF)
BAD	A	Layer name (ISO Media file label name)	C (in QF/QR/QCC)
BAD	A	Layer name (ISO Media file label name)	C (in QF/QR/QAA)
BAD	A	Layer name (ISO Media file label name)	C (in QF/AR/QAP)
BAD	A	Layer name (ISO Media file label name)	C (in QF/HAR/ASH)
BAD	A	Layer name (ISO Media file label name)	C (in QF/VAR/ASV)
BAD	A	Layer name (ISO Media file label name)	R (in SF/LR/SPR)
BAD	A	Layer name (ISO Media file label name)	R (in QF/QR/SPR)
BCT	I	Number of longitude coefficients	R/A (in SF/MSR/SCC)
BDF	TAG	BAND_ID_FIELD	R/A (in GIF/GIR)
BID	A	Band Identification (eg., RED)	R/A (in GIF/GIR/BDF)
BRV	I	Number of pixels in 360 degrees (N-S)	R/A (in GIF/GIR/GEN)
BX1	R	Longitude Coefficient 1	R/A (in SF/MSR/SDC)
BX2	R	Longitude Coefficient 2	R/A (in SF/MSR/SDC)
BX3	R	Longitude Coefficient 3	R/A (in SF/MSR/SDC)
BX4	R	Longitude Coefficient 4	R/A (in SF/MSR/SDC)
BX5	R	Longitude Coefficient 5	R/A (in SF/MSR/SDC)
BX6	R	Longitude Coefficient 6	R/A (in SF/MSR/SDC)
BX7	R	Longitude Coefficient 7	R/A (in SF/MSR/SDC)

CAI	I	i index of the coefficient MRE $b_{i,j}$	R/A (in SF/MSR/SLT)
CAJ	I	j index of the coefficient MRE $b_{i,j}$	R/A (in SF/MSR/SLT)
CBD	A	Name and/or Description for first color code (graphic color)	R (in QF/QR/COL)
CBI	I	i index of the coefficient MRE $b_{i,j}$	R/A (in SF/MSR/SLG)
CBJ	I	j index of the coefficient MRE $b_{i,j}$	R/A (in SF/MSR/SLG)
CCD	I (3)	0-255 Color Code assigned in the dataset	R (in QF/QR/COL)
CCR	A	Collection criteria (name of collection specification)	V (in QF/QR/QAA)
CDP	I	Type of magnetic date rate	R (in SF/SR/MAG)
CDT	I	Type of significant date	C (in SF/SR/SOR)

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CDV	A (8)	Significant date value	C (in SF/SR/SOR)
CDV	A (8)	Significant date	C (in SF/SR/SOR)
CDV	A (8)	Date of information (magnetic)	R (in SF/SR/MAG)
CDV07	A (8)	Date of creation of dataset	C (in QF/QR/QUV)
CDV07	A (8)	Publication date for this transmittal, YYYYMMDD.	C (in THF/TDR/VDR)
CDV10	A (8)	Date of downgrading (If QOD is Y or QSS is U then these characters are ASCII SPACE)	C (in QF/QR/QSR)
CDV10	A (8)	Date of downgrading (If QOD is Y or QSS is U then these characters are ASCII SPACE)	C (in SF/SR/QSR)
CDV10	A (8)	Date of downgrading (If QOD is Y or QSS is U, then these characters are ASCII SPACE)	C (in THF/SUR/QSR)
CDV12	A (8)	Publication Date of the DIGEST	C (in THF/SUR/QUV)
CDV20	A (8)	Date of earliest Source	C (in QF/QR/QUV)
CDV21	A (8)	Date of latest source	C (in QF/QR/QUV)
CDV22	A (8)	Date of specification	C (in QF/QR/QUV)
CDV22	A (8)	Date of specification	C (in TDR/SUR/QUV)
CDV24	A (8)	Date of revision or update	C (in QF/QR/QUV)
CDV27	A (8)	code Perishable information date (YYYYMMDD)	C (in SF/SR/SOR)
CNS	TAG	COUNTER_FIELD	V (in VGF/CFR)
CNS	TAG	COUNTER_FIELD	V (in VGF/AFR)
CNS	TAG	COUNTER_FIELD	V (in VGF/LFR)
CNS	TAG	COUNTER_FIELD	V (in VGF/PFR)
CNS	TAG	COUNTER_FIELD	V (in VGF/CFR)
CNT	TAG	COUNTER_FIELD	V (in VGF/ER)
CNT	TAG	COUNTER_FIELD	V3 (in VGF/FR)
CNT	TAG	COUNTER_FIELD	V (in VGF/NR)
CNT	TAG	COUNTER_FIELD	V0 (in VGF/SDR)
CNT	TAG	COUNTER_FIELD	V (in VGF/TPR)
COD	I	Column sequence (0=left to right, 1= right to left)	R/A (in GIF/GIR/SPR)
COD	I	Column direction (left/ right)	R (in SF/LR/SPR)
COD	I	Column direction (left/ right)	R (in QF/QR/SPR)
COL	TAG	COLOR_CODE_ID_FIELD	R (in QF/QR)
COR	TAG	COORDINATE_FIELD	V (in VGF/ER)
COR	TAG	COORDINATE_FIELD	V (in VGF/NR)
COR	TAG	COORDINATE_FIELD	V0 (in VGF/SDR)
COR	TAG	COORDINATE_FIELD	V (in VGF/TPR)
COU	A	Country Code(s)	C (in SF/SR/SOR)
COV	I	Data cover MBR in percent	V/A (in GIF/GIR/GEN)
CPI	TAG	COLOR_PATCH_ID_FIELD	R (in QF/QR)
CPT	TAG	COLOR_PATCH_TYPE_FIELD	R (in QF/QR)
CPY	TAG	COPYRIGHT_FIELD	C (in SF/SR)
CPZ	L	Copyright statement	C (in SF/SR/CPY)
CR1	I	CIE x	R (in QF/QR/COL)
CR2	I	CIE y	R (in QF/QR/COL)
CR3	I	CIE Reflectivity (Y)	R (in QF/QR/COL)
CSF	I	Coordinates scale factor	I (in GIF/GIF/GEN)
CX1	R	Northing Coefficient 1	R/A (in SF/MSR/MPC)
CX2	R	Northing Coefficient 2	R/A (in SF/MSR/MPC)
CX3	R	Northing Coefficient 3	R/A (in SF/MSR/MPC)
CX4	R	Northing Coefficient 4	R/A (in SF/MSR/MPC)
CX5	R	Northing Coefficient 5	R/A (in SF/MSR/MPC)
CX6	R	Northing Coefficient 6	R/A (in SF/MSR/MPC)
CX7	R	Northing Coefficient 7	R/A (in SF/MSR/MPC)
CX8	R	Northing Coefficient 8	R/A (in SF/MSR/MPC)
CX9	R	Northing Coefficient 9	R/A (in SF/MSR/MPC)

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CXA	R	Northing Coefficient 10	R/A (in SF/MSR/MPC)
DAA	TAG	FEATURE/ATTRIBUTE_ASSOCIATION_FIELD	V (in VGF/FAA)
DAG	A	Datum Geodetic Name	V (in GRF/GRR/GEP)
DAG	A	Geodetic Datum Name	C (in SF/SR/SOR)
DAV	TAG	ATTRIBUTE_FORMAT_DESCRIPTION_FIELD	V (in GDF/AAR)
DCC	TAG	DATUM_CHANGE_CONSTANTS_FIELD	R/A (in SF/MSR)
DCD	A	Datum Geodetic Code (see 9)	V (in GRF/GRR/GEP)
DCD	A	Geodetic Datum Code	C (in SF/SR/SOR)
DEF	L	Attribute or Feature Definition (description)	V (in VGF/FER/DFA)
DES	A	Description of Originator and/or source of the Feature or attribute	V (in VGF/FER/DFA)
DFA	TAG	FEATURE/ATTRIBUTE_ENTRY_FIELD	V (in VGF/FER)
DIX	R	X table coordinates of digitized control points (X (Pixel), Y (Line))	C (in GRF/GRR/RPR)
DIX	R	X table coordinates of digitized Diagnostic points (X(Pixel), Y (Line))	C (in GRF/GRR/DPR)
DIY	R	Y table coordinates of digitized control points (X(Pixel),Y(Line))	C (in GRF/GRR/RPR)
DIY	R	Y table coordinates of digitized Diagnostic points (X(Pixel), Y (Line))	C (in GRF/GRR/DPR)
DIZ	R	Z table coordinates of digitized points	C (in GFR/GRR/DPR)
DIZ	R	Z table coordinates of digitized control points	C (in GRF/GRR/RPR)
DPD	A	Diagnostic point ID	C (in GRF/GRR/DPR)
DPR	TAG	DIAGNOSTIC_POINT_FIELD	C (in GRF/GRR)
DRF	TAG	DATASET_DESCRIPTION_FIELD	C (in GIF/GIR)
DSI	TAG	DATA_SET_ID_FIELD	C (in GIF/GIR)
DVR	A	Name of Datum of Vertical Reference	C (in SF/SR/SOR)
DVR	A	Datum Vertical Reference name	V (in GRF/GRR/GEP)
DX1	R	Easting Coefficient 1	R/A (in SF/MSR/MPC)
DX2	R	Easting Coefficient 2	R/A (in SF/MSR/MPC)
DX3	R	Easting Coefficient 3	R/A (in SF/MSR/MPC)
DX4	R	Easting Coefficient 4	R/A (in SF/MSR/MPC)
DX5	R	Easting Coefficient 5	R/A (in SF/MSR/MPC)
DX6	R	Easting Coefficient 6	R/A (in SF/MSR/MPC)
DX7	R	Easting Coefficient 7	R/A (in SF/MSR/MPC)
DX8	R	Easting Coefficient 8	R/A (in SF/MSR/MPC)
DX9	R	Easting Coefficient 9	R/A (in SF/MSR/MPC)
DXA	R	Easting Coefficient 10	R/A (in SF/MSR/MPC)
EAS	R	Easting/Longitude	V (in VGF/ER/IAT)
EAS	R	Easting/Longitude	V3 (in VGF/FR/IAT)
EAS	R	Easting/Longitude	V0 (in VGF/SDR/IAT)
EDN	A	Source Edition Number	C (in SF/SR/SOR)
EDN	I	Edition number of dataset	C (in QF/QR/QUV)
EDN	I	Transmittal Edition Number	C (in THF/TDR/VDR)
ELC	A	Ellipsoid Code	C (in SF/SR/SOR)
ELC	A	Ellipsoid Code (see 8)	C (in GRF/GRR/GEP)
ELE	R	Elevation	V (in VGF/ER/COR)
ELE	R	Elevation (no repetition)	V (in VGF/NR/COR)
ELE	R	Elevation	V (in VGF/ER/IAT)
ELE	R	Elevation	V3 (in VGF/FR/IAT)
ELE	R	Elevation	V0 (in VGF/jSDR/IAT
ELE	E	Elevation	V (in VGF/SDR/COR))
ELL	A	Ellipsoid Name (as appropriate add details regarding ellipsoid parameters)	C (in GRF/GRR/GEP)

Withdrawn/Retired

ELL	A	Ellipsoid Name	C (in SF/SR/SOR)
ELV	R	Eastern limit of validity to use multiple regression equations	R/A (in SF/MSR/DCC)
ERT	A	Relation Type	V (in VGF/LFR/R1L)
ERT	A	Relation Type	V (in VGF/PFR/R1L)
ERT	A	Relation Type	V (in VGF/AFR/R1L)
ERT	A	Relation Type	V (in VGF/CFR/R1L)
ESF	R	Easting scale factor	R (in SF/MSR/NCD)
ETT	R	Easting translation term	R/A (in SF/MSR/NCD)
EXC	I	Number of Coordinate Sets	R/A (in VGF/ER/CNT)
EXC	I	Null for use in the face record	V3 (in VGF/FR/CNT)
EXC	I	Number of Coordinate Sets	V3 (in VGF/NR/CNT)
EXC	I	Number of Coordinate Sets {EXC = 1 for IRS/RTY=CFP}	V0 (in VGF/SDR/CNT)
EXC	I	Number of Coordinate Sets	V (in VGF/TPR/CNT)
EXE	I	Number of Faces ("Composed of")	V (in VGF/AFR/CNS)
EXE	I	Number of Edges ("Composed of")	V (in VGF/LFR/CNS)
EXE	I	Number of Nodes ("Composed of")	V (in VGF/PFR/CNS)
EXE	I	Number of Components ("Composed of")	V (in VGF/CFR/CNS)
EXR	I	Number of Explicit Relations	V (in VGF/AFR/CNS)
EXR	I	Number of Explicit Relations	V (in VGF/CFR/CNS)
EXR	I	Number of Explicit Relations	V (in VGF/LFR/CNS)
EXR	I	Number of Explicit Relations	V (in VGF/PFR/CNS)
EXT	I	Number of Explicit Attributes	V (in VGF/AFR/CNS)
EXT	I	Number of Explicit Attributes	V (in VGF/CFR/CNS)
EXT	I	Number of Explicit Attributes	V (in VGF/ER/CNT)
EXT	I	Number of Explicit Attributes	V3 (in VGF/FR/CNT)
EXT	I	Number of Explicit Attributes	V (in VGF/LFR/CNS)
EXT	I	Number of Explicit Attributes	V (in VGF/NR/CNT)
EXT	I	Number of Explicit Attributes	V (in VGF/PFR/CNS)
EXT	I	Number of Explicit Attributes	V0 (in VGF/SDR/CNT)
EXT	I	Number of Explicit Attributes	V (in VGF/TPR/CNT)

FAC	A (5)	FACC code identifier for feature	V (in VGF/AFR/IAS)
FAC	A (5)	FACC code identifier for feature	V (in VGF/CFR/IAS)
FAC	A (5)	FACC code identifier for feature	V (in VGF/LFR/IAS)
FAC	A (5)	FACC code identifier for feature	V (in VGF/PFR/IAS)
FAL	@	Left Face Pointer	V3 (in VGF/ER/IRE)
FAQ	I	Feature or attribute (1=Feat, 2=Att)	V (in VGF/FER/DFA)
FAR	@	Right Face Pointer	V3 (in VGF/ER/IRE)
FCC	I	Face record count	V (in VGF/GIR/GEN)
FDR	TAG	DATA_SET_DESCRIPTION_FIELD	C (in THF/TDR)
FEC	I	Feature count total in dataset	V (in GIF/GIR/GEN)
FOR	A	Value format	V (in VGF/ER/ATT)
FOR	A	Value format	V (in VGF/NR/ATT)
FOR	A	Value format	V3 (in VGF/FR/ATT)
FOR	A	Value format	V (in VGF/LFR/ATT)
FOR	A	Value format	V (in VGF/PFR/ATT)
FOR	A	Value format	V (in VGF/AFR/ATT)
FOR	A	Value format	V (in VGF/CFR/ATT)
FOR	A	Value format	V0 (in VGF/SDR/ATT)
FOR	A	Value format	V (in VGF/TPR/ATT)
FRM	A	Mathematical relation to other colour codes (free text)	R (in QF/QR/COL)
FTX	L	Text	V (in VGF/TPR/TXT)

GCA	R	Grid Convergence Angle	R (in SF/SR/MAG)
GEN	TAG	GENERAL_INFORMATION_FIELD	C (in GIF/GIR)

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GEP	TAG	GEO_PARAMETERS_FIELD	V (in VGF/GRR/001)
GLA	R	Latitude/Northing of Geographic Reference Point	V (in GVGF/AFR/IAS)
GLA	R	Latitude/Northing of Geographic Reference Point	V (in VGF/CFR/IAS)
GLA	R	Latitude/Northing of Geographic Reference Point	V (in VGF/LFR/IAS)
GLA	R	Latitude/Northing of Geographic Reference Point	V (in VGF/PFR/IAS)
GLO	R	Longitude/Easting of Geographic Reference Point	V (in VGF/AFR/IAS)
GLO	R	Longitude/Easting of Geographic Reference Point	V (in VGF/CFR/IAS)
GLO	R	Longitude/Easting of Geographic Reference Point	V (in VGF/LFR/IAS)
GLO	R	Longitude/Easting of Geographic Reference Point	V (in VGF/PFR/IAS)
GMA	R	Grid north - Magnetic north (G-M) Angle	R (in SF/SR/MAG)
GOF	R	Longitude/Easting normalizing offset	R/A (in SF/MSR/DCC)
GRC	TAG	GRID_ROTATION_COEFFICIENTS_FIELD	R (in SF/MSR)
GRD	A	Cartographic Grid (Implicit sub-divisions (G1, G2,..Gn))	C (in SF/SR/SOR)
GSF	R	Longitude scale factor	R/A (in SF/MSR/NCD)
GTT	R	Longitude translation term	R/A (in SF/MSR/NCD)

HKE	I	Highest Known Elevation (of the source)	R (in SF/SR/SOR)

IAS	TAG	IMPLICIT_ATTRIBUTES_FIELD	V (in VGF/AFR)
IAS	TAG	IMPLICIT_ATTRIBUTES_FIELD	V (in VGF/CFR)
IAS	TAG	IMPLICIT_ATTRIBUTES_FIELD	V (in VGF/LFR)
IAS	TAG	IMPLICIT_ATTRIBUTES_FIELD	V (in VGF/PFR)
IAT	TAG	IMPLICIT_ATTRIBUTES_FIELD	V (in VGF/ER)
IAT	TAG	IMPLICIT_ATTRIBUTES_FIELD	V3 (in VGF/FR)
IAT	TAG	IMPLICIT_ATTRIBUTES_FIELD	V0 (in VGF/SDR)
IMG	TAG	Image-Record	R (in RGF)
IMR	A	Image Rectified during Scanning (Y/N)	R (in GIF/GIR/GEN)
INS	TAG	INSET_FIELD	R (in SF/SR)
INT	A	Unique ID for inset	R (in SF/SR/INS)
IRE	TAG	EDGE_IMPLICIT_RELATION_POINTERS_FIELD	V1-3 (in GDF/ER)
IRN	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/NR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/AFR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/CFR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/LFR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/PFR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V0 (in VGF/SDR)
IRS	TAG	IMPLICIT_RELATION_POINTERS_FIELD	V (in VGF/TPR)

LAB	A (3)	Attribute label	V (in VGF/AAR/DAV)
LAB	A	Feature code/name or Attribute Label	V (in VGF/FER/DFA)
LAB	A (5)	Feature Label	V (in VGF/FAA/DAA)
LAD	R	Data density in N/S direction at nominal scale	R/A (in GIF/GIR/GEN)
LAT	R	Latitude/Northing	V (in VGF/ER/COR)
LAT	R	Latitude/Northing	V(in VGF/NR/COR)
LAT	R	Latitude/Northing	V0 (in VGF/SDR/COR)
LAT	R	Latitude/Northing of a Diagnostic point	C (in VGF/GRR/DPR)
LAT	R	Latitude/Northing of a Registration point	C (in VGF/GRR/RPR)
LAT	R	Latitude/Northing Coordinate	C (in QF/AR/RCI)
LAT	R	Latitude/Northing Coordinate	C (in QF/HAR/RCI)
LAT	R	Latitude/Northing Coordinate	C (in QF/VAR/RCI)
LAT	R	Latitude/Northing Coordinate	C (in SF/SR/RCI)
LAT	R	Latitude/Northing Coordinate	C (in VGF/TPR/COR)
LAT	R	Latitude/Northing of the HKE	R (in SF/SR/SOR)
LAT	R	Latitude/Northing of the G-M angle reference point	R (in SF/SR/MAG)
LGC	R	Coefficient of MRE $b_{i,j}$ ($b_{i,j}$ coefficients are ordered with respect to increasing i, then j)	R/A (in SF/MSR/SLG)

Withdrawn/Retired

LGI	TAG	LEGEND_FIELD	R (in SF/LR)
LIC	I	Linear Feature count	V (in GIF/GIR/GEN)
LLK	I	Left link	V (in VGF/LFR/ATT)
LLK	I	Left link	V (in VGF/PFR/ATT)
LLK	I	Left link	V (in VGF/AFR/ATT)
LLK	I	Left link	V (in VGF/CFR/ATT)
LOD	A	Data density in E/W direction at nominal scale	R/A (in GIF/GIR/GEN)
LON	R	Longitude/Easting of a Diagnostic Point	C (in GRF/GRR/DPR)
LON	R	Longitude/Easting of a Registration point	C (in GRF/GRR/RPR)
LON	R	Longitude/Easting of the HKE	C(in SF/SR/SOR)
LON	R	Longitude/Easting	V(in VGF/ER/COR)
LON	R	Longitude/Easting	V(in VGF/NR/COR)
LON	R	Longitude/Easting	V0 (in VGF/SDR/COR)
LON	R	Longitude/Easting Coordinate	C (in QF/AR/RCI)
LON	R	Longitude/Easting Coordinate	C (in QF/HAR/RCI)
LON	R	Longitude/Easting Coordinate	C (in QF/VAR/RCI)
LON	R	Longitude/Easting Coordinate	C (in SF/SR/RCI)
LON	R	Longitude/Easting coordinate	C (in VGF/TPR/COR)
LON	R	Longitude/Easting of the G-M angle reference point	R (in SF/SR/MAG)
LSO	R	Longitude/Easting of Origin ±SSSSSS.SS	C (in GIF/GIR/GEN)
LTC	R	Coefficient of MRE $b_{i,j}$ ($b_{i,j}$ coefficients are ordered with respect to increasing i, then j)	R/A (in SF/MSR/SLT)
MAE	R	Maximum Easting/Longitude Value	V (in VGF/AFR/IAS)
MAE	R	Maximum Easting/Longitude Value	V (in VGF/LFR/IAS)
MAE	R	Maximum Easting/Longitude Value	V (in VGF/PFR/IAS)
MAG	TAG	MAGNETIC_RATE_FIELD	R (in SF/SR)
MAI	R	Maximum Northing/Latitude Value	V (in VGF/AFR/IAS)
MAI	R	Maximum Northing/Latitude Value	V (in VGF/CFR/IAS)
MAI	R	Maximum Northing/Latitude Value	V (in VGF/LFR/IAS)
MAI	R	Maximum Northing/Latitude Value	V (in VGF/PFR/IAS)
MAX	@	Maximum	V (in VGF/ER/IAT)
MAX	@	Maximum	V3 (in VGF/FR/IAT)
MAX	@	Maximum	V0 (in VGF/SDR/IAT)
MBU	A	MBR and GRP units	V (in GIF/GIR/GEN)
MIE	R	Minimum Easting/Longitude Value	V (in VGF/AFR/IAS)
MIE	R	Minimum Easting/Longitude Value	V (in VGF/CFR/IAS)
MIE	R	Minimum Easting /LongitudeValue	V (in VGF/LFR/IAS)
MIE	R	Minimum Easting/Longitude Value	V (in VGF/PFR/IAS)
MIN	R	Minimum Northing/Latitude Value	V (in VGF/AFR/IAS)
MIN	R	Minimum Northing /LatitudeValue	V (in VGF/CFR/IAS)
MIN	R	Minimum Northing/Latitude Value	V (in VGF/LFR/IAS)
MIN	R	Minimum Northing/Latitude Value	V (in VGF/PFR/IAS)
MIN	@	Minimum	V (in VGF/ER/IAT)
MIN	@	Minimum	V3 (in VGF/FR/IAT)
MIN	@	Minimum	V0 (in VGF/SDR/IAT)
MPC	TAG	MAP_PROJECTION_COEFFICIENTS_DATA_FIELD	R (in SF/MSR)
MSD	A	Media recording standard used for this transmittal (free text,see Part 2 — 14 for applicable media standard)	C (in THF/TDR/VDR)
NAM	A	Dataset name (use appropriate ISO Media File Label namefor the dataset not including the extension (eg., ".IMG"or ".VEC"). See Part 2 — 14.4 for naming conventions)	C (in GIF/GIR/DSI)

Withdrawn/Retired

NAM	A	Legend name (use appropriate ISO Media File label name not including the extension (eg. "LEG").of the legend image file.See Part 2 — 14.4 for naming conventions)	R (in SF/LR/LGI)
NAM	A	Inset Name, free text.	R (in SF/SR/INS)
NAM	A	Full Name of Source Doc, free text.	C (in SF/SR/SOR)
NAM	A	ISO file label name for the associated General_ Information_File (use appropriate ISO Media File Label name not including the extension (eg., ".GEN"). See Part 2 — 14.4 for naming conventions)	C (in THF/TDR/FDR)
NCD	TAG	NORMALIZATION_CONSTANTS_FIELD	R (in SF/MSR)
NCD	I	Nominal code assigned in data set	A (in QF/QR/NOM)
NCI	A	Code Identifier	A (in QF/QR/NOM)
NDB	A	Description/meaning of code	A (in QF/QR/NOM)
NEA	R	Northernmost Latitude/Northing of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in THF/TDR/FDR)
NEA	R	Northernmost Latitude/Northing of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in GIF/GIR/GEN)
NEC	I	Node record count	V (in GIF/GIR/GEN)
NEL	@	Pointer to next left directed edge	V1-3 (in VGF/ER/IRE)
NEO	R	Easternmost Longitude/Easting of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in THF/TDR/FDR)
NEO	R	Easternmost Longitude/Easting of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in GIF/GIR/GEN)
NER	@	Pointer to next right directed edge	V1-3 (in VGF/ER/IRE)
NES	R	Normalized Eastings shift	R/A (in SF/MSR/GRC)
NFC	I	Number of subblocks west/east	R/A (in GIF/GIR/SPR)
NFC	I	# subblocks, left /right	R (in SF/LR/SPR)
NFC	I	# subblocks, left /right	R (in QF/QR/SPR)
NFL	I	Number of subblocks north/south	R/A (in GIF/GIR/SPR)
NFL	I	# subblocks, top/bottom	R (in SF/LR/SPR)
NFL	I	# subblocks, top/bottom	R (in QF/QR/SPR)
NFR	I	Number of sub-blocks, horizontally	R (in QF/QR/SPR)
NIN	I	Number of Insets	R (in SF/SR/SGF)
NLF	I	Number of feature "composed of" this edge	V (in VGF/ER/CNT)
NLF	I	Number of feature "composed of" this edge	V (in VGF/NR/CNT)
NLF	I	Number of feature "composed of" this edge	V3 (in VGF/FR/CNT)
NLF	I	Number of feature "composed of" this edge	V (in VGF/TPR/CNT)
NLF	I	Number of feature "composed of" this spatial data	V0 (in VGF/SDR/CNT)
NLI	I	Number of Legend Images	R (in SF/SR/SGF)
NLL	I	Row #, lower left Corner of the MBR, in pixels	R/A (in GIF/GIR/SPR)
NLL	I	Row #, lower left Corner of the MBR, in pixels	R (in SF/LR/SPR)
NLL	I	Row #, lower left Corner of the MBR, in pixels	R (in QF/QR/SPR)
NLS	I	Col. #, lower left Corner of the MBR, in pixels	R/A (in GIF/GIR/SPR)
NLS	I	Col. #, lower left Corner of the MBR, in pixels	R (in QF/QR/SPR)
NLS	I	Col. #, lower left Corner of the MBR, in pixels	R (in SF/LR/SPR)
NLV	R	Northern limit of validity to use multiple regression equations	R/A (in SF/MSR/DCC)
NNS	R	Normalized northings shift	R/A (in SF/MSR/GRC)

Without SR/Retire

NOE	@	End Node Pointer	V1-3 (in VGF/ER/IRE)
NOF	I	Number of datasets in this transmittal	C (in THF/TDR/VDR)
NOM	TAG	NOMINAL_CODE_ID_FIELD	A (in QF/QR)
NOR	A	Northing/Latitude	V3 (in VGF/ER/IAT)
NOR	A	Northing/Latitude	V3 (in VGF/FR/IAT)
NOR	R	Northing/Latitude	V0 (in VGF/SDR/IAT)
NOS	@	Starting Node Pointer	V1-3 (in VGF/ER/IRE)
NOV	I	Number of Media volume in this transmittal (can be space or null for magnetic tape)	C (in THF/TDR/VDR)
NOS	I (2)	Number of source graphics	C (in GIF/DDR/DRF)
NOZ	I (2)	Number of zone image files	C (in GIF/DDR/DRF)
NRL	R	Relative Long./Easting of Lower Left Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
NRR	R	Relative Long./Easting of Upper Right Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
NSB	I (3)	0-255 Color Intensities (BLUE actual)	R (in QF/QR/COL)
NSF	R	Northing Scale Factor	R/A (in SF/MSR/NCD)
NSG	I (3)	0-255 Color Intensities (GREEN actual)	R (in QF/QR/COL)
NSH	I (2)	Number of horizontal accuracy subregions	C (in GIF/DDR/DRF)
NSL	R	Relative Long./Easting of Upper Left Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear of the host graphic)	R (in SF/SR/INS)
NSP	I (2)	Total number of position accuracy sub-regions	C (in GIF/DDR/DRF)
NSR	I (3)	0-255 Color Intensities (RED actual)	R (in QF/QR/COL)
NSR	R	Relative Long./Easting of Lower Right Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
NST	I	Navigational System Type	C (in SF/SR/SOR)
NST	I (4)	Number of supplementary text records	C (in SF/SR/SGF)
NSV	I (2)	Number of vertical accuracy subregions	C (in GIF/DDR/DRF)
NTL	R	Absolute Long./Easting of Lower Left Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
NTT	R	Northing/Latitude translation term	R/A (in SF/MSR/NCD)
NTR	R	Absolute Long./Easting of Upper Right Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
NUL	I	Row #, Upper right Corner of the MBR in pixels	R/A (in GIF/GIR/SPR)
NUL	I	Row #, Upper right Corner of the MBR in pixels	R (in QF/QR/SPR)
NUL	I	Row #, Upper right Corner of the MBR in pixels	R (in SF/LR/SPR)
NUS	I	Col. #, Upper right Corner of the MBR in pixels	R (in SF/LR/SPR)
NUS	I	Col. #, Upper right Corner of the MBR in pixels	R (in QF/QR/SPR)
NUS	I	Col. #, Upper right Corner of the MBR in pixels	R/A (in GIF/GIR/SPR)
NVL	R	Absolute Long./Easting of Upper Left Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
NVR	R	Absolute Long./Easting of Lower Right Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
NZT	R	Normalizing factor	R/A (in SF/MSR/DCC)

OQI	L	Free text	C (in QF/QR/QOI)

PAA	R	Projection Parameter 1	C (in SF/SR/PRR)
PAA	R	Projection Parameter 1	C (in GRF/GRR/PRR)

Withdrawn Retired

PAB	R	Projection Parameter 2	C (in SF/SR/PRR)
PAB	R	Projection Parameter 2	C (in GRF/GRR/PRR)
PAC	R	Projection Parameter 3	C (in SF/SR/PRR)
PAC	A	Projection Parameter 3	C (in GRF/GRR/PRR)
PAD	TAG	PADDING_FIELD	R (in RGF/IR)
PAD	A	Padding characters added to pad the file so that the image pixels start at the beginning of a logical sector on the media	R (in RGF/IR/PAD)
PAE	R	Projection Parameter 4	C (in VGF/GRR/PRR)
PAE	R	Projection Parameter 4	C (in SF/SR/PRR)
PCB	I	Size of pixel count in bits (for run length encoding)	R/A (in GIF/GIR/SPR)
PCB	I	Size of pixel count subfield in bits (for run length encoding)	R (in SF/LR/SPR)
PCB	I	Size of pixel count subfield in bits (for run length encoding)	R (in QF/QR/SPR)
PCI	I	Prominent Contour Interval	C (in SF/SR/SOR)
PCO	A	Projection Code (see 6), null if Geo coordinates	C (in GRF/GRR/PRR)
PCO	A	Projection code	C (in SF/SR/PRR)
PIB	I	Patch Intensity Values, actual (BLUE)	R (in QF/QR/CPI)
PID	A	Registration point ID	C (in GRF/GRR/RPR)
PIG	I	Patch in tensity Values, actual (GREEN)	R (in QF/QR/CPI)
PIR	I	Patch Intensity Values,actual (RED)	R (in QF/QR/CPI)
PIX	B (8)	Pixels	R (in RGF/IR/SCN)
PIX	B (8)	Pixels	A (in MGF/MR/SCN)
PNC	I	Number of pixels / subblock line (Q)	R/A (in GIF/GIR/SPR)
PNC	I	Pixels/sub-block	R (in SF/LR/SPR)
PNC	I	Pixels/sub-block	R (in QF/QR/SPR)
PNL	I	Lines/sub-block	R (in SF/LR/SPR)
PNL	I	Lines/sub-block	R (in QF/QR/SPR)
PNL	I	Number of lines / subblock	R/A (in GIF/GIR/SPR)
PNL	I	Number of scan lines/sub-block	R (in QF/QR/SPR)
PNM	A	Color Patch Name (e.g. Red)	R (in QF/QR/CPI)
PNR	I	Number of pixels/sub-block line	R (in QF/QR/SPR)
POC	I	Point feature count	V (in GIF/GIR/GEN)
POR	I	Pixel order (see Part 2 — 11.3.3)	R (in GIF/GIR/SPR)
POR	I	Pixel order	R (in SF/LR/SPR)
POR	I	Pixel order	R (in QF/QR/SPR)
PRB	I	Size of pixel/element count in bits	R (in QF/QR/SPR)
PRN	A	Projection Name	C (in SF/SR/PRR)
PRN	A	Projection Name	C (in GRF/GRR/PRR)
PRR	TAG	PROJECTION_FIELD	C (in GRF/GRR)
PRR	TAG	PROJECTION_FIELD	C (in SF/SR)
PRT	A	Series Designator for Series	C (in SF/SR/SOR)
PRT	A	Product type and level (e.g.ASRG)	C (in THF/TDR/FDR)
PRT	A	Series designator of product type and level	C (in GIF/GIR/DSI)
PSO	R	Latitude/Northing of Origin values ±SSSSSS.SS	C (in GIF/GIR/GEN)
PSP	R	Sample Pixel Spacing in microns	R (in GIF/GIR/GEN)
PVB	I	Size of pixel value in bits (for run length encoding)	R/A (in GIF/GIR/SPR)
PVB	I	Size of pixel value subfield in bits (for run length encoding)	R (in SF/LR/SPR)
PVB	I	Size of pixel value subfield in bits (for run length encoding)	R (in QF/QR/SPR)

QAA	TAG	ATTRIBUTE_ACCURACY_FIELD	V (in QF/QR)
QAC	I	Attribute completeness percent	V (in QF/QR/QCC)

Withdrawn/Retired

QAP	TAG	POSITIONAL_ACCURACY_FIELD	C (in QF/AR)
QCC	TAG	COMPLETENESS_AND_CONSISTENCY_FIELD	V (in QF/QR)
QFC	I	Feature completeness percent	V (in QF/QR/QCC)
QLC	A	Logical Consistency (text)	V (in QF/QR/QCC)
QLE	A	Releasability statement (Free text)	C (in THF/SUR/QSR)
QLE	A	Releasability statement (Free text)	C (in SF/SR/QSR)
QLE	A	Releasability statement (Free text)	C (in QF/QR/QSR)
QOD	A	Originating agency's determination is required for downgrading (Y or N)	C (in QF/QR/QSR)
QOD	A	Originating agency's determination is required for downgrading (Y or N)	C (in SF/SR/QSR)
QOD	A	Originating agency's determination is required for downgrading (Y or N)	C (in THF/SUR/QSR)
QOI	TAG	OTHER_QUALITY_INFORMATION_FIELD (free text)	R (in QF/QR)
QSR	TAG	SECURITY_AND_RELEASE_FIELD	C (in QF/QR)
QSR	TAG	SECURITY_AND_RELEASE_FIELD	C (in SF/SR)
QSR	TAG	SECURITY_AND_RELEASE_FIELD	C (in THF/SUR)
QSS	A	Highest security classification of the referenced object (T=Top Secret, S=Secret, C=Confidential, R=Restricted, U=Unclass)	C (in QF/QR/QSR)
QSS	A	Security classification of the source (T=Top Secret, S=Secret C=Confidential, R=Restricted, U=Unclass)	(in SF/SR/QSR)
QSS	A	Highest Security classification of the transmittal (T=Top Secret, S=Secret, C=Confidential, R=Restricted, U=Unclass)	(in THF/SUR/QSR)
QUL	I	Percent reliability of qualitative attributes	V (in QF/QR/QAA)
QUT	I	Standard deviation of quantitative attributes	V (in QF/QR/QAA)
QUV	TAG	UP_TO_DATENESS_FIELD	C (in QF/QR)
QUV	TAG	UP_TO_DATENESS_FIELD	C (in THF/SUR)

R1L	TAG	EXPLICIT_RELATION_POINTER_FIELD	V (in VGF/AFR)
R1L	TAG	EXPLICIT_RELATION_POINTER_FIELD	V (in VGF/CFR)
R1L	TAG	EXPLICIT_RELATION_POINTER_FIELD	V (in VGF/LFR)
R1L	TAG	EXPLICIT_RELATION_POINTER_FIELD	V (in VGF/PFR)
R1V	TAG	EXPLICIT_RELATION_VALUE_FIELD	V (in VGF/AFR)
R1V	TAG	EXPLICIT_RELATION_VALUE_FIELD	V (in VGF/CFR)
R1V	TAG	EXPLICIT_RELATION_VALUE_FIELD	V (in VGF/LFR)
R1V	TAG	EXPLICIT_RELATION_VALUE_FIELD	V (in VGF/PFR)
RAT	R	Magnetic rate of change	R (in SF/SR/MAG)
RCI	TAG	BOUNDING_POLYGON_COORDINATES_FIELD	C (in QF/AR)
RCI	TAG	BOUNDING_POLYGON_COORDINATES_FIELD	C (in QF/HAR)
RCI	TAG	BOUNDING_POLYGON_COORDINATES_FIELD	C (in QF/VAR)
RCI	TAG	BOUNDING_POLYGON_COORDINATES_FIELD	C (in SF/SR)
REC	I	Recompilation count	C (in QF/QR/QUV)
REV	I	Revision count	C (in QF/QR/QUV)
RID	I	Record ID number	V (in VGF/AAR/001)
RID	I	Record ID number	V (in VGF/AFR/001)
RID	I	Record ID number	V (in VGF/CFR/001)
RID	I	Record ID number	V (in VGF/FER/001)
RID	I	Record ID number	V (in VGF/FAA/001)
RID	I	Record ID number	V (in VGF/ER/001)
RID	I	Record ID number	V3 (in VGF/FR/001)
RID	I	Record ID number	R (in VGF/IR/001)
RID	I	Record ID number	V (in VGF/LFR/001)
RID	I	Record ID number	V (in VGF/NR/001)

Withdrawn/Retired

RID	I		Record ID number	V (in VGF/PFR/001)
RID	I		Record-ID-number	V0 (in VGF/SDR/001)
RID	I		Record ID number	C (in GIF/GIR/001)
RID	I		Record ID number	C (in GRF/GRR/001)
RID	I		Record ID number	C (in QF/AR/001)
RID	I		Record ID number	C (in QF/HAR/001)
RID	I		Record ID number	C (in QF/QR/001)
RID	I		Record ID number	C (in QF/VAR/001)
RID	I		Record ID number	R (in SF/LR/001)
RID	I		Record ID number	C (in SF/SR/001)
RID	I		Record ID number	C (in THF/SUR/001)
RID	I		Record ID number	C (in THF/TDR/001)
RID	I		Record ID number	R (in SF/MSR/001)
RID	I		Record ID number	C (in GIF/DDR/001)
RID	I		Record ID number	C (in SFF/STR/001)
RID	I		Record ID number	C (in VGF/TPR/001)
RID	I		Record ID number	V1-3 (in VGF/ER/IRE)
RID	I		Record ID number	C (in VGF/LFR/R1V)
RID	I		Record ID number	C (in VGF/AFR/R1V)
RID	I		Record ID number	C (in VGF/PFR/R1V)
RID	I		Record ID number	C (in VGF/CFR/R1V)
RID	I		Record ID number	V (in VGF/NR/IRN)
RID	I		Record ID number	V (in VGF/LFR/IRS)
RID	I		Record ID number	V (in VGF/PFR/IRS)
RID	I		Record ID number	V (in VGF/CFR/IRS)
RID	I		Record ID number	A (in MGF/MR/001)
RID	I		Record ID number	V (in VGF/AFR/IRS)
RID	I		Record ID number	V (in VGF/TPR/IRS)
RID	I		Record ID number	V0 (in VGF/SDR/IRS)
RLK	I	Right link		V (in VGF/LFR/ATT)
RLK	I	Right link		V (in VGF/PFR/ATT)
RLK	I	Right link		V (in VGF/AFR/ATT)
RLK	I	Right link		V (in VGF/CFR/ATT)
ROD	I	Row sequence (0=bottom to top, 1=top to bottom)		R (in GIF/GIR/SPR)
ROD	I	Row direction (top /bottom)		R (in SF/LR/SPR)
ROD	I	Row direction (top /bottom)		R (in QF/QR/SPR)
RPR	TAG	REGISTRATION_POINT_FIELD		C (in GRF/GRR)
RTY	A (3)	DA	Record Type	C (in VGF/AAR/001)
RTY	A (3)	DD	Record Type	C (in VGF/FER/001)
RTY	A (3)	DF	Record Type	C (in VGF/FAA/001)
RTY	A (3)	DSS	Record Type	C (in GIF/DDR/001)
RTY	A (3)	ED	Record Type	V (in VGF/ER/001)
RTY	A (3)	FA	Record Type	V (in VGF/AFR/001)
RTY	A (3)	FC	Record Type	V (in VGF/CFR/001)
RTY	A (3)	FE	Record Type	V3 (in VGF/FR/001)
RTY	A (3)	FL	Record Type	V (in VGF/LFR/001)
RTY	A (3)	FP	Record Type	V (in VGF/PFR/001)
RTY	A (3)	SP	Record-Type	V0 (in VGF/SDR/001)
RTY	A (3)	CFL	Record-Type	V0 (in VGF/SDR/IRS)
RTY	A (3)	CFP	Record-Type	V0 (in VGF/SDR/IRS)
RTY	A (3)	CFA	Record-Type	V0 (in VGF/SDR/IRS)
RTY	A (3)	GEO	Record Type	C (in VGF/GRR/001)
RTY	A (3)	GIN	Record Type	C (in GIF/GIR/001)
RTY	A (3)	HOR	Record Type	C (in QF/HAR/001)
RTY	A (3)	IMG	Record Type	R (in RGF/IR/001)

Withdrawn/Retired

RTY	A (3)	LCF	Record Type	C (in THF/SUR/001)
RTY	A (3)	LEG	Record Type	R (in SF/LR/001)
RTY	A (3)	MSD	Record Type	C (in SF/MSR/001)
RTY	A (3)	NO	Record Type	V (in VGF/NR/001)
RTY	A (3)	QAI	Record Type	C (in QF/AR/001)
RTY	A (3)	QAL	Record Type	C (in QF/QR/001)
RTY	A (3)	SOU	Record Type	C (in SF/SR/001)
RTY	A (3)	STR	Record-Type	C (in SF/STR/001)
RTY	A (3)	THF	Record Type	C (in THF/TDR/001)
RTY	A (3)	TP	Record Type	C (in VGF/TPR/001)
RTY	A (3)	VER	Record Type	C (in QF/VAR/001)
RTY	A (3)		Record Type	V1-3 (in VGF/ER/IRE)
RTY	A (3)		Record Type	V (in VGF/NR/IRN)
RTY	A (3)		Record Type	V (in VGF/LFR/IRS)
RTY	A (3)		Record Type	V (in VGF/PFR/IRS)
RTY	A (3)		Record Type	V (in VGF/CFR/IRS)
RTY	A (3)		Record Type	V (in VGF/AFR/IRS)
RTY	A (3)		Record Type	V (in VGF/TPR/IRS)
RTY	A (3)		Record Type	C (in VGF/LFR/R1V)
RTY	A (3)		Record Type	C (in VGF/PFR/R1V)
RTY	A (3)		Record Type	C (in VGF/AFR/R1V)
RTY	A (3)		Record Type	A (in MGR/MR/001)
RTY	A (3)		Record Type	C (in VGF/CFR/R1V)

SCA	I	Reciprocal cartographic scale of inset	R (in SF/SR/INS)
SCA	I	Cartographic Scale (e.g 50,000)	C (in SF/SR/SOR)
SCA	I	Source graphic scale reciprocal	C (in GIF/GIR/GEN)
SCC	TAG	SOURCE_DATUM_COEFFICIENTS_COUNTER_FIELD	R (in SF/MSR)
SCN	TAG	PIXEL_FIELD	R (in RGF/IR)
SCN	TAG	PIXEL_FIELD	A (in MGF/MR)
SCR	A	Standard Color Patch Ref.	R (in QF/QR/CPT)
SDA	A	Name of Sounding Datum	C (in SF/SR/SOR)
SDA	A	Sounding Datum Name	C (in GRF/GRR/GEP)
SDC	TAG	SOURCE_DATUM_COEFFICIENTS_DATA_FIELD	R (in SF/MSR)
SEC	A	Security	V (in VGF/ER/IRE)
SEC	A	Security	V (in VGF/NR/IRN)
SEC	A	Security	V (in VGF/LFR/IRS)
SEC	A	Security	V (in VGF/PFR/IRS)
SEC	A	Security	V (in VGF/CFR/IRS)
SEC	A	Security	V (in VGF/AFR/IRS)
SEC	A	Security	V (in VGF/TPR/IRS)
SEC	A	Security	V (in VGF/LFR/R1V)
SEC	A	Security	V (in VGF/PFR/R1V)
SEC	A	Security	V (in VGF/CFR/R1V)
SEC	A	Security	V (in VGF/AFR/R1V)
SEC	A	Security	V0 (in VGF/SDR/IRS)
SFT	I	Simple feature count	V (in VGF/GIR/GEN)
SGC	I	Segment count	V (in GIF/TPR/R1V)
SGC	I	Segment/Edge Record count	V (in GIF/GIR/GEN)
SGF	TAG	SOURCE_SUMMARY_FIELD	V (in SF/SR)
SLG	TAG	SOURCE_DATUM_LONGITUDE_COEFFICIENTS_FIELD	R (in SF/MSR)
SLT	TAG	SOURCE_DATUM_LATITUDE_COEFFICIENTS_FIELD	R (in SF/MSR)
SLV	R	Southern limit of validity to use multiple regression equations	R/A (in SF/MSR/DCC)
SOG	A	Source for the feature or attribute description	V (in VGF/FER/DFA)
SOR	TAG	SOURCE_FIELD	C (in SF/SR)

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SPA1	A	DIGEST amendment number	C (in THF/SUR/QUV)
SPA2	A	Specification amendment	C (in QF/QR/QUV)
SPR	TAG	DATA_SET_PARAMETERS_FIELD	R (in GIF/GIR)
SPR	TAG	QUALITY_PARAMETERS_FIELD	R (in QF/QR)
SPR	TAG	LEGEND_PARAMETERS_FIELD	R (in SF/LR)
SQU	I	Area Coverage	C (in SF/SR/SOR)
SRC1	A	Free text, identifier of the DIGEST used for all datasets on the transmittal	C (in THF/SUR/QUV)
SRC2	A	Specification ID	C (in QF/QR/QUV)
SRN	A	Library/Sounding Reference Number (to be used as each nation requires) stated in the host graphics coordinates	C (in SF/SR/SOR)
STR	I (1)	Structure of the data 1=Matrix (values), 2=Matrix (coded), 3 = Raster (RGB), 4 = Raster (Colour coded) 5 = Vector (Type 0 Topology -Cartographic Spaghetti) 6 = Vector (Type 1 Topology -Chain-Node) 7 = Vector (Type 2 Topology -Planar Graph) 8 = Vector (Type 3 Topology -Full Topology)	C (in GIF/GIR/GEN)
STR	I	Data Structure Code 3 = Raster (RGB), 4 = Raster (Colour coded)	R (in SF/LR/LGI)
STR	I	Data structure code 1=Matrix (values), 2=Matrix (coded), 3 = Raster (RGB), 4 = Raster (Colour coded) 5 = Vector (Type 0 Topology -Cartographic Spaghetti) 6 = Vector (Type 1 Topology -Chain-Node) 7 = Vector (Type 2 Topology -Planar Graph) 8 = Vector (Type 3 Topology -Full Topology)	C (in THF/TDR/FDR)
SUP	TAG	SUPPLEMENTARY_TEXT_RECORD_FIELD	C (in SF/STR)
SWA	R	Southernmost Latitude/Northing of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in THF/TDR/FDR)
SWA	R	Southernmost Latitude/Northing of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in GIF/GIR/GEN)
SWO	R	Westernmost Longitude/Easting of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in THF/TDR/FDR)
SWO	R	Westernmost Longitude/Easting of the extent of the cartographic image (i.e. NOT including margin and legend information and bleeding edges). Value: ±SSSSSS.SS	C (in GIF/GIR/GEN)

TIF	A (1)	A / N Tile index Map Flag.	R (in GIF/GIR/SPR)
TIF	A (1)	Tile Index Map Flag. "Y" indicates there is an index,"N", there is none	R (in SF/LR/SPR)
TIF	A (1)	Tile Index Map Flag. "Y" indicates there is an index,"N", there is none	R (in QF/QR/SPR)
TIM	TAG	TILE_INDEX_MAP_FIELD	R (in GIF/GIR)
TIM	TAG	TILE_INDEX_MAP_FIELD	R (in SF/LR)
TOF	R	Latitude normalizing offset	R/A (in SF/MSR/DCC)
TRI	A	Supplementary text field reference identifier	C (in SF/STR/SUP)

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TRL	R	Relative Lat./Northing of Lower Left Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
TRR	R	Relative Lat./Northing of Upper Right Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
TRY	A	Supplementary Text record type	C (in SF/STR/SUP)
TSF	R	Latitude/Northing scale factor	R (in SF/MSR/NCD)
TSI	I	Tile Index Map value.	R (in SF/LR/TIM)
TSI	I	Tile Index Map value (see Part 2 — x.x).	R/A (in GIF/GIR/TIM)
TSL	R	Relative Lat./Northing of Upper Left Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic)	R (in SF/SR/INS)
TSR	R	Relative Lat./Northing of Lower Right Corner of the inset as stated in the host graphics coordinates (the value of these coordinates are stated in terms of host graphic, as if the inset did not appear on the host graphic)	R (in SF/SR/INS)
TTL	R	Absolute Lat./Northing of Lower Left Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
TTR	R	Absolute Lat./Northing of Upper Right Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
TTT	R	Latitude translation term	R (in SF/MSR/NCD)
TVL	R	Absolute Lat./Northing of Upper Left Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
TVR	R	Absolute Lat./Northing of Lower Right Corner of the inset as stated in the insets coordinates	R (in SF/SR/INS)
TXT	A	Free Text (e.g., Digitizer)	C (in GIF/GIR/GEN)
TXT	L	Supplementary Text	C (in SF/STR/SUP)
TXT	TAG	TEXT_FIELD	V (in GVGF/TPR)
TYP	A	Data type (Geographic (GEO), Table (DIG) or Grid (MAP) Coordinates)	V (in GRF/GRR/GEP)

UNI	A	Unit of measure for coordinates of this dataset (see 10)	C (in GRF/GRR/GEP)
UNIaah	I	Unit of measure for absolute horizontal accuracy	C (in QF/AR/QAP)
UNIaah	I	Unit of measure for absolute horizontal accuracy	C (in QF/HAR/ASH)
UNIaav	I	Unit of measure for absolute vertical accuracy	C (in QF/AR/QAP)
UNIaav	I	Unit of measure for abolute vertivcal accuracy	C (in QF/VAR/ASV)
UNIaph	I	Unit of measure for relative horizontal accuracy	C (in QF/HAR/ASH)
UNIaph	I	Unit of measure for point to point horizontal accuracy	C (in QF/AR/QAP)
UNIapv	I	Unit of measure for point to point vertical accuracy	C (in QF/AR/QAP)
UNIapv	I	Unit of measure for relative vertical accuracy	C (in QF/VAR/ASV)
UNIgca	A	Units of Grid Convergence Angle	R (in SF/SR/MAG)
UNIgma	I	Units of G-M angle	R (in SF/SR/MAG)
UNIhke	A	Units of the elevation value	R (in SF/SR/SOR)
UNIloa	A	Unit of Measure for LOD and LAD (see UNI in 10 for value)	R/A (in GIF/GIR/GEN)
UNImat	A	Unit of Measure for Matrix Data	A (in GIF/GIR/GEN)
UNIpci	A	Unit of Measure for Contour Interval	C (in SF/SR/SOR)
UNIrat	A	Units of Rate of change (See 10)	R (in SF/SR/MAG)
UNIsqu	A	Unit of Measure for Area Coverage	C (in SF/SR/SOR)
URF	A	Unique ID for this transmittal	C (in THF/TDR/VDR)
URF	A	Unique Source ID	C (in SF/SR/SOR)

VAD	TAG	ATTRIBUTE_VALUE_DESCRIPTION_FIELD	V (in VGF/AAR)
VAL	A	Attribute value	V (in VGF/ER/ATT)
VAL	A	Attribute value	V (in VGF/NR/ATT)

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VAL	A/I/R/L	Attribute value	V3 (in VGF/FR/ATT)
VAL	A	Attribute value	V (in VGF/PFR/ATT)
VAL	A	Attribute value	V (in VGF/LFR/ATT)
VAL	A	Attribute value	V (in VGF/AFR/ATT)
VAL	A	Attribute value	V (in VGF/CFR/ATT)
VAL	A/I/I3/R	Attribute value	V (in VGF/TPR/ATT)
VAL	A/I/L/R	Attribute-value	V0 (in VGF/SDR/ATT)
VAR	TAG	Matrix-Record	A (in MGF)
VDCdvr	I	Vertical Datum Code	V (in GRF/GRR/GEP)
VDCdvr	A	Code for Datum of Vertical Reference	C (in SF/SR/SOR)
VDCsda	I	Sounding Datum Category	V (in GRF/GRR/GEP)
VDCsda	A	Code for Sounding Datum	C (in SF/SR/SOR)
VDR	TAG	TRANSMITTAL_HEADER_FIELD	C (in THF/TDR)
VOO	A	Free text,title and address of originator (/ used as line separator)	C (in THF/TDR/VDR)

WLV	R	Western limit of validity to use multiple regression equations	R (in SF/MSR/DCC)
WPC	I	Percentage Covered by water	C (in SF/SR/SOR)
WS1	I	Lower limit wavelength span or "ON" color code (in nanometers)	R (in GIF/GIR/BDF)
WS2	I	Upper limit wavelength span or "OFF" color code (in nanometers)	R (in GIF/GIR/BDF)

XOR	R	Easting false origin	V (in GRF/GRR/PRR)
XOR	R	Easting false origin	V (in SF/SR/PRR)

YOR	R	Northing false origin	V (in GRF/GRR/PRR)
YOR	R	Northing false origin	V (in SF/SR/PRR)

ZNA	I	Zone #	R/A (in GIF/GIR/GEN)
ZOR	R	Elevation false origin for Z values (TBR-US)	C (in GRF/GRR/PRR)
ZOR	R	Z-values	V (in SF/SR/PRR)
ZV1	R	Minimum Elevation Value	V (in VGF/CFR/IAS)
ZV1	R	Minimum Elevation Value	V (in VGF/LFR/IAS)
ZV1	R	Minimum Elevation Value	V (in VGF/PFR/IAS)
ZV1	R	Minimum Elevation Value	V (in VGF/AFR/IAS)
ZV2	R	Maximum Elevation Value	V (in VGF/AFR/IAS)
ZV2	R	Maximum Elevation Value	V (in VGF/CFR/IAS)
ZV2	R	Maximum Elevation Value	V (in VGF/LFR/IAS)
ZV2	R	Maximum Elevation Value	V (in VGF/PFR/IAS)
ZVL	R	Elevation of a Diagnostic point	C (in GRF/GRR/DPR)
ZVL	R	Elevation of a Registration point	C (in GRF/GRR/RPR)

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16 ISO 8824 TAGS

The tags for the ISO 8824 implementation have been separated roughly into three classes: those which are associated with header information in the hierarchy and have a rather lengthy tag (see Table 16-1: Header Tags); those near the elemental level which have a short acronym (see Table 16-2: Elementary Tags); and those which may be used as pointers into particutar files/records of the data set (see Table 16-3: Application Tags). This classification allows the hierarchy to be presented more compactly.

Codes for Data Types

Basic-Text-String	BTS
General-Text-String	GTS
IMPLICIT-INTEGER	II
INTEGER	INT
Date	Date
Fraction-Number	FN
Integer-Number	Int
Dif-Coordinate-String	Dif
Abs-Coordinate-String	Abs
Rel-Coordinate-String	Rel
OCTETSTRING	OS

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Table 16-1 ISO 8824 Header Tags

Tag	Parent
Accuracy-Record	Quality-File
Arc-System-Metric-Support-Record	Metric-Support-Data-Record
Area-Coverage-Subfield	Source-Field
Attribute-Accuracy-Field	Vector-Quality-Section
Attribute-Association-Field	Feature/Attribute-Association-Record
Attribute-Format-Description-Field	Attribute/Value-Association-Record
Attribute-Value-Description-Field	Attribute/Value-Association-Record
Attribute/Value-Association-Record	Vector-Geo-Data-File
Band-ID-Subfield	Raster-General, Matrix-General
Bounding-Polygon-Coordinates-Field	Source-Record, Accuracy-Record, Horizontal-Accuracies-Record, Vertical-Accuracies-Record
CIE-Color-Description-Subfield	Color-Code-ID-Field
Color-Code-ID-Field	Raster-Quality-Section
Color-Patch-Description-Field	Raster-Quality-Section
Color-Patch-ID-Subfield	Color-Patch-Description-Field
Color-Patch-Type-Subfield	Color-Patch-Description-Field
Completeness-and-Consistency-Field	Vector-Quality-Section
Component-Accuracies-Record	Quality-File
Contour-Interval-Subfield	Source-Field
Control-Point-Subfield	Feature-Record

Coordinate-Field	Node-Record, Spatial-Data-Record, Text-Placement-Record
Copyright-Field	Source-Field
Corners-of-MBR-Subfield	Dataset-Parameters-Subfield
Data-Density-Subfield	Raster-General, Matrix-General
Dataset-Description-Field	Dataset-Description-Record
Dataset-Description-Field	Transmittal-Description-Record
Dataset-Description-Record	General-Information-File
Dataset-ID-Field	General-Information-Record
Dataset-Parameters-Subfield	Raster-General, Matrix-General, Legend-Parameters-Field, Color-Patch-Description-Field
Datum-Change-Constants-Field	UTM/UPS-System-Metric-Support-Record
Diagnostic-Points-Field	Geo-Reference-Record
Edge-Coordinates-Field	Edge-Record
Edge-Implicit-Relation-Pointers-Field	Edge-Record
Edge-Node-Topology-Field	Edge-Implicit-Relation-Pointers-Field
Edge-Record	Vector-Geo-Data-File
End-Node-Pointer	Edge-Node-Topology-Field
Explicit-Attribute-Labels-and-Values-Field	Edge-Record, Node-Record, Feature-Record, Text-Placement-Record, Feature-Explicit-Attribute-Labels-and-Values-Field
Explicit-Relation-Pointers-Field	Feature-Record
Explicit-Relation-Value-Field	Explicit-Relation-Pointers-Field
Face-Record	Vector-Geo-Data-File
Face-Topology-Field	Edge-Implicit-Relation-Pointers-Field
Feature-Association-Field	Feature/Attribute-Association-Record
Feature-Explicit-Attributes-Labels-and-Values-Field	Feature-Record
Feature-Implicit-Attributes-Field	Feature-Record
Feature-Record	Vector-Geo-Data-File
Feature/Attribute-Association-Record	Vector-Geo-Data-File
Feature/Attribute-Entry-Field	Feature/Attribute-Entry-Record
Feature/Attribute-Entry-Record	Vector-Geo-Data-File
General-Information-File	Geo-Dataset-File
General-Information-Record	General-Information-File
Geo-Dataset-File	Exchange-Set
Geo-Parameters-Field	Geo-Reference-Record
Geo-Reference-File	Geo-Dataset-File
Geo-Reference-Record	Geo-Reference-File
Geodetic-Datum-Subfield	Geo-Parameters-Field, Source-Field
Geodetic-Ellipsoid-Subfield	Geo-Parameters-Field, Source-Field
Grid-Convergence-Subfield	Magnetic-Rate-Field
Grid-Rotation-Coefficients-Field	UTM/UPS-System-Metric-Support-Record
Highest-Elevation-Subfield	Source-Field
Horizontal-Accuracies-Field	Horizontal-Accuracies-Record
Horizontal-Accuracies-Record	Component-Accuracies-Record
Image-Record	Raster-Geo-Data-File

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Implicit-Attributes-Field	Edge-Record, Face-Record, Spatial-Data-Record
Implicit-Relations-Pointer-Field	Edge-Record, Node-Record, Face-Record, Spatial-Data-Record, Feature-Record, Text-Placement-Record
Inset-Field	Source-Field
Layer-Section	Geo-Dataset-File
Left-Face-Pointer	Face-Topology-Field
Legend-Field	Legend-Record
Legend-Parameters-Field	Legend-Record
Legend-Record	Source-File
Magnetic-Rate-Field	Source-Record
Magnetic-Rate-Reference-Point-Subfield	Magnetic-Rate-Field
Map-Boundary-Coordinates-Subfield	Vector-General, Raster-General, Matrix-General
Map-Projections-Coefficients-Data	Arc-System-Metric-Support-Record
Matrix-General	General-Information-Record
Matrix-Geo-Data-File	Layer-Section
Matrix-Quality-Section	Quality-Record
Matrix-Record	Matrix-Geo-Data-File
Metric-Support-Record	Source-File
Node-Implicit-Relation-Pointer-Field	Node-Record
Node-Record	Vector-Geo-Data-File
Nominal-Code-ID-Field	Matrix-Quality-Section
Normalization-Constants-Field	Arc-System-Metric-Support-Record
Ordered-Rooted-Tree-Links	Feature-Explicit-Labels-and-Values-Field
Other-Quality-Information-Field	Quality-Record
Pixel-Field	Image-Record, Matrix-Record
Pixel-Ground-Spacing-Subfield	Raster-General, Matrix-General
Pointer-to-Next-Left-Directed-Edge	Winged-Edge-Topology-Field
Pointer-to-Next-Right-Directed-Edge	Winged-Edge-Topology-Field
Positional-Accuracy-Field	Accuracy-Record
Projection-False-Origin-Subfield	Projection-Field
Projection-Field	Geo-Reference-Record, Source-Record
Quality-Record	Quality-File
Qualtiy-Up-to-Dateness-Field	Quality-Record
Raster-General	General-Information-Record
Raster-Geo-Data-File	Layer-Section
Raster-Quality-Section	Quality-Record
Record-ID-Number	Edge-Record, Node-Record, Face-Record, Spatial-Data-Record, Feature-Record, Text-Placement-Record, Feature/Attribute-Entry-Record, Feature/Attribute-Association-Record, Attribute/Value-Association-Record, Image-Record, Matrix-Record

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Registration-Points-Field	Geo-Reference-Record
RGB-Color-Description-Subfield	Color-Code-ID-Field
Right-Face-Pointer	Face-Topology-Field
Security-and-Release-Field	Qualtiy-Record
Security-and-Release-Field	Security-and-Update-Record
Security-and-Release-Field	Source-Record
Security-and-Update-Record	Transmittal-Header-File
Security-Level	Security-and-Release-Field
Sounding-Datum-Subfield	Geo-Parameters-Field, Source-Field
Source-Datum-Coefficients-Data-Field	Arc-System-Metric-Support-Record
Source-Datum-Coefficients-Counter-Field	UTM/UPS-System-Metric-Support-Record
Source-Datum-Latitude-Coefficients-Field	UTM/UPS-System-Metric-Support-Record
Source-Datum-Longitude-Coefficients-Field	UTM/UPS-System-Metric-Support-Record
Source-Field	Source-Record
Source-File	Geo-Dataset-File
Source-Record	Source-File
Source-Summary-Field	Source-Record
Spatial-Data-Record	Vector-Geo-Data-File
Start-Node-Pointer	Edge-Node-Topology-Field
Supplementary-Text-Field	Supplementary-Text-Record
Supplementary-Text-Record	Source-File
Text-Field	Text-Placement-Record
Text-Placement-Record	Vector-Geo-Data-File
Tile-Index-Map-Subfield	Raster-General, Matrix-General, Legend-General
Transmittal-Description-Record	Transmittal-Header-File
Transmittal-Header-Field	Transmittal-Description-Record
Transmittal-Header-File	Exchange-Set
Up-to-Dateness-Field	Security-and-Update-Record
UTM/UPS-System-Metric-Support-Record	Metric-Support-Data-Record
Vector-General	General-Information-Record
Vector-Geo-Data-File	Layer-Section
Vector-Quality-Section	Qualtiy-Record
Vertical-Accuracies-Field	Vertical-Accuracies-Record
Vertical-Accuracies-Record	Component-Accuracies-Record
Vertical-Datum-Subfield	Geo-Parameters-Field, Source-Field
Winged-Edge-Topology-Field	Edge-Implicit-Relation-Pointers-Field

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Table 16-2 ISO 8824 Elementary Tags

Tag	Data Type	Description / Parent
aad	tag	Attribute-Association-Field, Feature/Attribute-Association-Record
aah	tag	Horizontal-Accuracies-Field, Horizontal-Accuracies-Record
aah-p	Int	Accuracy Absolute Horizontal, Positional-Accuraacy-Field
aah-h	Int	Absolute Horizontal Accuracy, Horizontal-Accuracies-Field
aav	Int	Accuracy Absolute Vertical, Positional-Accuracy-Field

alb-f	BTS	Attribute label, Attribute-Association-Field
alb-v	Int	Attribute values; enumerated values of Integer only Attribute-Value-Description-Field
alc-v	Int	Areal feature count, Vector-General
aor	RN	Angle of orientation from source datum grid to WGS UTM grid Grid-Rotation-Coefficients-Field
aph	Int	Accuracy point to point horizontal, Positional-Accuracy-Field
aph-h	Int	Relative Horizontal Accuracy, Horizontal-Accuracies-Field
apv	Int	Accuracy point to point vertical, Positional-Accuracy-Field
apv-v	Int	Relative vertical accuracy, Vertical-Accuracies-Field
arv	Int	Number of pizels in 360 degrees (E-W), Pixel-Ground-Spacing-Subfield
asv	tag	Vertical-Accuracies-Field, Vertical-Accuracies-Record
atc	BTS	Attribute label, Explicit-Attribute-Labels-and-Values-Field
att-e	tag	Explicit-Attribute-Labels-and-Values-Field, Edge-Record
att-f	tag	Explicit-Attribute-Labels-and-Values-Field Feature-Explicit-Attribute-Labels-and-Values-Field
att-fe	tag	Feature-Explicit-Attribute-Labels-and-Values-Field, Feature-Record
att-n	tag	Explicit-Attribute-Labels-and-Values-Field, Node-Record
att-r	tag	Explicit-Attribute-Labels-and-Values-Field, Face-Record
att-s	tag	Explicit-Attribute-Labels-and-Values-Field, Spatial-Data-Record
att-t	tag	Explicit-Attribute-Labels-and-Values-Field, Text-Placement-Record
avd-v	GTS	Attribute value definition, Attribute-Value-Description-Field
avf	BTS	Attribute value format, Attribute-Format-Description-Field
avt	BTS	Enumerated "EN" or actual value "AV", Attribute-Format-Description-Field
avu	BTS	Atribute measurement unit, Attribute-Format-Description-Field
ax1	RN	Latitude coefficient 1, Source-Datum-Coefficients-Field
ax2	RN	Latitude coefficient 2, Source-Datum-Coefficints-Field
ax3	RN	Latitude coefficient 3, Source-Datum-Coefficients-Field
ax4	RN	Latitude coefficient 4, Source-Datum-Coefficients-Field
ax5	RN	Latitude coefficient 5, Source-Datum-Coefficients-Field
ax6	RN	Latitude coefficient 6, Source-Datum-Coefficients-Field
ax7	RN	Latitude coefficient 7, Source-Datum-Coefficients-Field

bad-a	BTS	Layer name, Attribute-Accuracy-Field
bad-c	BTS	Layer name, Completeness-and-Consistency-Field
bad-d	BTS	Layer file name, Dataset-Parameters-Subfield
bad-f	BTS	Layer name, Vertical-Accuracies-Field
bad-h	BTS	Layer name, Horizontal-Accuracies-Field
bad-p	BTS	Layer name, Positional-Accuracy-Field
bad-s	BTS	Name of derived layer, Source-Summary-Field
bad-v	BTS	Layer file name, Vector-General
bct	Int	Number of longitude coefficients, Source-Datum-Coefficients-Counter-Field
bdf-r	tag	Band-ID-Subfield, Raster-General
bdf-a	tag	Band-ID-Subfield, Matrix-General
bid	BTS	Band identification, Band-ID-Subfield
brv	Int	Number of pixels in 360 degrees (N-S), Pixel-Ground-Spacing-Subfield
bx1	RN	Longitude coefficient 1, Source-Datum-Coefficients-Field
bx2	RN	Longitude coefficient 2, Source-Datum-Coefficients-Field
bx3	RN	Longitude coefficient 3, Source-Datum-Coefficients-Field
bx4	RN	Longitude coefficient 4, Source-Datum-Coefficients-Field
bx5	RN	Longitude coefficient 5, Source-Datum-Coefficients-Field
bx6	RN	Longitude coefficient 6, Source-Datum-Coefficients-Field
bx7	RN	Longitude coefficient 7, Source-Datum-Coefficients-Field

Withdrawn

cae	Int	i index of the coefficient of MRE a $_{i,j}$, Source-Datum-Latitude-Coefficients-Field
caj	Int	j index of the coefficient of MRE b $_{i,j}$, Source-Datum-Latitude-Coefficients-Field
car	tag	Component-Accuracies-Record; Quality-File
cbd	BTS	Name and/or description of color code, Color-Code-ID-Field
cbi	Int	i index of the coefficient of MRE b $i_{j,}$ Source-Datum-Longitude-Coefficients-Field
cbj	Int	j index of the coefficient of MRE b $i_{j,}$ Source-Datum-Longitude-Coefficients-Field
ccd	Int	Color code assigned in data set (0-255), Color-Code-ID-Field
ccr	BTS	Collection criteria, Attribute-Accuracy-Field
cdp	Int	Type of magnetic date rate, Magnetic-Rate-Field
cdt-s	Int	Type of significant date, Source-Field
cdv	Date	Magnetic rate date value, Magnetic-Rate-Field
cdv-s	Date	Significant date value, Source-Field
cdv07-u	Date	Creation of dataset date value, Quality-Up-to-Dateness-Field
cdv07	Date	Creation date, Transmittal-Header-Field
cdv12	Date	DIGEST edition date, Up-to-Dateness-Field
cdv20	Date	Earliest source date value, Quality-Up-to-Dateness-Field
cdv21	Date	Latest source date value, Quality-Up-to-Dateness-Field
cdv22	Date	Specification edition date, Up-to-Dateness-Field
cdv22-u	Date	Specification date value, Quality-Up-to-Dateness-Field
cdv24	Date	Revision or Update date value, Quality-Up-to-Dateness-Field
cdv27	BTS	Perishable information date value, Source-Field
cod	Int	Column sequence, Dataset-Parameters-Subfield
col	tag	Color-Code-ID-Field, Raster-Quality-Section
cor-e	tag	Edge-Coordinates-Field, Edge-Record
cor-n	tag	Coordinate-Field, Node-Record
cor-s	tag	Coordinte-Field, Spatial-Data-Record
cor-t	tag	Coordinate-Field, Text-Placement-Record
cou-s	BTS	Country code (see Part 3-11), Source-Field
cov-a	Int	Data cover MBR in percent, Matrix-General
cov-v	Int	Data cover MBR in percent, Vector-General
cpi	tag	Color-Patch-ID-Subfield, Color-Patch-Description-Field
cpt	tag	Color-Patch-Type-Subfield, Color-Patch-Description-Field
cpy	tag	Copyright-Field, Source-Record
cpz	GTS	Copyright statement, Copyright-Field
cr1	Int	CIE $_{x,}$ CIE-Color-Description-Subfield
cr2	Int	CIE $_{y,}$ CIE-Color-Description-Subfield
cr3	Int	CIE Reflectivity (y), CIE-Color-Description-Subfield
csf-v	Int	Coordinates scale factor, Vector-General
cx1	RN	Northing coefficient 1, Map-Projection-Coefficients-Field
cx2	RN	Northing coefficient 2, Map-Projection-Coefficients-Field
cx3	RN	Northing coefficient 3, Map-Projection-Coefficients-Field
cx4	RN	Northing coefficient 4, Map-Projection-Coefficients-Field
cx5	RN	Northing coefficnet 5, Map-Projection-Coefficients-Field
cx6	RN	Northing coefficient 6, Map-Projection-Coefficients-Field
cx7	RN	Northing coefficient 7, Map-Projection-Coefficients-Field
cx8	RN	Northing coefficient 8, Map-Projection-Coefficients-Field
cx9	RN	Northing coefficient 9, Map-Projection-Coefficients-Field
cx10	RN	Northing coefficient 10, Map-Projection-Coefficients-Field

da	tag	Attribute/Value-Association-Record, Vector-Geo-Data-File
daa	tag	Feature-Association-Field, Feature/Attribute-Association-Record
dag	BTS	Geodetic Datum Name, Geodetic-Datum-Subfield
dav	tag	Attribute-Format-Description-Field, Attribute/Value-Association-Record
dcc	tag	Datum-Change-Constants-Field, UTM/UPS-System-Metric-Support-Record

Withdrawn Retirée

dcd	BTS	Geodetic Datum Code, Geodetic-Datum-Subfield
dd	tag	Feature/Attribute-Entry-Record, Vector-Geo-Data-File
def	GTS	Attribute or feature definition, Feature/Attribute-Entry-Field
des	BTS	Description of originator and/or source, Feature/Attribute-Entry-Field
df	tag	Feature/Attribute-Association-Record, Vector-Geo-Data-File
dfa	tag	Feature/Attribute-Entry-Field, Feature/Attribute-Entry-Record
dix-d	RN	X table coordinate of digitized diagnostic point, Diagnostic-Points-Field
dix-r	RN	X table cooridinate of digitized registration point, Registration-Points-Field
diy-d	RN	Y table coordinate of digitized diagnostic point, Diagnostic-Points-Field
diy-r	RN	Y table coordinate of digitized registration points, Registration-Points-Field
diz-d	RN	Z table coordinate of digitized diagnostic point, Diagnostic-Points-Field
diz-r	RN	Z table coordinate of digitized registration points, Registration-Points-Field
dpd-d	BTS	Diagnostic point ID, Diagnostic-Points-Field
dpr	tag	Diagnostic-Points-Field, Geo-Reference-Record
drf	tag	Dataset-Description, Dataset-Description-Record
dsi	tag	Dataset-ID-Field, General-Information-Record
dss	tag	Dataset-Description-Record, General-Information-File
dvr	BTS	Datum vertical name, Vertical-Datum-Subfield
dx1	RN	Easting coefficient 1, Map-Projection-Coefficients-Field
dx2	RN	Easting coefficient 2, Map-Projection-Coefficients-Field
dx3	RN	Easting coefficient 3, Map-Projection-Coefficients-Field
dx4	RN	Easting coefficient 4, Map-Projection-Coefficients-Field
dx5	RN	Easting coefficient 5, Map-Projection-Coefficients-Field
dx6	RN	Easting coefficient 6, Map-Projection-Coefficients-Field
dx7	RN	Easting coefficient 7, Map-Projection-Coefficients-Field
dx8	RN	Easting coefficient 8, Map-Projection-Coefficients-Field
dx9	RN	Easting coefficient 9, Map-Projection-Coefficients-Field
dx10	RN	Easting coefficient 10, Map-Projection-Coefficients-Field

ed	tag	Edge-Record, Vector-Geo-Data-File
edn	Int	Edition number, Transmittal-Header-Field
edn-s	BTS	Source edition number, Source-Field
edn-u	Int	Edition number of data set, Quality-Up-to-Dateness-Field
elc	BTS	Ellipsoid code, Geodetic-Ellipsoid-Subfield
ele-f	RN	Elevation, Coordinate-Field
ell	BTS	Ellipsoid name, Geodetic-Ellipsoid-Subfield
elv	RN	Eastern limit of validity to use muptiple regression equations Datum-Change-Constants-Field
ert	BTS	Relation type, Explicit-Relation-Pointers-Field
esf	RN	Easting scale factor, Normalization-Constants-Field
ett	RN	Easting translation term, Normalization-Constants-Field

fa	tag	(Area) Feature-Record, Vector-Geo-Data-File
fac	BTS	FACC identifier code, Feature-Implicit-Attributes-Field
fal	tag	Left-Face-Pointer, Face-Topology-Field
fan	BTS	Short name for the feature or attribute, Feature/Attribute-Entry-Field
faq	Int	Feature or attribute (1 = feature, 2 = attribute), Feature/Attribute-Entry-Field
far	tag	Right-Face-Pointer, Face-Topology-Field
fc	tag	(Complex) Feature-Record, Vector-Geo-Data-File
fcc	Int	Face record count, Vector-General
fdr	tag	Dataset-Description-Field, Transmittal-Description-Record
fe	tag	Face-Record, Vector-Geo-Data-File
fec-v	Int	Feature count total in dataset, Vector-General
fl	tag	(Line) Feature-Record, Vector-Geo-Data-File

Withdrawn Pending Future

for	BTS	Value format, Explicit-Attribute-Labels-and-Values-Field
fp	tag	(Point) Feature-Record, Vector-Geo-Data-File
ftx	GTS	Text, Text-Field

gca	RN	Grid convergence angle, Grid-Convergence-Subfield
gen		General-Information-Field, General-Information-Record
gen-m	tag	Matrix-General, General-Information-Record
gen-r	tag	Raster-General, General-Information-Record
gen-v	tag	Vector-General, General-Information-Record
geo	tag	Geo-Reference-Record, Geo-Reference-File
gep	tag	Geo-Parameters-Field, Geo-Reference-Record
gin	tag	General-Information-Record, General-Information-File
gla	RN	Latitude/northing of geographic reference point, Control-Point-Subfield
glo	RN	Longitude/easting of geographic reference point, Control-Point-Subfield
gma	RN	Grid north-magnetic north, Magnetic-Rate-Field
gof	RN	Longitude normalizing offset, Datum-Change-Constants-Field
grc	tag	Grid-Rotation-Coefficients-Field, UTM/UPS-System-Metric-Support-Record
grd	BTS	Cartographic grid code, Source-Field
gsf	RN	Longitude scale factor, Normalization-Constants-Field
gtt	RN	Longitude translation term, Normalization-Constants-Field

hke	Int	Highest known elevation of source, Highest-Elevation-Subfield

iat-e	tag	Implicit-Attributes-Field, Edge-Record
iat-f	tag	Feature-Implicit-Attributes-Field, Feature-Record
iat-i	tag	Implicit-Attributes-Field, Feature-Implicit-Attributes-Field
iat-r	tag	Implicit-Attributes-Field, Face-Record
iat-s	tag	Implicit-Attributes-Field, Spatial-Data-Record
imr-r	BTS	Rectifierd ("Y"), unrectified ("N"), Raster-General
img	tag	Image-Record;Raster-Geo-Data-File
ins	tag	Inset-Field, Source-Record
int	BTS	Unique ID of an Inset, Inset-Field
ire-e	tag	Edge-Implicit-Relation-Pointers-Field, Edge-Record
irn	tag	Node-Implicit-Relation-Pointer-Field, Node-Record
irs-e	tag	Implicit-Relations-Pointer-Field, Edge-Record
irs-f	tag	Implicit-Relations-Pointer-Field, Feature-Record
irs-n	tag	Implicit-Relations-Pointer-Field, Node-Record
irs-r	tag	Implicit-Relations-Pointer-Field, Face-Record
irs-s	tag	Implicit-Relations-Pointer-Field, Spatial-Data-Record
irs-t	tag	Implicit-Relations-Pointer-Field, Text-Placement-Record

lab	BTS	Feature code/name or attribute label, Feature/Attribute-Entry-Field
lab-a	BTS	Attribute label, Attribute-Format-Description-Field
lab-f	BTS	Feature label, Feature-Association-Field
lad-r	RN	Data interval in N/S direction, Data-Density-Subfield
lat	FN	Latitude/Northing coordinate, Bounding-Polygon-Coordinates-Field
lat-d	FN	Latitude/Northing of diagnostic point, Diagnostic-Points-Subfield
lat-f	FN	Latitude/Northing, Coordinate-Field
lat-h	FN	Latitude/Northing of HKE, Highest-Elevation-Point
lat-m	FN	Latitude/Northing of the G-M angle reference point Magnetic-Rate-Reference-Point-Subfield
lat-r	FN	Latitude/Northing of registration point, Registration-Points-Subfield
lcf	tag	Security-and-Update-Record, Transmittal-Header-File

Withdrawn/Retirée

lgc	RN	Coefficient of MRE $b_{i,j}$, Source-Datum-Longitude-Coefficients-Field
lgi	tag	Legend-Field, Legend-Record
lic-v	Int	Linear feature count, Vector-General
llk	Int	Left link, Ordered-Rooted-Tree-Links
lod-r	RN	Data interval in E/W direction, Data-Density-Subfield
lon	FN	Longitude/Easting coordinate, Bounding-Polygon-Coordinates-Field
lon-d	FN	Longitude/Easting of diagnostic point, Diagnostic-Points-Subfield
lon-f	FN	Longitude/Easting, Coordinate-Field
lon-h	FN	Longitude/Easting of HKE, Highest-Elevation-Point
lon-m	FN	Longitude/Easting of the G-M angle reference point Magnetic-Rate-Reference-Point-Subfield
lon-r	FN	Longitude/Easting of registration point, Registration-Points-Subfield
lso-a	FN	Longitude/Eastings of origin, Matrix-General
lso-r	FN	Longitude/Eastings of origin, Raster-General
lso-v	FN	Longitude/Eastings of origin, Vector-General
ltc	RN	Coefficient of MRE $a_{i,j}$, Source-Datum-Latitude-Coefficients-Field

mae	RN	Maximum Easting/Latitude value of the MBR, Implicit-Attributes-Field
mag	tag	Magnetic-Rate-Field, Source-Record
man	RN	Maximum northing/longitude value of the MBR, Implicit-Attributes-Field
mbu-v	BTS	Units of GRP and MBR, Vector-General
mie	RN	Minimum easting/longitude value of the MBR, Implicit-Attributes-Field
min	RN	Minimum northing/latitude value of the MBR, Implicit-Attributes-Field
mpc	tag	Map-Projection-Coefficients-Field, Arc-System-Metric-Support-Record
msd	tag	Metric-Support-Record, Source-File

nam	BTS	Dataset ID, Dataset-Description-Field
nam-d	BTS	Dataset ID, Dataset-ID-Field
nam-i	BTS	Name of inset, Inset-Field
nam-l	BTS	Legend name, Legend-Field
nam-s	BTS	Full name of source document, Source-Field
nbd	BTS	Description/meaning of code, Nominal-Code-ID
ncd	tag	Normalization-Constants-Field, Arc-System-Metric-Support-Record
ncd-n	Int	Nominal code assigned in dataset, Nominal-Code-ID
nci	BTS	Code identifier, Nominal-Code-ID
nea	RN	Northernmost latitude, Dataset-Description-Field
nea-mb	FN	Northernmost latitude, Map-Boundary-Coordinates-Subfield
nec	Int	Node record count, Vector-General
nel	tag	Pointer-to-Next-Left-Directed-Edge, Winged-Edge-Topology-Field
neo	RN	Easternmost longitude, Dataset-Description-Field
neo-mb	FN	Easternmost longitude, Map-Boundary-Coordinates-Subfield
ner	tag	Pointer-to-Next-Right-Directed-Edge, Winged-Edge-Topology-Field
nes	RN	Normalized eastings shift, Grid-Rotation-Coefficients-Field
nfc	Int	Number of sub-blocks horizontally, Dataset-Parameters-Subfield
nfl	Int	Number of sub-blocks vertically, Dataset-Parameters-Subfield
nin	Int	Number of insets, Source-Summary-Field
nli	Int	Number of legend images, Source-Summary-Field
nll	Int	Row number, lower left corner of the MBR, Corners-of-MBR-Subfield
nls	Int	Column number, lower left corner of the MBR, Corners-of-MBR-Subfield
nlv	RN	Northern limit of validity to use multiple regression equations Datum-Change-Constants-Field
nns	RN	Normalized northings shift, Grid-Rotation-Coefficients-Field
no	tag	Node-Record, Vector-Geo-Data-File
noe-e	tag	End-Node-Pointer, Edge-Node-Topology-Field

Withdrawn/Retirée

nom-m	tag	Matrix-Quality-Section, Quality-Record
nos	Int	Number of source graphics, Dataset-Description
nos-e	tag	Start-Node-Pointer, Edge-Node-Topology-Field
noz	Int	Number of layers, Dataset-Description
nrl	FN	Relative longitude of lower left corner, Inset-Field
nrr	FN	Relative longitude of upper right corner, Inset-Field
nsb	Int	Color intensity - Blue actual (0-255), RGB-Color-Description-Subfield
nsf	RN	Northing scale factor, Normalization-Constants-Field
nsg	Int	Color intensity - Green actual (0-255), RGB-Color-Description-Subfield
nsh	Int	Number of horizontal accuracy sub-regions, Dataset-Description
nsl	FN	Relative longitude of upper left corner, Inset-Field
nsp	Int	Number of position accuracy sub-regions, Dataset-Description
nsr-i	FN	Relative longitude of lower right corner, Inset-Field
nsr	Int	Color intensity - Red actual (0-255), RGB-Color-Description-Subfield
nst	Int	Number of supplementary text records, Source-Summary-Field
nst-s	Int	Navigational system type, Source-Field
nsv	Int	Number of vertical accuracy sub-regions, Dataset-Description
ntl	FN	Absolute longitude of lower left corner, Inset-Field
ntr	FN	Absolute longitude of upper right corner, Inset-Field
ntt	RN	Northing translation term, Normalization-Constants-Field
nul	Int	Row number, upper right corner of the MBR, Corners-of-MBR-Subfield
nus	Int	Column number, upper right corner of the MBR, Corners-of-MBR-Subfield
nvl	FN	Absolute longitude of upper left corner, Inset-Field
nvr	FN	Absolute longitude of lower right corner, Inset-Field
nzt	RN	Normalizing factor, Datum-Change-Constants-Field

oqi	GTS	Free text, Other-Quality-Information-Field

paa	RN	Projection parameter 1, Projection-Field
pab	RN	Projection parameter 2, Projection-Field
pac	RN	Projection parameter 3, Projection-Field
pae	RN	Projection parameter 4, Projection-Field
pcb	Int	Size of pixel/element count in bits, Dataset-Parameters-Subfield
pci	Int	Predominant contour interval, Contour-Interval-Subfield
pco	BTS	Projection codes (see Part 3-6), Projection-Field
pib	Int	Patch intensity value - blue, Color-Patch-ID-Subfield
pid-r	BTS	Registration point ID, Registration-Points-Subfield
pig	Int	Patch intensity value - green, Color-Patch-ID-Subfield
pir	Int	Patch intensity value - red, Color-Patch-ID-Subfield
pnc	Int	Number of pixels/sub-block line, Dataset-Parameters-Subfield
pnl	Int	Number of scan lines/sub-block, Dataset-Parameters-Subfield
pnm	BTS	Color patch name (e.g. red), Color-Patch-ID-Subfield
poc-v	Int	Point feature count, Vector-General
por	Int	Pixel order, Dataset-Parameters-Subfield
prn	BTS	Projection name, Projection-Field
prr	tag	Projection-Field, Geo-Reference-Record
prr-s	tag	Projection-Field, Source-Record
prt	BTS	Dataset type, Dataset-Description-Field
prt-d	BTS	Dataset type, Dataset-ID-Field
prt-s	BTS	Series designator for the series, Source-Field
pso-a	FN	Latitude/Northings of origin, Matrix-General
pso-r	FN	Latitude/Northings of origin, Raster-General
pso-v	FN	Latitude/Northings of origin, Vector-General

Withdrawn/Retired

psp-r	RN	Sample pixel spacing in microns, Raster-General
pvb	Int	Size of pixel/element value in bits, Dataset-Parameters-Subfield

qaa-v	tag	Attribute-Accuracy-Field, Vector-Quality-Section
qac	Int	Attribute completeness percent, Completeness-and-Consistency-Field
qai	tag	Accuracy-Record, Quality-File
qal	tag	Quality-Record, Quality-File
qap	tag	Positional-Accuracy-Field, Accuracy-Record
qcc-v	tag	Completeness-and-Consistency-Field, Vector-Quality-Section
qdv10	Date	Date of downgrading, Security-and-Release-Field
qfc	Int	Feature completeness percent, Completeness-and-Consistency-Field
qlc	BTS	Logical consistency, Completeness-and-Consistency-Field
qle	BTS	Releasability, Security-and-Release-Field
qod	BTS	Downgrading instructions, Security-and-Release-Field
qoi	tag	Other-Quality-Information-Field, Quality-Record
qsr	tag	Security-and-Release-Field, Security-and-Update-Record
qsr-s	tag	Security-and-Release-Field, Source-Record
qsr-q	tag	Security-and-Release-Field, Quality-Record
qss	tag	Security-Level, Security-and-Release-Field
qul	Int	Percent reliability of qualitative attributes, Attribute-Accuracy-Field
quq	tag	Quality-Up-To-Dateness-Field, Quality-Record
qut	Int	Standard deviation of quantitative attributes, Attribute-Accuracy-Field
quv	tag	Up-to-Dateness-Field, Security-and-Update-Record

r1l	tag	Explicit-Relation-Pointers-Field, Feature-Record
r1v	tag	Explicit-Relation-Value-Field, Explicit-Relation-Pointers-Field
rat	RN	Magnetic rate of change, Magnetic-Rate-Field
rci	tag	Bounding-Polygon-Coordinates-Field, Source-Record
rci-a	tag	Bounding-Polygon-Coordinates-Field, Accuracy-Record
rci-h	tag	Bounding-Polygon-Coordinates-Field, Horizontal-Accuracies-Record
rci-v	tag	Bounding-Polygon-Coordinate-Field, Vertical-Accuracies-Record
rec-u	Int	Recompilation count, Quality-Up-to-Dateness-Field
rev-u	Int	Revision count, Quality-Up-to-Dateness-Field
rid-COP	Int	Record ID, Node-Implicit-Relation-Pointer-Field
rid-COS	Int	Record ID, Implicit-Relations-Pointer-Field
rid-e	Int	Record ID number, Explicit-Relation-Value-Field
rid-FAL	Int	Record ID, Left-Face-Pointer
rid-FAR	Int	Record ID, Right-Face-Pointer
rid-NEL	Int	Record ID, Pointer-to-Next-Left-Directed-Edge
rid-NER	Int	Record ID, Pointer-to-Next-Right-Directed-Edge
rid-NOE	Int	Record ID, End-Node-Pointer
rid-NOS	Int	Record ID, Start-Node-Pointer
rlk	Int	Right link, Ordered-Rooted-Tree-Links
rod	Int	Row sequence, Dataset-Parameters-Subfield
rpr	tag	Registration-Points-Field, Geo-Reference-Record

sca	Int	Cartographic scale of inset, Inset-Field
sca-a	Int	Source graphic scale reciprocal, Matrix-General
sca-r	Int	Source graphic scale reciprocal, Raster-General
sca-s	Int	Cartographic scale, Source-Field
sca-v	Int	Source graphic scale reciprocal, Vector-General
scc	tag	Source-Datum-Coefficients-Counter-Field UTM/UPS-System-Metric-Support-System

Withdrawn/Retiree

scn	tag	Pixel-Field, Image-Record
scn-m	tag	Element-Field, Matrix-Record
scr	BTS	Standard color patch reference, Color-Patch-Type-Subfield
sda	BTS	Sounding datum name, Sounding-Datum-Subfield
sdc	tag	Source-Datum-Coefficients-Field, Arc-System-Metric-Support-Record
sec-COP	BTS	Security, Node-Implicit-Relation-Pointer-Field
sec-COS	BTS	Security, Implicit-Relations-Pointer-Field
sec-e	BTS	Security, Explicit-Relation-Value-Field
sec-FAL	BTS	Security, Left-Face-Pointer
sec-FAR	Int	Security, Right-Face-Pointer
sec-NEL	BTS	Security, Pointer-to-Next-Left-Directed-Edge
sec-NER	BTS	Security, Pointer-to-Next-Right-Directed-Edge
sec-NOE	BTS	Security, End-Node-Pointer
sec-NOS	BTS	Security, Start-Node-Pointer
sft	Int	Simple feature count, Vector-General
sgc-v	Int	Segment/edge record count, Vector-General
sgf	tag	Source-Summary-Field, Source-Record
slg	tag	Source-Datum-Longitude-Coefficients-Field UTM/UPS-System-Metric-Support-Record
slt	tag	Source-Datum-Latitude-Coefficients-Field UTM/UPS-System-Metric-Support-Record
slv	RN	Southern limit of validity to use multiple regression equations Datum-Change-Constants-Field
sog	BTS	Source for the feature or attribute, Feature/Attribute-Entry-Field
sor	tag	Source-Field, Source-Record
sou	tag	Source-Record, Source-File
sp	tag	Spatial-Data-Record, Vector-Geo-Data-File
spa-u	BTS	Specification amendment, Quality-Up-to-Dateness-Field
spa1	BTS	DIGEST amendment number, Up-to-Dateness-Field
spa2	BTS	Specification amendment number, Up-to-Dateness-Field
spr-a	tag	Dataset-Parameters-Subfield, Matrix-General
spr-c	tag	Dataset-Parameters-Subfield, Color-Patch-ID-Subfield
spr-l	tag	Legend-Parameters-Field, Legend-Record
spr-p	tag	Dataset-Parameters-Subfield, Legend-Parameters-Field
spr-r	tag	Dataset-Parameters-Subfield, Raster-General
spt	tag	Supplementary-Text-Record, Source-File
squ	Int	Area coverage, Area-Coverage-Subfield
src-u	BTS	Specification ID, Quality-Up-to-Dateness-Field
src1	BTS	DIGEST Edition ID, Up-to-Dateness-Field
src2	BTS	Specification edition ID, Up-to-Dateness-Field
srn-s	Int	Library/Source reference number, Source-Field
str	Int	Structure code, Dataset-Description-Field
str-a	II	Structure of the data, Matrix-General
str-l	Int	Structure class code, Legend-Field
str-r	II	Structure of the data, Raster-General
str-v	II	Structure of the data, Vector-General
sup	tag	Supplementary-Text-Field, Supplementary-Text-Record
swa	RN	Southernmost longitude, Dataset-Description-Field
swa-mb	FN	Southernmost latitude, Map-Boundary-Coordinates-Subfield
swo	RN	Westernmost longitude, Dataset-Description-Field
swo-mb	FN	Westernmost longitude, Map-Boundary-Coordinates-Subfield

thf	tag	Transmittal-Description-Record, Transmittal-Header-File
tif	BTS	Tile index map image ("Y" or "N"), Dataset-Parameters-Subfield
tim-a	tag	Tile-Index-Map-Subfield, Matrix-General

Withdrawn/Retirée

tim-l	tag	Tile-Index-Map-Subfield, Legend-Record
tim-r	tag	Tile-Index-Map-Subfield, Raster-General
tof	RN	Latitude normalizing offset, Datum-Change-Constants-Field
tp	tag	Text-Placement-Record, Vector-Geo-Data-File
tri	BTS	Supplementary text field reference identifier, Supplementary-Text-Field
trl	FN	Relative latitude of lower left corner, Inset-Field
trr	FN	Relative latitude of upper right corner, Inset-Field
try	BTS	Supplementary text record type, Supplementary-Text-Field
tsf	RN	Latitude scale factor, Normalization-Constants-Field
tsi	Int	Tile index map, Tile-Index-Map-Subfield
tsl	FN	Relative latitude of upper left corner, Inset-Field
tsr	FN	Relative latitude of lower right corner, Inset-Field
ttl	FN	Absolute latitude of lower left corner, Inset-Field
ttr	FN	Absolute latitude of upper right corner, Inset-Field
ttt	RN	Latitude translation term, Normalization-Constants-Field
tvl	FN	Absolute latitude of upper left corner, Inset-Field
tvr	FN	Absolute latitude of lower right corner, Inset-Field
txt	GTS	Supplementary text, Supplementary-Text-Field
txt-a	BTS	Free text, Matrix-General
txt-r	BTS	Free text, Raster-General
txt-t	tag	Text-Field, Text-Placement-Record
txt-v	BTS	Free text, Vector-General
typ	BTS	Data type, Geo-Parameters-Field

uni	BTS	Unit of measure for coordinates, Geo-Parameters-Field
uniaah	Int	Unit of measure for accuracy absolute horizontal, Positonal-Accuracy-Field
uniaah-h	Int	Unit of measure for absolute horizontal accuracy, Horizontal-Accuracies-Field
uniaav	Int	Unit of measure for accuracy absolute vertical, Positonal-Accuracy-Field
uniaav-v	Int	Unit of measure for absolute vertical accuracy, Vertical-Accuracies-Field
uniaph	Int	Unit of measure for accuracy point to point horizontal, Positional-Accuracy-Field
uniaph-h	Int	Unit of measure for relative horizontal accuracy, Horizontal-Accuracies-Field
uniapv	Int	Unit of measure for accuracy point to point vertical, Positional-Accuracy-Field
uniapv-v	Int	Unit of measure for relative vertical accuracy, Vertical-Accuracies-Field
unisqu	BTS	Unit of measure for area coverage, Area-Coverage-Subfield
unigca	RN	Unit of grid convergence angle, Grid-Convergence-Subfield
unigma	BTS	Units of grid magnetic angle, Magnetic-Rate-Field
unihke	BTS	Units of elevation value, Highest-Elevation-Subfield
unilmat-a	Int	Unit of measure for matrix data, Matrix-General
uniloa-r	BTS	Unit of measure for LOD and LAD, Data-Density-Subfield
unipci	BTS	Unit of measure for contour interval, Contour-Interval-Subfield
unirat	BTS	Units of rate of change, Magnetic-Rate-Field
urf	BTS	Transmittal ID, Transmittal-Header-Field
urf-s	BTS	Unique source ID, Source-Field

vad	tag	Attribute-Value-Description-Field, Attribute/Value-Association-Record
val	BTS/Int/RN	Attribute value, Explicit-Attribute-Labels-and-Values-Field
var	tag	Matrix-Record; Matrix-Geo-Data-File
vdcdvr	Int	Vertical datum code, Vertical-Datum-Subfield
vdcsda	Int	Sounding datum category, Sounding-Datum-Subfield
vdr	tag	Transmittal-Header-Field, Transmittal-Description-Record
voo	BTS	Originator, Transmittal-Header-Field

Withdrawn/Retirée

wlv	RN	Western limit of validity to use multiple regression equations Datum-Change-Constants-Field
wpc	Int	Percentage covered by water, Source-Field
ws1	Int	Lower limit wavelength, Band-ID-Subfield
ws2	Int	Upper limit wavelength, Band-ID-Subfield

xor	RN	Easting false origin, Projection-False-Origin-Subfield

yor	RN	Northing false origin, Projection-False-Origin-Subfield

zna-a	Int	Zone number, Matrix-General
zna-r	Int	Zone number, Raster-General
zor	RN	Z-values false origin, Projection-Field
zv2	RN	Maximum elevation value of the MBR, Implicit-Attributes-Field
zvl-d	RN	Elevation of diagnostic point, Diagnostic-Points-Subfield
zvl-r	RN	Elevation of registration point, Registration-Points-Subfield
zwi	RN	Minimum elevation value of the MBR, Implicit-Attributes-Field

Table 16-3 ISO 8824 Application Tags

Application Tag Number	Header / Elementary Tag	File/Record(s) Identified
1	GIF	General-Information-File
2	GRF	Geo-Reference-File
3	SOU	Source-Record
4	LEG	Legend-Record
5	MSD	Metric-Support-Record
6	SPT	Supplementary-Text-Record
7	QAL	Quality-Record
8	QAI / CAR	Accuracy-Record and/or Component-Accuracies-Record
9	ED	Edge-Record
10	NO	Node-Record
11	FE	Face-Record
12	SP	Spatial-Data-Record
13	FL / FP / FA / FC	Feature-Record
14	TP	Text-Placement-Record
15	DD	Feature/Attribute-Entry-Record
16	DF	Feature/Attribute-Association-Record
17	DA	Attribute/Value-Association-Record
18	IMG	Image-Record
19	VAR	Matrix-Record

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The

DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD

(DIGEST)

Part 4

FEATURE AND ATTRIBUTE CODING CATALOGUE

(FACC)

Withdrawn/Retirée

Produced and issued under the direction of the Defense Mapping Agency, United States of America in cooperation with the Directorate of Geographic Operations, Department of National Defence, Canada on behalf of the Digital Geographic Information Working Group.

Edition 1.2 January 1994

DIGEST Part 4

FEATURE AND ATTRIBUTE CODING CATALOGUE (FACC)

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ANNEXES

A Feature Codes
B Attribute and Value Codes
C Features and Associated Attributes

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NOTICE TO USERS

1. This international exchange standard has been designed to enable the transfer of Digital Geographic Information (DGI) between geographic information systems. This documentation now forms a baseline from which both system developers and national survey organizations can plan their development and production activities.

2. Research into all aspects of DGI is continuing within the Digital Geographic Information Working Group (DGIWG) forum and any subsequent potential changes will be subject to formal change control procedures.

RECORD OF AMENDMENTS

NUMBER	DATE	ENTERED BY	REMARKS

Withdrawn/Retirée

FOREWORD

Authority. The **DI**gital **G**eographic Information **Ex**change **ST**andard (DIGEST) was prepared by and issued under the authority of the Digital Geographic Information Working Group (DGIWG).

Security Classification. All parts of DIGEST are unclassified but may be subject to the limitation of use that the copying of the documents is prohibited without the authority of the national point of contact (see Part 1 — 5.2).

Changes from Last Edition. DIGEST Edition 1.2 cancels and replaces DIGEST Edition 1.1 (October 1992). The major changes have been technical improvements to the theoretical data model, reworking of the encapsulations, and updating of the coding scheme. The major changes to FACC 1.2 (this Part 4 of DIGEST) are as follows.

- Annexes A and B have been expanded to include many new features, attributes, and attribute values.
- Tables of Contents have been included in the annexes, providing convenient quick-reference lists.
- In Annex A (Feature Codes), the UK and US feature names have been combined into a single English entry, with any differences between UK and US terms noted where required. (Terminology/spelling used throughout the rest of FACC is in US English.)
- In Annex B (Attribute and Value Codes), there is a new format for describing "Actual Value" attributes which provides some restrictions on the permissible values.
- Annex C (an earlier version appeared in DIGEST 1.0, but was removed from DIGEST 1.1) lists attributes which might typically be associated with certain (most) features.

Document Structure. DIGEST is published as four parts:

- Part 1: General Description
- Part 2: Theoretical Model, Exchange Structure, and Encapsulation Specifications
- Part 3: Codes and Technical Parameters
- Part 4: Feature and Attribute Coding Catalogue

This part comprises the feature and attribute coding scheme used by DIGEST. It is structured as follows.

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- The first three clauses provide the scope, purpose and field of application; conformance; and references applicable to DIGEST as a whole.

- The fourth clause provides terminology associated with DIGEST Part 4 (FACC).

- The fifth clause explains in detail the coding structure for features, attributes and their values. It also provides rules for documenting new features and attributes.

- Annex A lists features and their codes; Annex B lists attributes, their codes, as well as values and additional actual value information; and Annex C lists features and associated attributes. These annexes are all normative.

Document Maintenance. The maintenance of DIGEST is covered in Part 1 — 5, including custodianship, national representatives, procedures for effecting changes to the standard, and distribution of the documents.

Acknowledgements. It is truly remarkable when a group of individuals from 11 different countries spanning two continents can work together on a project as extensive and complex as designing an exchange standard for digital geographic information. The editor would like to acknowledge the efforts and contributions of all DGIWG members—past and present—in the creation and evolution of this standard, including this Feature and Attribute Coding Catalogue.

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1 SCOPE, PURPOSE AND FIELD OF APPLICATION

1.1 SCOPE

Digital geographic information (DGI) has evolved into an essential element in the planning and conduct of civil and military operations. The required data volume, demands and data complexity dictate that multi-national agreements for digital data standards be established to assure compatibility. In support of this aim these standards define those aspects necessary to the exchange of DGI. They are as follows:

- the data structures to be supported;
- format;
- feature and attribute coding scheme;
- exchange media; and
- administrative procedures.

The type of data to be exchanged using these standards includes the digital representation of the following:

- elevation and depth information;
- geographic feature geometry and feature attribute information;
- information concerning the appearance and status of the Earth's surface and its features in the electromagnetic spectrum, e.g. radar, infra-red; and
- other geographic information.

The data will all be available on a common worldwide reference datum of World Geodetic System 1984 (WGS 84).

1.2 PURPOSE

These standards will enable interoperability and compatibility among national and multi-national systems and users. They will also support the increasing use of joint development programs. In fact it is essential that geographic staffs included in the development of national Geographic Information Systems ensure that the data structures and feature and attribute coding schemes are compatible with these standards.

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1.3 FIELD OF APPLICATION

The application of the agreed standards being dealt with hereafter has several aspects, including organizational; geo-scientific; and regional and thematic.

1.3.1 ORGANIZATIONAL APPLICABILITY

This document applies to the topographic, hydrographic and aeronautical institutions of the participating nations. The standards have been built to support exchange of DGI between the central agencies operating in this geo-scientific field. This does not preclude the use by other institutions; on the contrary, all users are requested to widen the field of applications even to their contractors on the commercial side by making these standards part of relevant contracts. This will help to avoid redundant developments and cut costs by using common approaches.

1.3.2 GEO-SCIENTIFIC APPLICABILITY

These standards apply to geodetic, geographic, geological and geophysical data of interest. Since the present, and even more importantly the future area of interest for research, development, planning, and execution of operations is hard to define, the term has to be interpreted in a wide sense. Positioning, navigation, simulation, targeting, map and chart automated production, display and manipulation of data are some applications. All the data in this document are covered by the term "Geo data". Geo data will be turned into applications-specific user-oriented "product data" out of the original "non-product oriented data".

1.3.3 REGIONAL AND THEMATIC APPLICABILITY

The contents of databases are mainly a national responsibility, but authorities may wish to state points of interest referring to the regional extension and the thematic subjects held in these databases. An integrated multi-national database is not foreseen. Should it come into existence, the standards of this document can easily be applied, since international agreements (ISO standards and NATO STANAGs) have been considered as far as published and known to the DGIWG. For bi- or multi-national system developments this document should apply.

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2 CONFORMANCE

This standard is applicable to all member nations of DGIWG. Information processing systems which have the capability of exchanging DGI shall have the capability of reading and writing data in conformance with this standard. This standard shall be used for the exchange of DGI unless the interchanging parties have agreed on an alternative exchange format.

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3 REFERENCES

Following are the normative references which are used in the application of DIGEST. References which are informative or which merely assisted in the preparation of the standard are included in the bibliography (Annex G to Part 2).

International/Multinational

1. ISO 646 — *Information Processing — ISO 7-bit coded character set for information interchange*, Ed. 2, 1983.

2 ISO 1000 — *SI units and recommendations for the use of their multiples and of certain other units*, Third Edition 1992-11-01

3. ISO 1001 — *Information Processing — File Structure and Labelling of Magnetic Tapes for Information Interchange*, Ed. 2, 1986. Common with references 16 and 24.

4. ISO 2022 — *Information Processing — ISO 7-Bit and 8-Bit Coded Character Sets — Code Extension Techniques*, Ed. 3, 1986.

5. ISO 2375 — *Data Processing — Procedure for registration of escape sequences*, Ed. 3, 1985.

6. ISO 3788 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information Interchange recorded at 63 cpmm (1600 cpi), Phase Encoded.* Ed. 1, 1976. Common with references 17 and 22.

7. ISO 5652 — *Information Processing — 9 Track 12.7 mm (0.5 in) Wide Magnetic Tape for Information interchange formats and recording, using group coding 246 cpmm (6,250 cpi).* Common with references 19 and 23.

8. ISO 6937 — *Information Processing — Coded character sets for text communication*, Ed. 1, 1983.

9. ISO 8211 — *Information Processing — Specification for a data descriptive file for information interchange*, 1985.

10. ISO 8601 — *Data Elements and Interchange Format; Information Interchange Representation of Dates and Time*, 1988. (Replaces ISO 4031)

11. ISO 8824 — *Information processing systems — Open Systems Interconnection — Specifications of Abstract Syntax Notation One (ASN.1)*, 1987. (CCITT X.208)

12. ISO 8825 — *Information processing systems — Open Systems Interconnection — Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*, Ed. 1, 1987.

13. ISO 9660 — *Information Processing — Volume and File Structure of CD-ROM for Information Interchange*, Ed. 1, 1988.

14. ISO 8859 -1— *Information processing — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*, First Edition 1987-02-15

15. ISO/IEC/10646 -1 — *Infornation technology - Universal Multiple-Octet Coded Character Set (UCS), Part 1: Architecture and Basic Multilingual Plane*, First edition 1993-05-01

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16. CCITT Recommendation, 1992, Geneva:
T50 — *International Reference Alphabet* (IA5),
T51 — *Latin Alphabet Coded Character Sets for Telematic Services,*
T52 — *Non Latin Alphabet Coded Character Sets for Telematic Services.*

17. DLMS Accuracy Working Group. (*Accuracy Determination Method.*)

18. European Computer Manufacturer's Associates (ECMA), *Standard for Data Interchange on Read Only 120 mm Optical Data Disks (CD-ROM).* ECMA/TTC31/87/47, September 1987. (DRAFT).

National

19. ANSI X3.27—1978, *Magnetic Tape Labels and File Structure for Information Interchange (ASCII)*, 1978. Common with references 2 and 24.

20. ANSI X3.39—1973, *Recorded Magnetic Tape for Information Interchange (1,600 cpi, PE)*, 1973. Common with references 5 and 22.

21. ANSI X3.4—1977, *Code for Information Interchange*, 1977.

22. ANSI X3.54—1976, *Recorded Magnetic Tape for Information Interchange (6,250 CPI, Group-Coded Recording)*, 1976. Common with references 7 and 23.

23. ANSI/IEEE - 754—1986, *IEEE Standard for Binary Floating Point Arithmetic.*

24. FIPS PUB 1-1 — *Code for Information Interchange*, 24 Dec 1980.

25. FIPS PUB 10-3 — *Countries, Dependencies, Areas of Special Sovereignty, and their Principal Administrative Divisions*, 9 Feb 1984.

26. FIPS PUB 25 — *Recorded Magnetic Tape for Information Interchange (1,600 CPI, Phase Encoded)*, 30 Jun 1973. Common with references 5 and 17.

27. FIPS PUB 50 — *Recorded Magnetic Tape for Information Interchange, 6,250 cpi (246 cpmm), Group-Coded Recording*, 1 Feb 1978. Common with references 7 and 19.

28. FIPS PUB 79 — *Magnetic Tape Labels and File Structure for Information Interchange*, 17 Oct 1980. Common with references 2 and 16.

29. DoD (US Department of Defense) *Standard Printing Color Catalog.*

30. DoD (US Department of Defense) *Operators Manual for the MC&G Standard Printing Color Identification System.*

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4 TERMINOLOGY

4.1 TERMS AND DEFINITIONS

A complete list of terms and definitions used in DIGEST can be found in the corresponding element of Part 2 — 4.1.

4.2 ACRONYMS AND ABBREVIATIONS

Although most acronyms and abbreviations are defined the first time they are used, the following list is provided as a quick reference for the acronyms and abbreviations (excluding feature and attribute codes) appearing in this part of DIGEST.

AMSL	**A**bove **M**ean **S**ea **L**evel
ANSI	**A**merican **N**ational **S**tandards **I**nstitute
ASCII	**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
ASN	**A**bstract **S**yntax **N**otation
ATS	**A**ir **T**raffic **S**ervice
CCITT	**C**omité **C**onsultatif **I**nternational **T**élégraphique et **T**éléphonique
CD-ROM	**C**ompact **D**isk — **R**ead **O**nly **M**emory
cpi	**c**haracters **p**er **i**nch
cpmm	**c**haracters **p**er **m**ilimetre
DCC	**D**ocument **C**hange **C**ontrol
Dept	**Dep**artment
DG	**D**irector **G**eneral
DGI	**D**igital **G**eographic **I**nformation
DGIWG	**D**igital **G**eographic **I**nformation **W**orking **G**roup
DIA	(US) **D**efense **I**ntelligence **A**gency
DIGEST	**D**igital **G**eographic **I**nformation **E**xchange **S**tandard
DLMS	**D**igital **L**andmass **S**ystem
ECMA	**E**uropean **C**omputer **M**anufacturer's **A**ssociates
FACC	**F**eature and **A**ttribute **C**oding **C**atalog
FIPS PUB	(US) **F**ederal **I**nformation **P**rocessing **S**tandard **Pub**lication
GDS	**G**eo **D**ata **S**et
Geo	**Geo**graphic
HDS	**H**eader **D**ata **S**et
HQ	**H**ead**q**uarters
IA5	**I**nternational **R**eference **A**lphabet **5**
ICAO	**I**nternational **C**ivilian **A**eronautical **O**rganization
ID	**Id**entification
IEEE	**I**nstitute of **E**lectrical and **E**lectronic **E**ngineers
IHO	**I**nternational **H**ydrographic **O**rganization
IMO	**I**nternational **M**aritime **O**rganization
INS	**I**nertial **N**avigation **S**ystem
ISO	**I**nternational **O**rganization for **S**tandardization ("iso" = Greek for "same")

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MC&G	**M**apping, **C**harting, and **G**eodesy
NATO	**N**orth **A**tlantic **T**reaty **O**rganization
NAVAIDS	**Nav**igation **Aids**
NBC	**N**uclear, **B**iological or **C**hemical
OMDIES	**O**cean **M**apping **D**igital **I**nformation **E**xchange **S**tandard
RGB	**r**ed, **g**reen, **b**lue
STANAG	**Stan**dardization **Ag**reement
TBD	**T**o **B**e **D**etermined
TBR	**T**o **B**e **R**esolved
THF	**T**ransmittal **H**eader **F**ile
TSS	**T**raffic **S**eparation **S**cheme
UTM	**U**niversal **T**ransverse **M**ercator
VRF	**V**ector **R**elational **F**ormat
WGS	**W**orld **G**eodetic **S**ystem

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5 FEATURE AND ATTRIBUTE CODING CATALOGUE

Standards for DGI exchange require a standard scheme for documenting features and attributes necessary to distinguish those features commonly found in Mapping, Charting, and Geodesy (MC&G), and GIS, and for the orderly exchange of such data between MC&G organizations.

5.1 USE OF FACC

This fourth part of DIGEST, the Feature and Attribute Coding Catalogue (FACC), provides a common menu of features (Annex A — Feature Codes) and attributes (Annex B — Attribute and Value Codes) along with a standardized coding system. FACC provides additional attribute information in Annex B — Attribute and Value Codes, as to the Units, Formats, Ranges, Increments, and Maximum Text Characters typically associated with each actual value attribute. Where particular applications require the definition of a few specialized features and attributes not yet contained in the FACC, a Data Dictionary may be used (see Part 2 — 6.2). Otherwise, features and attributes shall be encoded using the FACC standard.

FACC provides guidance in Annex C — Features and Associated Attributes, as to which attributes might typically be associated with each feature. It has not been developed to the requirements of any single application, or level of resolution, and in itself cannot support a digital product. For a product, the menus of features and attributes must be employed in concert with a product specification.

5.2 CODING STRUCTURE

The product specification determines, in concert with procedural standards, which features and attributes will be collected as well as defining specific collection criteria such as positional accuracy and feature granularity. FACC provides the coding structure for features and their attributes.

5.2.1 FEATURES

Within FACC, each feature is identified by a unique five-character code. The first character corresponds to the feature category and can have an alphabetic value from A through Z. Currently there are ten feature categories, including one category, S, which has been reserved for dataset-specific features. The categories are as follows:

1st Character	Category
A	Culture
B	Hydrography
C	Hypsography
D	Physiography
E	Vegetation
F	Demarcation

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G	Aeronautical Information
I	Cadastral
S	Special Use (Dataset-specific)
Z	General

Each major category is further divided into subcategories which are identified by the second character of the five-digit code containing an alphabetic value from A through Z. The subcategories that have currently been defined for each major category are as follows:

A — CULTURE

AA	Extraction
AB	Disposal
AC	Processing Industry
AD	Power Generation
AE	Fabrication Industry
AF	Associated Industrial Structures
AG	Commercial
AH	Institutional/Governmental
AI	Residential
AJ	Agriculture
AK	Recreational
AL	Miscellaneous Features
AM	Storage
AN	Transportation — Railroad
AP	Transportation — Roads
AQ	Associated Transportation
AR	Air Traffic Services
AT	Communication/Transmission
AU	Airport

B — HYDROGRAPHY

BA	Coastal Hydro
BB	Ports and Harbors
BC	NAVAIDS
BD	Dangers/Hazards
BE	Depth Information
BF	Bottom Features
BG	Tide and Current Information
BH	Inland Water
BI	Miscellaneous Inland Water
BJ	Snow/Ice

C — HYPSOGRAPHY

CA	Relief Portrayal

D — PHYSIOGRAPHY

DA	Exposed Surface Material
DB	Landforms

E — VEGETATION

EA	Cropland
EB	Rangeland
EC	Woodland
ED	Wetlands
EE	Miscellaneous Vegetation

F — DEMARCATION

FA	Boundaries/Limits/Zones (Topographic)
FB	Boundaries/Limits/Zones (Aeronautical)
FC	Boundaries/Limits/Zones (Hydrographic)

G — AERONAUTICAL INFORMATION

GA	Air Route

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GB Aerodrome

I — CADASTRAL

IA Areas
ID Reference Points
IE Special Characteristics

S — SPECIAL USE (Dataset-specific)

SA Terrain Analysis Dataset
SB Background Display Dataset
SC Transportation and Logistics Dataset
SD Aeronautical Information Dataset
SE Toponymic Dataset
SF Simulation Dataset
SU Dataset Development

Z — GENERAL

ZA Annotation
ZB Control Points
ZC Magnetic Variation
ZD Miscellaneous
ZE Background Features

Finally, the third, fourth, and fifth characters of the five-character feature code are a numeric value from 000 through 999. This value provides unique feature identification within categories yet allows flexibility. All features must be identified by all five alphanumeric characters (for example, the feature "Building" is represented by AL015). Annex A is the listing of features currently identified.

The block of numeric values (of the last three characters of the feature code) from 500 through 899 has been reserved for special (non-FACC) usage, e.g. National use within a particular country.

5.2.2 ATTRIBUTES

Each attribute consists of an Attribute Code and an Attribute Value as described below.

5.2.2.1 ATTRIBUTE CODES

Each attribute is identified by a unique three character alphanumeric code. For example, the attribute "Building Function Code" has the code BFC, and the attribute "Total Usable Width" has the code WD2.

DIGEST differentiates between implicit and explicit attributes. Implicit attribute coding is explained in Part 2 — 12.2.3. Annex B to FACC deals exclusively with explicit attribute coding; the annex defines all the currently identified attributes and lists corresponding attribute values.

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Attribute codes which begin with the letter "X" have been reserved for display attributes. Attribute codes which begin with the letter "Y" have been reserved for special attribution for datasets.

5.2.2.2 ATTRIBUTE VALUES

There are two types of attribute values: coded and actual values. A given attribute has only one type of value, which is specified in Annex B. The units of measurement associated with an attribute are abbreviated according to the units of measurement codes as detailed in DIGEST Part 3—10.

Coded values range from 0 to 999. As an example of a coded value, a hospital would be coded as a building feature (feature code AL015) with an attribute "Building Function Code" (attribute code BFC) having a value equal to "Hospital" (coded value 6). An attribute which has coded values will have an Attribute Value Format of I (integer). Thus, a hospital would be AL015 attributed as follows:

Attribute Code	Attribute Value Format	Attribute Value (coded)
BFC	I	6

The block of coded attribute values from 500 through 899 has been reserved for special (non-FACC) usage, e.g. National use within a particular country.

Actual values can have an Attribute Value Format of either A (Alphanumeric), I (Integer), L (Lexical), R (Real Number) or S (Structured Text). For example, a road (feature code AP030) which has the name "M-4", has four lanes, and is 19.5 meters wide (including hard shoulders), would be attributed as follows:

Attribute Code	Attribute Value Format	Attribute Value (actual)
RTN (route number)	A	M-4
LTN (track/lane number)	I	4
WD2 (total usable width in decimetres)	I	195

Data types or values for lexical default to Lexical level 0 or ASCII. However, when a LEX flag is present, a much wider range of character sets is available and it follows the ISO 10646 set of characters. Lexical values are detailed in DIGEST Part 3—5.

The values for structured text are relegated to a few "low frequency of occurrence" attributes which must be expressed in a non-standard unit. The format for structured text:

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number(unit)[qualifier], where

number is the numeric quantity of the attribute,
unit (see Part 3—10) is enclosed in parentheses ( ), and
qualifier is an expression (such as a rate) which qualifies "unit" and is enclosed in brackets [ ]

For instance, the rate at which aircraft can safely fly according to Minimum Enroute Altitude (MEA) would be attributed as follows:

Attribute Code	Attribute Value Format	Attribute Value (structured)
MEA	S	6000[ft](AMSL)

Where: ft is the code for Feet (Reference DIGEST Part 3-10)
and AMSL equates to "Above Mean Sea Level"

Detailed information for actual value attributes is prescribed in Annex B.

5.3 RULES FOR DOCUMENTING FEATURES/ATTRIBUTES

FACC can be modified and updated to keep pace with the dynamic technology improvements and changing requirements, as it is not tied to any specific database or product line. In this way, it is intended that FACC should be extended so as ultimately to meet the requirements of every application.

This subclause lists the rules that were used to document the features and attributes contained in the Annexes A and B. A basic principle that was observed was that no single geographic entity should be capable of being defined by more than one combination of feature and attribute codes.

Although the coded values for some attributes may be the same, their meaning depends upon the definition of the attribute. For example, the Material Composition Category (MCC) and Product Category (PRO) attributes both contain the values Aluminum, Ash, Asphalt, etc.). For this reason the names of attributes (and features) should be carefully chosen to represent their definition.

The rules used in the definition of FACC are listed below. All additions/modifications shall also follow these rules.

- A feature and attribute shall not have the same name.
- A feature and attribute shall not have the same definition.
- A feature or attribute can have multiple names but only one definition.
- A feature or attribute name shall not be used in the definition of the feature or attribute.

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- Measurements shall not be used in the definition of a feature or attribute.
- A feature name or definition shall not specify if the feature is an area, point, or line feature.
- A feature shall be relatively permanent.
- A feature shall not be duplicated between categories.
- All attribute values are positive unless otherwise stated.
- A boundary is just a geographic object or information that can be considered a line feature and not a perimeter or solid surface of an area or spatial feature.
- The systematic structure of the coding scheme shall be permanent.

The features and attributes in FACC represent geographic information. Other information, not geographic in nature (e.g., the maximum stress which can be supported by the girder of a bridge, or the susceptibility of crops to certain diseases) should be developed and maintained by the requiring party. DGIWG will assist these users in their development by ensuring that conflicts do not arise between FACC and the users' feature/attribute codes. Users should, for the development of their feature/attribute requirements, seek international cooperation and coordination.

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Annex A — Feature Codes

Table of Contents

Code		Page
A — CULTURE		**A-1**
AA — Culture—Extraction		**A-1**
AA010	Mine	A-1
AA011	Quarry/Mine Shear Wall	A-1
AA012	Quarry	A-1
AA013	Pit	A-1
AA040	Rig/Superstructure	A-2
AA050	Well	A-2
AA051	Wellhead	A-2
AA052	Oil/Gas Field	A-2
AB — Culture—Disposal		**A-2**
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Withdrawn/Retirée

Annex A — Feature Codes

A—CULTURE

AA — Culture—Extraction

AA010

An excavation made in the earth for the purpose of extracting natural deposits. (See also AQ090.)

English:	Mine
French:	Mine
German:	Grube/Zeche
Italian:	Miniera
Dutch:	Mijn
Spanish:	Mina

AA011

The wall facing of the excavation within a quarry/mine.

English:	Quarry/Mine Shear Wall
French:	Mur de cisaillement d'une carrière/d'une mine
German:	Abgrabungsfläche/Abbauwand
Italian:	Muro di Tagliata di Miniera/Cava
Dutch:	Steile Kant van Groeve/Afgraving
Spanish:	Cantera

AA012

An excavation created by removal of stone by blasting or cutting.

English:	Quarry
French:	Carrière de pierre
German:	Steinbruch
Italian:	Cava
Dutch:	Groeve
Spanish:	Cantera

AA013

An excavation where gravel, sand, or clay are removed for use elsewhere.

English:	Pit
French:	Carrière de graviers, sables, argiles ...
German:	Sandgrube/Kiesgrube/Tongrube
Italian:	Scavo
Dutch:	Afgraving
Spanish:	Excavación

Withdrawn/Retirée

AA040

A vertical structure fitted for drilling or lifting operations.

English:	Rig/Superstructure
French:	Installation/Superstructure de puits
German:	Bohrturm/Geruest
Italian:	Impianto Perforazione/Sollevamento
Dutch:	Boortoren/Schachttoren
Spanish:	Torre de Perforacion/Superestructura

AA050

A hole drilled into the earth or sea bed for the extraction of liquids or gasses. (See also BH170.)

English:	Well
French:	Puits
German:	Brunnen/Bohrloch
Italian:	Pozzo
Dutch:	Boorput/Aangeboorde Bron
Spanish:	Pozo

AA051

The top of a well, as in oil, gas, or water well, that caps the well structure and which may be located on land or partially submerged offshore which nautical vessels can use for lashings.

English:	Wellhead
French:	Tête de puits
German:	TBD
Italian:	Torre petrolifera
Dutch:	(Onderwater) Boorput
Spanish:	Cabecera de pozo

AA052

An area where oil and/or gas is pumped or otherwise removed from the ground.

English:	Oil/Gas Field
French:	Champ pétrolier ou gazier
German:	Oelfeld/Gasfeld
Italian:	Area di estrazione
Dutch:	Olie/Gasveld
Spanish:	Campo de petróleo/gas

AB — Culture—Disposal

AB000

An area for the collecting/depositing of refuse or discarded material. (See also AB010, AM010, and AM040.)

English:	Disposal Site/Waste Pile
French:	Dépôt d'ordures/Terril
German:	Muellhalde/Muelldeponie
Italian:	Discarica/Ammasso Rifiuti
Dutch:	Vuilstortplaats/Afvalstortplaats/Vuilnisbelt
Spanish:	Vertedero/Escorial/Basurero

Withdrawn/Retiree

AB010

An area or site engaged in the wrecking, dismantling, storage, or resale of discarded products. (See also AB000.)

English:	Wrecking Yard/Scrap Yard
French:	Ferraille/Casse/Dépôt de déchets naturels
German:	Abwrackplatz/Schrottplatz
Italian:	Area Deposito Metalli/Ferraglie
Dutch:	Sloperij/Opslagplaats voor Schroot
Spanish:	Chatarrería/Parque de Desguace

AB020

A permanent structure used for the disposal of waste products by burning.

English:	US—Burner UK—Flare Stack
French:	Foyer de décharge
German:	Müllverbrennungsanlage
Italian:	Inceneritore
Dutch:	Vuilverbrander
Spanish:	Quemador/Mechero

AB021

An artificial installation at or below water level, where liquids (e.g. cooling water, spillage) are spread out.

English:	Diffuser
French:	Diffuseur
German:	TBD
Italian:	Diffusore
Dutch:	(Vuilwater) Verspreider
Spanish:	Difusor/Colector

AC — Culture—Processing Industry

AC000

A site used for changing or refining a particular material.

English:	Processing Plant/Treatment Plant
French:	Usine de traitement ou de transformation
German:	Verarbeitungsbetrieb/Aufbereitungsanlage
Italian:	Impianto di Transformazione/Stabilimento Industria
Dutch:	Fabriek-/Industrie voor Halffabrikaten/Basisindust
Spanish:	Planta Procesadora/Planta de Transformación

AC010

A heat chamber used for smelting iron ore.

English:	Blast Furnace
French:	Haut-fourneau
German:	Hochofen
Italian:	Altoforno
Dutch:	Fabriek/Industrie voor Halffabrikaten/Basisindustrie
Spanish:	Alto Horno

Withdrawn/Retirée

AC020

A unit in which petroleum separation is carried out in the presence of a catalyst.

English:	Catalytic Cracker
French:	Craqueur catalytique
German:	Katalytische Krackanlage
Italian:	Cracker Catalitico
Dutch:	Olieraffinaderij/Kraakinstallatie
Spanish:	Cracker Catalítico

AC030

A site where solid matter is precipitated from a liquid by evaporating or settling.

English:	Settling Basin/Sludge Pond
French:	Bassin de décantation/d' évaporation
German:	Absetzbecken/Schlammteich
Italian:	Bacino di Sedimentazione
Dutch:	Bezinkingsbekken/Verdampingsbassin/Vloeiveld
Spanish:	Planta de decantación/Estanque de sedimentación

AC040

An area involved in the production or distribution of oil or natural gas production.

English:	Oil/Gas Facilities
French:	Industries pétrolières ou gazières
German:	TBD
Italian:	Impianto d'estrazione di petrolio/gas
Dutch:	Olie- en Gasbehandelingsinstallatie
Spanish:	Instalaciones petrolíferas/de gas

AC050

The structures, grounds, machinery etc. of a manufacturing establishment or structures in engineering such as docks, bridges.

English:	Works
French:	Equipements industriels
German:	TBD
Italian:	Cantieri
Dutch:	Fabriek
Spanish:	Obras

AD — Culture—Power Generation

AD010

The building(s) and equipment necessary for the generation of electric power. (See also AD020.)

English:	US—Power Plant UK—Power Station
French:	Centrale électrique
German:	Kraftwerk
Italian:	Centrale Elettrica
Dutch:	Elektriciteits Centrale
Spanish:	Central eléctrica

Withdrawn/Retiree

AD020

Units of solar cells for converting sunlight into electrical energy or heat. (See also AD010.)

English:	Solar Panels
French:	Panneaux solaires
German:	Sonnenkollektoren
Italian:	Pannelli Solari
Dutch:	Zonnepanelen
Spanish:	Paneles solares

AD030

A facility, along a power line route, in which electric current is transformed and/or distributed.

English:	Substation/Transformer Yard
French:	Sous-station/Poste de transformation
German:	Umspannwerk/Unterwerk
Italian:	Sottostazione di Trasformazione/Distribuzione
Dutch:	Transformatorstation/Verdeelstation
Spanish:	Subestación/Transformador

AD040

An apparatus in which a nuclear chain reaction is initiated, sustained, and controlled. (See also AD010.) This code is used to define a nuclear reactor which may be contained within a nuclear reactor.

English:	Nuclear Reactor
French:	Réacteur nucléaire
German:	Kernreaktor
Italian:	Reattore Nucleare
Dutch:	Kernreactor
Spanish:	Reactor nuclear

AE — Culture—Fabrication Industry

No features are currently defined in this sub-category.

AF — Culture—Associated Industiral Structures

AF010

A vertical structure containing a passage or flue for discharging smoke and gases of combustion.

English:	Chimney/Smokestack
French:	Cheminée/Cheminée d'usine
German:	Schornstein/Schlot
Italian:	Ciminiera/Fumaiolo
Dutch:	Schoorsteen/Pijp
Spanish:	Chimenea/Escape de humos

AF020

An apparatus for moving material from place to place on a moving belt or series of rollers. (See also AQ010.)

English:	Conveyor
French:	Convoyeur

Withdrawn/Retiree

German: Foerderanlage
Italian: Sistema Trasportatore/Convogliatore
Dutch: Transportband
Spanish: Cinta transportadora

AF030

A tower used to cool liquids.

English: Cooling Tower
French: Tour de refroidissement
German: Kuehlturm
Italian: Torre di Raffredamento
Dutch: Koeltoren
Spanish: Torre de enfriamiento

AF040

A machine for lifting, shifting, and lowering objects or materials by means of a swinging boom or with the lifting apparatus supported on an overhead track.

English: Crane
French: Grue
German: Kran
Italian: Gru
Dutch: Kraan
Spanish: Grúa

AF041

Comprises two or three spars standing on end and lashed together, aloft. They serve as a derrick or tripod to lift heavy weights, step or lower masts , stacks, etc.

English: Sheerlegs (Shear Legs)
French: Grue de chargement
German: Scherenkran
Italian: Biga/Capra
Dutch: Bok
Spanish: Machina/Cabria

AF050

An excavating machine for removing earth or materials.

English: Dredge/Powershovel/Dragline
French: Drague/Pelle mécanique/Pelleteuse
German: Schwimmbagger/Loeffelbagger/Schuerfkuebelbagger
Italian: Draga/Pala Meccanica/Scavatrice
Dutch: Baggermachine/Bulldozer/Graafmachine
Spanish: Draga/Pala mecánica/Excavadora

AF060

A structure wherein engines are tested.

English: Engine Test Cell
French: Banc d'essai
German: Motorenpruefstand/Triebwerkpruefraum
Italian: Cellula Prova Motori
Dutch: Motorenproefbank/Motorentestbank
Spanish: Banco de pruebas

Withdrawn/Retirée

AF070

An open ended pipe at which waste gases are burned.

English:	Flare Pipe
French:	Torchère
German:	Hochfackel
Italian:	Torcia
Dutch:	Fakkel/Vlampijp
Spanish:	Quemador/Mechero

AF080

A top-loaded funnel-shaped structure for temporary holding of loose material which will be dispensed from its bottom.

English:	Hopper
French:	Trémie
German:	Fuelltrichter
Italian:	Tramoggia
Dutch:	Trechter/Onderlosser
Spanish:	Tolva

AG — Culture—Commercial

No features are currently defined in this sub-category.

AH — Culture—Institutional/Government

AH010

A defensive wall built to defend a fort or other defensive work and sometimes equipped with guns.

English:	Bastion/Rampart/Fortification
French:	Bastion/Rempart/Fortification
German:	Verteidigungswall
Italian:	Bastione
Dutch:	Bastion/Vestingwal/Schans
Spanish:	Bastión/Muralla/Fortificación

AH020

A linear excavation dug for defensive purposes.

English:	Trench
French:	Tranchée/Fossé
German:	Schuetzengraben
Italian:	Trincea
Dutch:	Loopgraaf
Spanish:	Trinchera

AH050

A facility constructed for the military defense of a site. (See also AM060.)

English:	Fortification
French:	Fort
German:	Befestigungsanlage
Italian:	Fortificazione

Withdrawn/Retiree

Dutch:	Fortificatie/Bunker
Spanish:	Fuerte

AH060

An underground facility used by the military either for location of command/control centers or for troop encampment. (See also AL250.)

English:	Underground Bunker
French:	Abri souterrain
German:	Unterirdischer Bunker
Italian:	Bunker sotterraneo
Dutch:	Ondergrondse Bunker
Spanish:	Instalación Subterránea

AH070

An official place to register, declare or check goods and people.

English:	Checkpoint
French:	Poste de contrôle
German:	Überwachungsstelle/Kontrollpunkt
Italian:	Stazione di controllo
Dutch:	Controlepost
Spanish:	Aduana/Punto de control

AI — Culture—Residential

AI020

A site for the permanent parking of trailor(s) used as dwellings and designed without a permanent foundation. (See also AK060 and AQ140.)

English:	US—Mobile Home/Mobile Home Park UK—Caravan/Caravan Park/Mobile Home/Mobile Home Park
French:	Parc pour caravanes
German:	Mobil-Heim/Mobil-Heim-Park
Italian:	Parcheggio Roulotte/Case Mobili
Dutch:	Caravanpark/Woonwagencentrum
Spanish:	Caravana/Casa móvil/Aparcamiento de caravanas

AI030

A place where tents or buildings serve as temporary residences for members of an organization.

English:	Camp
French:	Camp
German:	Lager
Italian:	Campo/Attendaggio
Dutch:	Kamp/Kampement
Spanish:	Campamento

AJ — Culture—Agriculture

AJ010

An elevated irrigation system revolving around a central pivot point.

English:	Circular Irrigation System

Withdrawn/Retirée

French: Système circulaire d'irrigation
German: Kreisregner
Italian: Sistema di Irrigazione Circolare
Dutch: Cirkelvormige Irrigatie-installatie/Sproeikanon
Spanish: Sistema de irrigación circular

AJ020

Bent or curved tube so arranged that liquid flows up or down through it under the force of gravity.

English: Siphon
French: Siphon
German: Siphon
Italian: Sifone
Dutch: Sifon/Zinker/Grondduiker
Spanish: Sifón

AJ030

An enclosed area in which livestock are temporarily kept.

English: Feed Lot/Stockyard/Holding Pen
French: Enclos/Parc à bestiaux/Poulailler
German: Viehhof/Pferch/Mastplatz
Italian: Area Recintata per Bestiame
Dutch: Veebewaarplaats/Veekraal
Spanish: Establo/Majada/Redil/Corral

AJ050

A wind-driven system of vanes attached to a tower like structure (excluding wind-generated power plants).

English: Windmill
French: Moulin à vent
German: Windmuehle
Italian: Mulino a Vento
Dutch: Windmolen
Spanish: Molino de viento

AJ051

A modern structure for use of wind power.

English: Windmotor
French: Eolienne
German: Windgenerator
Italian: Aeromotore
Dutch: Energiemolen/Windturbine
Spanish: Motor eólico

AK — Culture—Recreational

AK020

A large structure located in an Amusement Park.

English: Amusement Park Attraction
French: Manège de parc d'attractions

Withdrawn/Retirée

German:	Vergnuegungsparkattraktion
Italian:	Struttura di Parco Divertimenti
Dutch:	Pretpark-attractie
Spanish:	Atracción de feria/Tiovivo

AK030

A predominately man-made facility equipped with recreational devices. (See also AK090 and AK120.)

English:	Amusement Park
French:	Parc de loisirs
German:	Vergnuegungspark/Freizeitpark
Italian:	Parco Divertimenti
Dutch:	Pretpark/Recreatiepark
Spanish:	Parque de atracciones

AK040

An open area where sporting events, exercises, or games occur.

English:	US—Athletic Field UK—Athletic Field/Sports Field/Playing Field
French:	Terrain de sport
German:	Sportplatz
Italian:	Campo Sportivo
Dutch:	Sportpark/Sportterrein/Sportveld
Spanish:	Campo de deportes/Campo de juegos

AK050

An area or site used for the sport of tennis.

English:	Tennis Court(s)
French:	Court de tennis
German:	Tennisplatz (plaetze)
Italian:	Campo di Tennis
Dutch:	Tennisbaan/Tennispark
Spanish:	Pista(s) de tenis

AK060

A location for camping. (See also AI020 and AQ140.)

English:	Campground/Campsite
French:	Terrain de camping/Camping
German:	Campingplatz/Zeltplatz
Italian:	Campeggio
Dutch:	Camping/Kampeerterrein
Spanish:	Camping

AK061

A parcel of land that has picnic tables for public use.

English:	Picnic Site
French:	Aire de pique-nique
German:	Picknickplatz
Italian:	Area picnic
Dutch:	Picnicplaats
Spanish:	Zona de picnic

Withdrawn/Retirée

AK070

A place where motion pictures are shown while viewers remain in their vehicles.

English:	US—Drive In Theater UK—Drive In Theatre
French:	Cinéma en plein air
German:	Autokino
Italian:	Drive-In
Dutch:	Drive-In-Bioscoop
Spanish:	Cine para vehículos/Autocine

AK080

A large outdoor screen for showing motion pictures.

English:	US—Drive In Theater Screen UK—Drive In Theatre Screen
French:	Ecran de cinéma en plein air
German:	Autokinoprojektionswand
Italian:	Schermo per Drive-In
Dutch:	Projectiescherm van Drive-In-Bioscoop
Spanish:	Pantalla de cine al aire libre

AK090

An area where permanent facilities exist to hold outdoor fairs, circuses or exhibitions. (See also AK030 and AK120.)

English:	Fairgrounds
French:	Champs de foire
German:	Messegelaende/Vergnuegungsplatz/Festplatz
Italian:	Area per Esposizioni
Dutch:	Beursterrein/Circusterrein/Kermisterrein
Spanish:	Recinto ferial

AK091

An area where permanent facilities exist to hold outdoor exhibitions. (See also AK030, AK090 and AK120.)

English:	Exhibition Grounds
French:	Parc d' exposition
German:	Ausstellungsgelände
Italian:	Area per pubbliche attrazioni
Dutch:	Tentoonstellingsterrein
Spanish:	Ferial

AK100

An area of land laid out for the game of golf.

English:	Golf Course
French:	Terrain de golf
German:	Golfplatz
Italian:	Campo di Golf
Dutch:	Golfbaan
Spanish:	Campo de golf

AK101

A parcel or tract of land used for practicing golf shots.

English:	Golf Driving Range

Withdrawn/Retirée

French: Parcours de golf
German: TBD
Italian: Campo di Golf
Dutch: Golfterrein
Spanish: Zona de entrenamiento de golf

AK110

A usually roofed structure for special viewing of events and having tiers of seats or standing room for spectators.

English: Grandstand
French: Tribune
German: Sitztribuene (ueberdacht)
Italian: Tribuna d'Onore
Dutch: Tribune
Spanish: Tribuna

AK120

An area used for recreational or ornamental purposes. (See also AK030, AK090, and AL170.)

English: Park
French: Parc
German: Park
Italian: Parco/Giardino
Dutch: Park/Plantsoen
Spanish: Parque

AK121

An area, generally an elevated place, with facilities for observing the scenery.

English: Lookout
French: Point de vue
German: Aussichtspunkt
Italian: Punto panoramico
Dutch: Uitkijk(post)
Spanish: Vistas panorámicas/Mirador

AK130

A course for racing.

English: US—Race Track UK—Race Track/Race Course
French: Piste de course
German: Rennbahn
Italian: Pista per Corsa
Dutch: Renbaan
Spanish: Circuito de carreras

AK150

A ramp used for ski jumping.

English: Ski Jump
French: Tremplin de ski
German: Sprungschanze
Italian: Trampolino da Sci
Dutch: Ski-springschans
Spanish: Trampolín de esquí

Withdrawn/Retirée

AK155

A course prepared for skiing.

English:	Ski Track
French:	Piste de ski
German:	Ski-Abfahrt
Italian:	Pista da Sci
Dutch:	Ski-piste
Spanish:	Pista de esquí

AK160

An arena for holding and viewing events.

English:	US—Stadium/Amphitheater UK—Stadium/Amphitheatre
French:	Stade/Amphithéâtre
German:	Stadion/Amphitheater
Italian:	Stadio/Anfiteatro
Dutch:	Stadion/Amfitheater
Spanish:	Estadio/Anfiteatro

AK170

A constructed basin used for swimming outdoors.

English:	Swimming Pool
French:	Piscine
German:	Freibad-Schwimmbecken
Italian:	Piscina
Dutch:	Openluchtzwembad
Spanish:	Piscina

AK180

An area with a collection of live animals usually for public display.

English:	Zoo/Safari Park
French:	Zoo/Parc animalier
German:	Zoo/Safaripark
Italian:	Zoo/Parco Safari
Dutch:	Dierentuin/Safaripark
Spanish:	Zoo/Safari Park

AL — Culture—Miscellaneous Features

AL005

A natural area set aside for the preservation and protection of wildlife.

English:	Animal Sanctuary
French:	Réserve animale
German:	Wildrescravat
Italian:	Riserva naturale
Dutch:	Wildreservaat
Spanish:	Reserva de animales

Withdrawn/Retirée

AL012

A site or location where remains of ancient civilizations or human activity have been discovered. (See also AL200.)

English:	Archeological Site
French:	Site archéologique
German:	Ausgrabungsstaette
Italian:	Area Archeologica
Dutch:	Archeologische Vindplaats/Opgraving
Spanish:	Restos arqueológicos

AL015

A relatively permanent structure, roofed and usually walled and designed for some particular use. (See also AL100.)

English:	Building
French:	Bâtiment
German:	Gebaeude
Italian:	Edificio/Costzuzione
Dutch:	Gebouw
Spanish:	Edificio

AL018

A supplemental portion of a building which rises from the roof but is not considered part of the general roof line.

English:	Building Superstructure Addition
French:	Superstructure ajoutée au bâtiment
German:	Dachaufbau
Italian:	Sovrastrut Aggiunt Edificio
Dutch:	Opbouw op Gebouw
Spanish:	Estructura anexa a un edificio

AL019

A storage facility usually characterized by one or more open sides, support pillars and a roof.

English:	Shed
French:	Hangar
German:	Schuppen(offen)
Italian:	Tettoia/Capannone
Dutch:	Kapschuur
Spanish:	Hangar/Nave

AL020

An area containing a concentration of buildings and other structures.

English:	Built-Up Area
French:	Zone bâtie
German:	Bebautes Gebiet
Italian:	Area Edificata/Centro Abitato
Dutch:	Bebouwd Gebied
Spanish:	Area edificada/Urbanización/Casco urbano

Withdrawn/Retirée

AL025

A heap of stones piled up as a memorial or a landmark. (See also AL090, and AL130.)

English:	Cairn
French:	Cairn
German:	Steinhaufen/Huegelgrab
Italian:	Tumulo
Dutch:	Steenhoop/Hunebed
Spanish:	Mojón/Muga

AL030

An area of land for burying the dead.

English:	US—Cemetery UK—Cemetery/Graveyard
French:	Cimetière
German:	Friedhof
Italian:	Cimitero
Dutch:	Begraafplaats
Spanish:	Cementerio/Camposanto

AL040

A dwelling built in the recesses of cliffs. (See also AL250.)

English:	Cliff Dwelling
French:	Habitation troglodyte
German:	Hoehlenwohnung
Italian:	Abitazione in Caverna
Dutch:	Grotwoning
Spanish:	Cueva en escarpado

AL045

An outline delimiting an area in which two or more like features have the same function.

English:	Complex Outline
French:	Groupe d'objets
German:	TBD
Italian:	Limite di area occupata da oggetti simili
Dutch:	Complexbegrenzing
Spanish:	Límite de entidad compuesta

AL050

An upright panel used to convey visual information. (See also AL080.)

English:	US—Display Sign UK—Display Sign/Notice Board
French:	Panneau d'affichage
German:	Hinweisschild/Anzeigetafel
Italian:	Cartello Segnaletico
Dutch:	Informatiebord/Wegwijzer
Spanish:	Anuncio/Valla publicitaria/Tablón de aviso/Cartel

Withdrawn/Retirée

AL060

Regularly spaced concrete or metal barriers laid in single or multiple rows to prevent vehicle movement.

English:	Dragon Teeth
French:	Barrières antichar
German:	Panzersperre
Italian:	Barriera Anticarro
Dutch:	Tankversperring/Wegversperring
Spanish:	Obstáculo anticarro

AL070

A man-made barrier of relatively light structure used as an enclosure or boundary. (See also AL260.)

English:	Fence
French:	Clôture
German:	Zaun
Italian:	Recinzione/Palizzata
Dutch:	Hek/Afrastering
Spanish:	Cerca/Valla/Empalizada

AL073

A staff or pole on which a flag is raised.

English:	Flagstaff/Flagpole
French:	Mât de drapeau
German:	Flaggenmast
Italian:	Asta della bandiera
Dutch:	Vlaggemast
Spanish:	Mástil

AL075

A sunken or cut passageway along a transportation route in mountainous regions constructed to protect vehicles from the elements. A series of openings on one side may be present for light or ventilation.

English:	Gallery
French:	Galerie pare-rocher/pare-avalanche
German:	Schutzgalerie
Italian:	Galleria
Dutch:	(Overdekte) Ingraving
Spanish:	Galería/Túnel lateral

AL080

A frame structure raised on side supports so as to span over or around something. (See also AL050.)

English:	Gantry
French:	Portique
German:	Geruest
Italian:	Incastellatura per Segnaletica
Dutch:	Stelling/Portaal
Spanish:	Andamio

Withdrawn/Retirée

AL090

A marker indicating an individual grave site. (See also AL025 and AL130.)

English:	US—Grave Marker UK—Grave Marker/Tombstone
French:	Pierre tombale
German:	Grabmarkierung
Italian:	Pietra Tombale
Dutch:	Grafzerk/Grafsteen
Spanish:	Lápida/Tumba

AL100

A small simple or crude house or shelter. (See also AL015.)

English:	Hut
French:	Hutte
German:	Huette
Italian:	Capanna/Baracca/Baita
Dutch:	Hut/Schuur
Spanish:	Cabaña/Barraca/Refugio

AL101

A building in a remote or wilderness area.

English:	Cabin
French:	Cabane
German:	TBD
Italian:	Capanna
Dutch:	Hut
Spanish:	Caseta aislada

AL105

A concentration of small dwellings.

English:	Settlement
French:	Groupement de petites habitations
German:	Siedlung
Italian:	Insediamento (Nucleo Abitato)
Dutch:	Nederzetting
Spanish:	Poblado/Aldea

AL110

A structure serving as a support for lighting.

English:	US—Light Standard/Light Support UK—Light Standard/Light Support/Lamp Post
French:	Lampadaire
German:	Laternenpfahl/Lichtmast/Tiefstrahler
Italian:	Lampione/Supporto per Faro
Dutch:	Lantaarnpaal/Lichtmast/Schijnwerper
Spanish:	Farola

AL116

A structure, mounted on a pedestal, composed of an upright member with a shorter horizontal member centered at approximately two thirds of the height of the upright member.

English:	Calvary Cross

Withdrawn/Retirée

French:	Calvaire
German:	Wegekreuz/Gipfelkreuz
Italian:	Crocifisso/Croce
Dutch:	Kruis
Spanish:	Cruz caballera

AL120

An area with related facilities for storing and launching missiles.

English:	Missile Site
French:	Site de missiles
German:	Flugkoerperstellung
Italian:	Base Missilistica
Dutch:	Lanceerterrein/Raketbasis
Spanish:	Base de misiles

AL130

A structure erected or maintained as a memorial to a person or event. (See also AL025 and AL090.)

English:	US—Monument UK—Monument/Folly
French:	Monument commémoratif
German:	Denkmal
Italian:	Monumento
Dutch:	Gedenkteken/Monument
Spanish:	Monumento

AL135

A concentration of native dwellings, generally of the hut type, which are not usually of substantial construction.

English:	Native Settlement
French:	Groupement d'habitations autochtones
German:	Eingeborenendorf
Italian:	Villaggio di capanne
Dutch:	Hutten van Inboorlingen/Nederzetting
Spanish:	Asentamiento nativo

AL140

An apparatus for imparting high velocities to charged particles.

English:	Particle Accelerator
French:	Accélérateur nucléaire
German:	Teilchenbeschleuniger
Italian:	Acceleratore di Particelle
Dutch:	Deeltjesversneller
Spanish:	Acelerador de partículas

AL141

An apparatus used for observing distant objects or phenomena.

English:	Telescope
French:	Télescope
German:	Teleskop
Italian:	Telescopio
Dutch:	Telescoop

Withdrawn/Retirée

Spanish: Telescopio

AL155

An undelineated obstruction location such as underpasses, overhead pipelines, building overhangs, and other covered traveled ways.

English: Overhead Obstruction Location
French: Obstacle en surplomb
German: Ort Mitbegremzter Durchfalirtshöhe
Italian: Ostacolo al Movimento in Altezza
Dutch: Beperkte Doorgangshoogte
Spanish: Localización de obstáculos elevados

AL170

An open area which serves as a public square in a city or town. (See also AK120.)

English: Plaza/City Square
French: Place/Jardin public
German: Platz/Plaza
Italian: Piazza
Dutch: Plein
Spanish: Plaza

AL195

An inclined plane usually man-made for moving between two levels. (See also BB240.)

English: Ramp
French: Rampe d'accès
German: Rampe
Italian: Rampa
Dutch: Helling/Laadhelling
Spanish: Rampa

AL200

The deteriorated remains of an unspecified structure. (See also AL012.)

English: Ruins
French: Ruines
German: Ruinen
Italian: Rovine/Diruti
Dutch: Ruïne
Spanish: Ruinas

AL201

Site or area declared to be of national or provincial historical significance or interest, maintained for the public.

English: Historic Site/Point of Interest
French: Site historique
German: Historische Sehenswürdigekeit
Italian: Luogo storico
Dutch: Historische Plaats
Spanish: Lugar de interés histórico

Withdrawn/Retirée

AL210

A shelter built to protect a section of road or railroad from snow/rock slides.

English:	Snow Shed/Rock Shed
French:	Pare-neige/Pare-rochers
German:	Schneeschutzdach/Steinschutzdach
Italian:	Sbarramenti Antineve/Caduta Massi
Dutch:	Lawineluifel
Spanish:	Barrera antialud/Muro de contención

AL220

A structure usually ending in a sharp point and which may be erected on a roof of a building.

English:	US—Steeple UK—Steeple/Spire
French:	Clocher
German:	Spitzturm/Dachturm
Italian:	Campanile/Guglia
Dutch:	Dakruiter/(Toren-)Spits
Spanish:	Campanario/Aguja de torre

AL240

A relatively tall structure which may be used for observation, support, storage, etc. (See also AF030, AM080, AQ060, and BI050.)

English:	Tower (Non- communication)
French:	Tour (transmission exceptée)
German:	Turm (Ausser Fernmelde)
Italian:	Torre (Non per Communicazioni)
Dutch:	Toren (Niet voor Telecommunicatie)
Spanish:	Torre (no de comunicaciones)

AL241

A relatively tall structure of undefined purpose.

English:	Tower (General)
French:	Tour
German:	Turm
Italian:	Torre
Dutch:	Toren
Spanish:	Torre

AL250

Underground living quarters. (See also AL040.)

English:	Underground Dwelling
French:	Habitation souterraine
German:	Unterirdische Wohnstaette/Wohnhoehle
Italian:	Abitazione Sotterranea
Dutch:	Ondergrondse Woning/Ondergrondse Leefruimte
Spanish:	Vivienda subterránea

Withdrawn/Retiree

AL260

A solid man-made barrier of heavy material used as an enclosure or boundary or for protection. (See also AL070.)

English:	Wall
French:	Mur
German:	Mauer/Schallschutzwand
Italian:	Muro
Dutch:	Muur
Spanish:	Muro/Tapia

AM — Culture—Storage

AM010

An area used for the storage of products or supplies. (See also AB000.)

English:	Depot (Storage)
French:	Dépôt (stockage)
German:	Lager/Depot
Italian:	Deposito (Generico)
Dutch:	Depot (Opslagterrein)
Spanish:	Depósito (almacenaje)

AM020

An enclosed container, used for storing grain or fodder.

English:	Grain Bin/Silo
French:	Silo
German:	Getreidesilo/Silo
Italian:	Contenitore Cereali/Silo
Dutch:	Graansilo
Spanish:	Silo

AM030

A tall structure, equipped for loading, unloading, processing and storing grain.

English:	Grain Elevator
French:	Elévateur à grains
German:	Getreidespeicher
Italian:	Sollevatore per Grano
Dutch:	Graanelevator
Spanish:	Elevador para cereales

AM031

An open area for the storage of wooden lumber and timbers.

English:	Timber Yard
French:	Zone de stockage de bois
German:	Holzlagerplatz
Italian:	Deposito di legname
Dutch:	Houtopslag
Spanish:	Almacenamiento madereroAP041

Withdrawn/Retirée

AM040

A man-made heap of mining or quarrying products excluding waste materials. (See also AB000.)

English:	US—Mineral Pile UK—Mineral Pile/Mineral Tip
French:	Dépôt de minerai
German:	Mineralhalde
Italian:	Deposito di Minerali
Dutch:	Hoop Delfstoffen
Spanish:	Depósito de minerales

AM060

A structure which may be covered or surrounded with earth which is resistant to ordnance where materials or products are stored. (See also AH050.)

English:	Storage Bunker/Storage Mound
French:	Stockage souterrain ou semi-enterré
German:	Vorratsbunker
Italian:	Bunker/Deposito Interrato
Dutch:	Opslagbunker/Voorraadput
Spanish:	Depósito enterrado/Bunker de almacenaje

AM070

A container used for the storage of liquids or gases.

English:	Tank
French:	Citerne
German:	Tank
Italian:	Serbatoio/Cisterna
Dutch:	Tank/Gashouder
Spanish:	Cisterna/Tanque/Algibe/Cuba/Gasómetro

AM080

An elevated container and its supporting structure used to hold water.

English:	Water Tower
French:	Château d'eau
German:	Wasserturm
Italian:	Torre Serbatoio
Dutch:	Watertoren
Spanish:	Depósito elevado de agua

AN — Culture—Transportation—Railroad

AN010

A rail or set of parallel rails on which a train or tram runs. (See also AN090.)

English:	US—Railroad UK—Railway
French:	Voie de chemin de fer
German:	Eisenbahn (1 oder mehrschienig)
Italian:	Ferrovia/Tranvia
Dutch:	Spoorweg
Spanish:	Vía de ferrocarril

Withdrawn/Retirée

AN050

A stretch of railroad tracks connected to the main track by switch(es) — used for temporary storage and loading/unloading.

English:	US—Railroad Siding/Railroad Spur UK—Railway Siding/Railway Spur
French:	Voie de garage ou d' evitement
German:	Nebengleis/Stichgleis
Italian:	Binari Parcheggio/Carico
Dutch:	Zijspoor
Spanish:	Espolón ferroviario

AN060

A system of tracks within defined limits, and associated features, provided for loading/unloading and assembling trains.

English:	Railroad Yard/Marshalling Yard
French:	Gare de triage
German:	Rangierbahnhof
Italian:	Piazzale/Sistema di Smistamento, Carico/Scarico
Dutch:	Rangeerterrein
Spanish:	Patio ferroviario

AN075

A rotating platform with railroad track used for turning locomotives or cars/carriages.

English:	US—Railroad Turntable UK—Railway Turntable
French:	Plateforme tournante
German:	Drehscheibe
Italian:	Piattaforma Ferroviaria Rotante
Dutch:	Draaischijf
Spanish:	Plataforma giratoria

AP — Culture—Transportation—Road

AP010

An unimproved roadway.

English:	Cart Track
French:	Chemin d'exploitation
German:	Feldweg/Waldweg
Italian:	Carrareccia
Dutch:	Landweg/Bospad
Spanish:	Camino carretero

AP020

A connection designed to provide traffic access from one road to another.

English:	US—Interchange UK—Interchange/Complex Junction
French:	Echangeur routier
German:	Autobahnkreuz/Autobahnzufahrt
Italian:	Svincolo
Dutch:	Kruising
Spanish:	Cruce de carretera

Withdrawn/Retirée

AP030

An open way maintained for vehicular use.

English:	Road
French:	Route
German:	Strasse
Italian:	Strada/Autostrada
Dutch:	Weg/Straat
Spanish:	Ruta

AP040

A barrier which controls passage to a road, railroad, tunnel, or bridge.

English:	Gate
French:	Poste de péage
German:	Sperre/Barriere/Schranke
Italian:	Barriera Pedaggio/Sbarramento
Dutch:	Slagboom/Poort
Spanish:	Barrera

AP041

A permanent obstruction placed across a route to prevent vehicular traffic.

English:	Barrier
French:	Barrière
German:	Sperre
Italian:	Barriera
Dutch:	Barrière
Spanish:	Barrera

AP050

A path worn by the passage of people or animals.

English:	US—Trail UK—Trail/Footpath
French:	Piste
German:	Pfad
Italian:	Sentiero/Mulattiera
Dutch:	Pad
Spanish:	Sendero

AP060

Wide track on the land's surface due to the regular movement of animal herds (e.g. sheep, cattle).

English:	Drove
French:	Draille/Passage de troupeaux
German:	Viehtrift
Italian:	Tratturo
Dutch:	Vee-route
Spanish:	Cañada

Withdrawn/Retirée

AQ — Culture—Associated Transportation

AQ010

Cables which are strung between elevated supports as part of a conveyor system on which cars, buckets, or other carrier units are suspended. (See also AF020.)

English:	US—Aerial Cableway Lines/Ski Lift Lines UK—Aerial Cableway Lines/Ski Lift Cables
French:	Ligne de téléphérique/Remonte-pente/Transport par câble aérien
German:	Seilbahnseil/Skiliftseil
Italian:	Impianto a Fune/Sciovia
Dutch:	Kabelbaan
Spanish:	Teleférico/Telesilla/Línea de transporte por cable

AQ020

A tower supporting steel cables which convey cars, buckets, or other suspended carrier units.

English:	Aerial Cableway Pylon/Ski Pylon
French:	Pylône de téléphérique/Remonte-pente/Transport par câble aérien
German:	Seilbahnstuetzmast/Skiliftmast
Italian:	Pilone Impianto a Fune/Sciovia
Dutch:	Kabelbaanmast
Spanish:	Pilón soporte de cables de transporte aéreo

AQ021

A straight piece of timber or a hollow cylinder of wood or metal set up vertically, or nearly so.

English:	Mast
French:	Mât
German:	Mast
Italian:	Legname accatastato verticalmente
Dutch:	Mast/Paal
Spanish:	Poste/Mástil

AQ030

A walkway made of wooden planks. (See also BB140.)

English:	US—Boardwalk UK—Wooden Causeway
French:	Trottoir/Promenade en planches
German:	Plankenweg
Italian:	Pontile/Pedanca/Passerella
Dutch:	Vlonder/Planken Wandelweg
Spanish:	Pasarela

AQ040

A man-made structure spanning and providing passage over a body of water, depression, or other obstacles.

English:	Bridge/Overpass/Viaduct
French:	Pont/Passerelle/Viaduc
German:	Bruecke/Ueberfuehrung/Viadukt
Italian:	Ponte/Cavalcavia/Viadotto
Dutch:	Brug/Viaduct
Spanish:	Puente/Viaducto/Paso elevado

Withdrawn/Retirée

AQ045

A section of the bridge deck between successive supports such as pillars, piers, or abutments.

English:	Bridge Span
French:	Travée de pont
German:	Brueckenfeld
Italian:	Campata di Ponte
Dutch:	Overspanning
Spanish:	Vano de puente/Luz de puente

AQ050

Those elements of the bridge structure which are above the lowest deck. (See also AQ055.)

English:	Bridge Superstructure
French:	Superstructure de pont
German:	Brueckenpfeifer/Brueckenmast
Italian:	Sovrastruttura di Ponte
Dutch:	Brug-bovenbouw
Spanish:	Superestructura de puente/Capa de rodadura

AQ055

A tower or pylon from which a bridge's deck is suspended.

English:	Bridge Tower/Bridge Pylon
French:	Tour de pont/Pylône de pont
German:	Brückenpylon
Italian:	Pilone di sostegno (a tensione)
Dutch:	Pyloon/Pijler
Spanish:	Pilón/Torre de puento

AQ056

The support(s) in the form of pillar(s) or abutment(s) for the spans of a bridge.

English:	Bridge Pier
French:	Pile de pont
German:	TBD
Italian:	Spalla del ponte
Dutch:	Brugondersteuning
Spanish:	Pillar de puente

AQ058

A point where a passage way narrows or expands beyond its normal width.

English:	Constriction/Expansion
French:	Resserrement/Elargissement
German:	Engstelle/Erweiterung
Italian:	Strozzatura/Allargamento
Dutch:	Versmalling/Verbreding
Spanish:	Estrechamiento/Ensanchamiento

AQ060

A tower-like structure that houses the persons and equipment used to control the flow of air, rail, or marine traffic. (See also AL240.)

English:	Control Tower
French:	Tour de contrôle

Withdrawn/Retiree

German: Kontrollturm/Stellwerk
Italian: Torre di Controllo
Dutch: Controletoren
Spanish: Torre de control

AQ062

A point where two or more line features intersect or cross at the same level about which information is required. (See also BH070.)

English: US—Crossing UK—Crossing/Level Crossing
French: Croisement
German: Kreuzung
Italian: Incrocio/Passaggio a Livello
Dutch: Galijkvloerse Kruising
Spanish: Cruce/Paso a nivel

AQ064

A raised roadway of solid structure built primarily to provide a route across wet ground or intertidal area.

English: Causeway
French: Chaussée
German: TBD
Italian: Strada rialzata su terreno acquitrinoso
Dutch: Dam/Verhoogde Weg
Spanish: Carretera sobre dique

AQ065

A sewer or drain crossing under a road, track, or embankment, without affecting the construction of the crossed feature.

English: Culvert
French: Buse d'ecoulement
German: Durchlass
Italian: Tombino
Dutch: Duiker
Spanish: Tajea/Alcantarilla

AQ070

A route in a body of water where a ferry crosses from one shoreline to another.

English: Ferry Crossing
French: Voie de passage de bac
German: Faehrlinie
Italian: Traghetto
Dutch: Veerroute
Spanish: Ruta de barco

AQ080

A point where a ferry takes on or discharges its load.

English: Ferry Site
French: Gare de ferry
German: Faehrstelle
Italian: Attracco Traghetto
Dutch: Veerkade

Withdrawn/Retirée

Spanish: Muelle/Amarradero

AQ090

A point of entrance or exit. (See also AA010 and AQ130.)

English: Entrance/Exit
French: Entrée/Sortie
German: Eingang/Ausgang/Zugang
Italian: Entrata/Uscita
Dutch: Ingang/Uitgang
Spanish: Entrada/Salida

AQ100

A marker which designates the distance from a given point, or a location.

English: US—Landmark Post/Distance Post
UK—Landmark Post/Distance Post/Milestone
French: Borne kilométrique
German: Kilometerstein/Meilenstein
Italian: Pietra Chilometrica
Dutch: Kilometerpaal
Spanish: Hito kilómetro

AQ110

A tower-like structure used to secure an airship.

English: Mooring Mast
French: Mât d'amarrage pour dirigeable
German: Ankermast
Italian: Torre Ormeggio Dirigibili
Dutch: Ankermast/Landingsmast
Spanish: Torre de amarre para dirigibles

AQ111

Site on a river or canal which has ramp, piling, and/or pier structures constructed on one or both shores to allow for suitable future crossing operations using floating bridge or rafting equipment.

English: Prepared Raft or Float Bridge Site
French: Berge aménagée pour pont flottant
German: Ersatzuebergangsstelle
Italian: Attracco per Ponti Galleggianti
Dutch: Veerstoep
Spanish: Puente flotante o sobre pontones

AQ113

A tube for the conveyance of solids, liquids or gases.

English: Pipeline/Pipe
French: Pipe-line/Conduit
German: Pipeline/Rohrleitung
Italian: Oleodotto/Gasdotto/Metanodotto
Dutch: Pijpleiding
Spanish: Tubería/Conducción

Withdrawn/Retirée

AQ116

A facility to move solids, liquids or gases by means of pressure or suction.

English:	Pumping Station
French:	Station de pompage
German:	Pumpstation
Italian:	Stazione di Pompaggio
Dutch:	Pompstation
Spanish:	Estación de bombeo

AQ118

A curve which may cause transportation restrictions.

English:	US—Sharp Curve(s) UK—Sharp Bend(s)
French:	Virage serré/Epingle à cheveux
German:	Scharfe Kurve
Italian:	Tornante
Dutch:	Scherpe Bocht
Spanish:	Curva peligrosa

AQ120

Location along any given traveled way where the percent (%) slope (ratio of change in elevation (vertical distance) to horizontal ground distance multiplied by 100) is high enough to slow, hinder, or even stop movement.

English:	Steep Grade
French:	Section à forte pente
German:	TBD
Italian:	Forte pendenza
Dutch:	Stijlehelling
Spanish:	Tramo de pendiente

AQ125

A stopping place for the transfer of passengers and/or freight.

English:	Station (Miscellaneous)
French:	Gare (diverse)
German:	Station/Haltestelle
Italian:	Stazione (Generica)
Dutch:	Station (diverse)
Spanish:	Estación (genérica)

AQ130

An underground or underwater passage, open at both ends, and usually containing a road or railroad. (See also AQ090.)

English:	Tunnel
French:	Tunnel
German:	Tunnel
Italian:	Galleria/Tunnel/Sottopassaggio
Dutch:	Tunnel
Spanish:	Túnel

Withdrawn/Retirée

AQ135

A roadside place usually having facilities for people and/or vehicles.

English:	US—Vehicle Stopping Area/Rest Area
	UK—Vehicle Stopping Area/Rest Area/Lay By
French:	Aire d'arrêt pour véhicules/Aire de repos
German:	Rastplatz
Italian:	Area Sosta/Servizio Veicoli
Dutch:	Parkeerplaats
Spanish:	Area de descanso/Area de servicio

AQ140

An open land area used for storing or parking vehicles or vessels (including recreational vehicles). (See also AI020 and AK060.)

English:	US—Vehicle Storage/Parking Area
	UK—Vehicle Storage/Parking Area/Car Park/Boat Park
French:	Aire de stockage de véhicules/Parking
German:	Parkplatz/Fahrzeugabstellplatz/Schiffslagerplatz
Italian:	Deposito/Parcheggio Autoveicoli
Dutch:	Parkeerterrein/Boot-stalling
Spanish:	Aparcamiento/Parking/Embarcadero

AQ150

A series of steps or stairs reaching from one level to another.

English:	Flight of Steps
French:	Escalier/Terrasse
German:	Freitreppe
Italian:	Scalinata
Dutch:	Trap/Bordes
Spanish:	Escaleras/Escalinatas

AR— Culture—Air Traffic Services

No Features are currently defined in this sub-subcategory. See sub-category GA.

AT — Culture—Communications/Transmission

AT005

An insulated wire, or group of wires, formed into one continuous strand, located underground or underwater. (See also AT030.)

English:	Cable
French:	Câble
German:	Kabel
Italian:	Cavo
Dutch:	Kabel
Spanish:	Cable

AT010

A concave object used for transmitting or receiving electronic signals.

English:	US—Disk/Dish UK—Disk Aerial/Dish Aerial
French:	Disque/Antenne parabolique

Withdrawn/Retirée

German: Parabolantenne/Antennenschuessel
Italian: Antenna Parabolica
Dutch: Schotelantenne/Paraboolantenne
Spanish: Antena parabólica

AT020

An installation utilizing long range radar to detect approaching aircraft or missiles.

English: Early Warning Radar Site
French: Station de radar d'alerte avancée
German: Fruehwarnradareinrichtung
Italian: Postazione Radar Avvistamento Lontano
Dutch: Radarwaarnemingsstation
Spanish: Estación de radar

AT030

A system of above ground wires including their supports, which transmits electricity over distance. (See also AT005.)

English: Power Transmission Line
French: Ligne de transport d'énergie/Ligne électrique
German: Hochspannungsleitung
Italian: Elettrodotto
Dutch: Hoogspanningsleiding (Bovengronds)
Spanish: Línea eléctrica

AT040

A pylon or pole used to support a power transmission line.

English: US—Power Transmission Pylon UK—Power Transmission Pylon/Pole
French: Pylône ou poteau électrique
German: Hochspannungmast
Italian: Palo/Pilone di Linea Elettrica
Dutch: Hoogspanningsmast
Spanish: Poste eléctrico/Pilón

AT041

A construction of cables strung between elevated supports on which carrier units are suspended.

English: Telpher
French: Téléphérique
German: TBD
Italian: Teleferica
Dutch: Kabelbaan
Spanish: Teleférico

AT045

A device for transmitting and receiving radar emissions

English: Radar Transmitter
French: Station radar
German: Radarantenno
Italian: Stazione radar
Dutch: Radar Zender/Ontvanger
Spanish: Transmisor de radar

Withdrawn/Retirée

AT050

A building in which communication signals are processed or controlled.

English:	Communication Building
French:	Station de transmission
German:	Fernmeldegebaeude
Italian:	Stazione per Communicazioni
Dutch:	Telecommunicatiegebouw
Spanish:	Estación de transmisiones

AT060

A system of above ground wires, including their supports, which transmit electrical signals over distance.

English:	Telephone Line/Telegraph Line
French:	Ligne téléphonique/télégraphique
German:	Telefonleitung/Telegraphenleitung
Italian:	Linea Telefonica/Telegrafica
Dutch:	Telefoonleiding/Telegraafleiding
Spanish:	Línea telefónica/Línea telegráfica

AT070

A pylon or pole used to support a telephone or telegraph line.

English:	Telephone-Telegraph Pylon/Pole
French:	Poteau ou pylône/téléphonique ou télégraphique
German:	Telefonmast/Telegraphenmast
Italian:	Palo/Pilone Telefono/Telegrafo
Dutch:	Telefoonpaal/Telegraafpaal
Spanish:	Poste telefónico/Poste telegráfico

AT080

A relatively tall structure used for transmitting and/or receiving electronic communication signals. (See also AQ060.)

English:	Communication Tower
French:	Tour de transmission
German:	Fernmeldeturm
Italian:	Torre per Comunicazioni
Dutch:	Telecommunicatietoren/Zendmast
Spanish:	Torre de comunicación/Repetidor

AG — Culture—Airport

No Features are currently defined in this sub-category. See sub-category GB.

Withdrawn/Retiree

B—HYDROGRAPHY

BA — Hydrography—Coastal Hydrography

BA010

The line where a land mass is in contact with a body of water.

English:	Coastline/Shoreline
French:	Trait de côte/Côte
German:	Kuestenlinie/Uferlinie
Italian:	Linea di Costa
Dutch:	Kustlijn/Vloedlijn
Spanish:	Línea de costa/Costa

BA020

That part of the shore or beach which lies between the low water mark and the coastline/shoreline. The same condition may exist in non-contiguous off-shore areas.

English:	Foreshore
French:	Estran
German:	Nasser Strand
Italian:	Battigia
Dutch:	Droogvallende Strand
Spanish:	Anteplaya

BA030

A land mass smaller than a continent and surrounded by water.

English:	Island
French:	Ile
German:	Insel
Italian:	Isola
Dutch:	Eiland
Spanish:	Isla

BA040

An area of water which normally has tidal fluctuations.

English:	Water (Except Inland)
French:	Mer (sauf continentales)
German:	Gewaesser (Nicht Inlandgewaesser)
Italian:	Mare
Dutch:	Water (Geen Binnenwater)
Spanish:	Mar (excepto islas)

Withdrawn/Retirée

BA050

The shore of the sea or lake, sandy or pebbly, brought up by the waves (including the foreshore area). (See also BA020.)

English:	Beach
French:	Plage
German:	Strand
Italian:	Spiaggia
Dutch:	Strand
Spanish:	Playa

BA051

A dyke (or dike) is an artificial embankment to contain or hold back water. The dyke crown is the topline of the dyke. (See also DB090.)

English:	Dyke Crown
French:	Sommet de digue
German:	Deichkrone
Italian:	Sommit diga
Dutch:	Kruin van een Dijk
Spanish:	Cresta de dique

BB — Hydrography—Ports and Harbors

BB005

A natural or artificial improved body of water providing protection for vessels and anchorage and docking facilities.

English:	US—Harbor UK—Harbour
French:	Port
German:	Hafen
Italian:	Porto
Dutch:	Haven
Spanish:	Puerto

BB006

Complex Feature with possible components: many simple features, and complex features BB011, BC099, BC098.

English:	US—Harbor Complex UK—Harbour Complex
French:	Zone portuaire
German:	Hafen (komplex)
Italian:	Zona di ormeggio
Dutch:	Haven
Spanish:	Puerto marítimo

BB007

Complex Feature with possible components: BC099, BC098.

English:	Channel Edge
French:	Limite de chenal
German:	TBD
Italian:	Sponda del canale
Dutch:	Vaarroute
Spanish:	Tramo de canal

Withdrawn/Retirée

BB010

An area of water where vessels anchor or may anchor.

English:	Anchorage
French:	Mouillage
German:	Ankerplatz/Reede
Italian:	Ancoraggio
Dutch:	Ankerplaats/Rede
Spanish:	Rada/Ensenada

BB011

Complex Feature with possible components: BB010, BC099, BC098, BB061.

English:	Anchorage
French:	Mouillage
German:	Ankerplatz/Reede (komplex)
Italian:	Zona di ancoraggio
Dutch:	Ankerplaats/Ankergebied
Spanish:	Fondeadero

BB012

A designated area of water where a single vessel, sea plane, oil rig, etc. is anchored or may anchor.

English:	Anchor Berth
French:	Poste de mouillage
German:	TBD
Italian:	Punto di fonda
Dutch:	Ankerligplaats
Spanish:	Punto de amarre

BB019

An anchor is a heavy forging usually comprising a shank with a large shackle or ring at one end and two arms with palms at the other. Shaped as to grip the sea bottom, and by means of a cable or rope, it holds a vessel, boat, or any other floating structure in place.

English:	Anchor
French:	Ancre
German:	Anker
Italian:	Ancora
Dutch:	Anker
Spanish:	Anclaje

BB020

The place where a ship lies when secured to a pier, wharf, dolphin(s), or dock. It may be a designated place away from the coast line.

English:	Berth
French:	Place à quai
German:	Liegeplatz
Italian:	Ormeggio
Dutch:	Ligplaats
Spanish:	Fondeadero

Withdrawn/Retiree

BB021

Complex feature with possible components: BB019, BC098.

English:	Mooring Trot
French:	Zone d'amarrage
German:	TBD
Italian:	Ormeggio
Dutch:	Boeienspannen
Spanish:	Amarradero

BB022

An enclosure containing water for a dock for ships.

English:	Basin
French:	Bassin
German:	TBD
Italian:	Bacino
Dutch:	Bassin/Dok
Spanish:	Dársena/Dique seco

BB030

A post on a wharf used for fastening mooring lines.

English:	Bollard
French:	Bitte d'amarrage
German:	Poller
Italian:	Bitta di Ormeggio
Dutch:	Bolder
Spanish:	Noray/Bolardo/Bita

BB040

A structure which protects a harbor or beach from forces of the sea. (See also BB140.)

English:	Breakwater/Groyne
French:	Brise lames
German:	Wellenbrecher/Buhne
Italian:	Frangiflutti
Dutch:	Golfbreker/Havenhoofd
Spanish:	Espigón/Malecón/Rompeolas

BB042

A loading and discharge place for vessels. It is usually a substantial masonry structure, and often serves as a breakwater on its outer side while offering facilities for ships in its inner side.

English:	Mole
French:	Jetée
German:	Mole
Italian:	Molo
Dutch:	Pier/Havendam
Spanish:	Muelle espigón

Withdrawn/Retirée

BB050

A specified point some distance from the harbor at which a vessel's navigator notifies the harbor authority of the ship's position. (Note that this is not the same as GA055 Waypoint/Reporting Point/Calling-in Point which is for aircraft only.)

English:	Calling-In Point
French:	Point de compte-rendu
German:	TBD
Italian:	Punto di chiamata radio
Dutch:	(Radio-)Meldingspositie
Spanish:	Información de posición

BB079

A structure used for mooring/warping a ship or as protection for harbor constructions.

English:	Mooring/Warping Facility
French:	Point d'amarrage
German:	TBD
Italian:	Struttura per ormeggio/tonneggio
Dutch:	Meerpalen/Meerstoelen/Dukdalf
Spanish:	Instalación de fondeadero

BB080

A post or group of posts used for mooring, warping a ship or as an aid to navigation.

English:	Dolphin
French:	Duc d'albe
German:	Dalben
Italian:	Boa di Ormeggio
Dutch:	Dukdalf
Spanish:	Poste de amarre

BB081

A fixed (not afloat) artificial structure attached to the land. Shoreline constructions are normally used for berthing and protection.

English:	Shoreline Construction
French:	Construction côtière/Trait de côte artificiel
German:	TBD
Italian:	Costruzione sulla linea di costa
Dutch:	Zeewering
Spanish:	Construcción de antaplaya

BB090

A structure, providing support for a vessel, which has a means of removing water so that the bottom of the vessel can be exposed.

English:	US—Drydock UK—Dry Dock
French:	Cale
German:	Trockendock
Italian:	Bacino di Carenaggio/Darsena
Dutch:	Dok/Droogdok
Spanish:	Dique seco/Dársena

Withdrawn/Retirée

BB100

Poles or stakes placed in shallow water to catch fish.

English:	US—Fish Stakes UK—Fishing Stakes
French:	Jalons de pêche/Casiers
German:	Fischstaken
Italian:	Riserva di Pesca
Dutch:	Visstaken
Spanish:	Estacas piscícolas

BB105

A harbor which is primarily used by fishing vessels.

English:	US—Fishing Harbor UK—Fishing Harbour
French:	Port de pêche
German:	Fischereihafen
Italian:	Porto per pescherecci
Dutch:	Visserijhaven
Spanish:	Puerto de pesca

BB110

A fence or enclosure set in water to catch fish.

English:	Fish Traps/Fish Weirs
French:	Pièges/Barrages à poisson
German:	Fischfalle/Fischwehr
Italian:	Trappole/Sbarramenti Per Pesci
Dutch:	Visnetten/Fuiken
Spanish:	Trampa para peces/Azud para peces

BB111

An area where nets used for catching tunny (tuna) may be found.

English:	Tunny (Tuna) Nets Area
French:	Zones à filets pour les thons
German:	Thunfischfangnetze
Italian:	Area con reti per tonni
Dutch:	Gebied met Tonijnnetten
Spanish:	Area de redes atuneras

BB115

A flat frame, usually of parallel timber baulks, erected on the foreshore so that a vessel may dry out on it for painting or repair at low water.

English:	US—Gridiron UK—Gridiron/Careening Grid
French:	Gril de carénage
German:	TBD
Italian:	Bacino di carenaggio
Dutch:	Kielplaats/Bankstelling
Spanish:	Carenero/Varadero

BB140

A man-made barrier built out into, or in the water primary to restrain or direct currents and waves. (See also AQ030 and BB040.)

English:	US—Jetty UK—Training Wall

Withdrawn/Retirée

French: Jetée
German: Hafendamm
Italian: Pennello/Gettata
Dutch: Krib/Havendam
Spanish: Muro de encauzamiento/Dique

BB150

A place on shore where landing from the sea is possible.

English: Landing Place
French: Aire de débarquement
German: Landungsplatz
Italian: Approdo/Sbarcatoio
Dutch: Landingsplaats
Spanish: Embarcadero/Muelle

BB151

Steps at the shoreline as the connection between land and water on different levels.

English: Landing Stairs
French: Escaliers
German: TBD
Italian: Scaletta da sbarco
Dutch: Ontschepingstrap
Spanish: Escalinata

BB160

A metal ring attached to a structure and used to secure a vessel.

English: Mooring Ring
French: Anneau d'amarrage
German: Festmachering
Italian: Anello di Ormeggio
Dutch: Meerring
Spanish: Argolla de amarre

BB170

A facility located offshore for loading and unloading cargo.

English: US—Offshore Loading Facility UK—Single Point Mooring
French: Installation de chargement au large
German: Kuestennahe Verladeeinrichtung
Italian: Struttura per Carico/Scarico in Mare
Dutch: Overlaadplaats (Buitengaats)
Spanish: Instalación de carga y descarga

BB180

A place in shallow water where oysters and mussels breed and may be cultivated.

English: Oyster Bed/Mussel Bed
French: Parc à huîtres/Parc à moules
German: Austernbank/Muschelbank
Italian: Colture di Mitili
Dutch: Oesterbank/Mosselbank
Spanish: Criadero de ostras

Withdrawn/Retirée

BB190

A structure primarily used as berthing places for vessels.

English:	US—Pier/Wharf/Quay UK—Pier/Wharf/Quay/Jetty
French:	Môle/Débarcadère/Quai
German:	Pier/Kai/Ladeplatz/Anleger
Italian:	Molo/Pontile/Banchina
Dutch:	Pier/Kade/Aanlegsteiger
Spanish:	Embarcadero/Muelle

BB199

A dock which normally consists of a bottom pontoon, on which a ship can be lifted out of the water, and two side walls to give stability to the bottom pontoon.

English:	Floating Dock
French:	Cale-sèche flottante
German:	Schwimmdock
Italian:	Bacino galleggiante
Dutch:	Drijvend Dok
Spanish:	Muelle flotante

BB200

A place on land to where ships can pump waste liquids.

English:	Pump Out Facility
French:	Système de pompage
German:	Auffanganlage
Italian:	Terminale di Discarica
Dutch:	Uitpompfaciliteit
Spanish:	Bomba de evacuación

BB201

An installation with a certain function or service generally of interest for small craft or pleasure boats.

English:	Small Craft Facility
French:	Installations pour petits bâtiments
German:	Versorgungseinrichtung (für klein Schiffe)
Italian:	Piccolo molo
Dutch:	Pleziervaart-faciliteiten
Spanish:	Instalación de servicio

BB220

A partially submerged hard surfaced area on a shoreline for launching and retrieving vessels or vehicles.

English:	Ramp (Maritime)
French:	Rampe
German:	Helling
Italian:	Rampa marittima
Dutch:	(Scheeps-)Helling
Spanish:	Rampa (Marítima)

Withdrawn/Retiree

BB230

A structure built to protect the shore from erosion.

English:	Seawall
French:	Digue
German:	TBD
Italian:	Frangi flutti
Dutch:	Strandmuur
Spanish:	Dique portuario/costero

BB240

A prepared slope for launching and recovering vessels. (See also BL195.)

English:	Slipway/Patent Slip
French:	Rampe de lancement
German:	Schlipp/Schlippanlage
Italian:	Scivolo per Varo/Scalo di Alaggio
Dutch:	Sleephelling/Scheepshelling
Spanish:	Rampa de botadura/Varadero

BB250

A place where vessels can replenish their water supply.

English:	Watering Place
French:	Point d'eau
German:	Wasserplatz
Italian:	Presa d'Acqua (Marittima)
Dutch:	Waterlaadplaats
Spanish:	Punto de aguada (marítimo)

BC — Hydrography—NAVAIDs

BC010

A fixed visual or electronic aid to navigation.

English:	Beacon
French:	Balise
German:	Bake
Italian:	Radio Faro/Meda
Dutch:	Baak
Spanish:	Baliza

BC020

A floating object, other than a lightship, moored or anchored to the bottom and serving as an aid to navigation.

English:	Buoy
French:	Bouée
German:	Tonne
Italian:	Boa
Dutch:	Boei/Ton
Spanish:	Boya

Withdrawn/Retiree

BC030

Two or more lights forming a leading line of a course to be followed.

English:	Leading Light(s)
French:	Alignements
German:	Richtfeuer
Italian:	Luci di Allineamento
Dutch:	Geleidelichten/Sectorlichten/Gerichte Lichten
Spanish:	Luces de alineación

BC031

A line generated by the straight line connection between two navigational aids, and which extends towards the area of navigational interest.

English:	Navigation Line
French:	Route de navigation
German:	TBD
Italian:	Rotta
Dutch:	Lijn t.b.v. Navigatie
Spanish:	Línea de navegación

BC032

Mid-channel lines corresponding to the lines in harbor radar displays.

English:	Radar Line
French:	Route de guidage radar
German:	TBD
Italian:	Linea con guida radar
Dutch:	Radar Referentielijn
Spanish:	Línea de radar

BC033

Indicates the coverage of a sea area by a radar surveillance station. Inside this area a vessel may request shore based radar assistance, particularly in poor visibility.

English:	Radar Range
French:	Zone de portée du radar
German:	TBD
Italian:	Portata dei radar
Dutch:	Radarbereik
Spanish:	Area de cobertura radar

BC035

Lights marking area limits, cable alignment, alignments for anchoring, etc., not marking direction or course.

English:	Lights in Line
French:	Alignements
German:	Feuer in Deckpeilung
Italian:	Luci di Demarcazione
Dutch:	Markeringslichten
Spanish:	Luces de demarcación

Withdrawn/Retiree

BC040

A specially constructed device which displays a luminous or lighted aid to navigation. (See also BC050.)

English:	Light
French:	Feu
German:	Leuchtfeuer
Italian:	Luce/Fanale
Dutch:	Licht
Spanish:	Fanal/Luz

BC050

A distinctive structure exhibiting light(s) designed to serve as an aid to navigation. (See also BC040.)

English:	Lighthouse
French:	Phare
German:	Leuchtturm
Italian:	Faro (Marittimo)
Dutch:	Vuurtoren
Spanish:	Faro

BC055

A colored (usually white) mark on a cliff, rock, wall, etc. which is a conspicuous landmark for marine navigation.

English:	Marker
French:	Repère
German:	Sichtzeichen
Italian:	Riferimento
Dutch:	Merkteken
Spanish:	Señal marítima

BC060

A sector defined by bearings from seaward within which a light shows a specified character or color, or is obscured.

English:	Light Sector
French:	Secteur d'eclairement
German:	Leuchtfeuersektor
Italian:	Settore Luminoso
Dutch:	Lichtsector
Spanish:	Sector luminoso

BC070

A distinctively marked manned vessel anchored or moored at a defined point to serve as an aid to navigation.

English:	Light Vessel/Lightship
French:	Bateau feu
German:	Feuerschiff
Italian:	Battello Fanale
Dutch:	Lichtschip
Spanish:	Barco faro

Withdrawn/Retirée

BC080

A small marker used to identify channels or to mark dangers such as rocks, shoals, etc. (See also BD100 and BD140.)

English:	Perches/Stakes
French:	Perches/Poteaux/Pieux
German:	Pricken/Stangen
Italian:	Pali/Briccole
Dutch:	Steekbaken/Staak
Spanish:	Jalón/Estacas

BC098

Complex Feature with possible components made of many simple features only.

English:	Navigational Mark, Afloat
French:	Marque de balisage flottant
German:	TBD
Italian:	Segnale per navigazione galleggiante
Dutch:	Drijvend Navigatiemerk
Spanish:	Marca de navegación,a flote

BC099

Complex Feature with possible components made of many simple features only.

English:	Navigational Mark, Fixed
French:	Marque de balisage fixe
German:	TBD
Italian:	Segnale per navigazionefisso
Dutch:	Vast Navigatiemerk
Spanish:	Marca de navegación,fija

BC100

A track which passes through one or more (usually two) clearly defined objects, along which a vessel can safely travel.

English:	Leading Line
French:	Route de guidage
German:	TBD
Italian:	Rotta tracciata
Dutch:	Geleidelijn
Spanish:	Línea directriz

BC101

A warning signal transmitted by a vessel, or aid to navigation, during periods of low visibility. Also, the device producing such a signal.

English:	Fog Signal
French:	Signal de brume
German:	Nebelsignal
Italian:	Segnale da nebbia
Dutch:	Mistsein
Spanish:	Señal antiniebla

Withdrawn/Retirée

BD — Hydrography—Dangers/Hazards

BD000

A known underwater object or area, known to be dangerous to surface navigation.

English:	US—Underwater Danger/Hazard UK—Underwater Danger
French:	Danger (submergé)
German:	Schiffahrtshindornis
Italian:	Pericolo/Rischio Sommerso
Dutch:	Scheepvaarthindernis (Onder Water)
Spanish:	Peligro sumergido

BD001

An explosive device used in naval warfare located on or below the sea.

English:	Mine
French:	Mine maritime
German:	Seemine
Italian:	Mina
Dutch:	Mijn
Spanish:	Mina

BD005

An object or area on the sea floor or underwater that is not identified by any other code in this specification. (See also BD000.)

English:	Miscellaneous Underwater Feature
French:	Objet submergé non identifié
German:	TBD
Italian:	Oggetto generico sommerso
Dutch:	Onderwater Object
Spanish:	Entidad sin identificar

BD010

Waves which break over off-lying shoals or near the shore. (See also BD080.)

English:	Breakers
French:	Brisants
German:	Brandung
Italian:	Frangenti Foranei
Dutch:	Brekers/Branding
Spanish:	Rompientes

BD020

A framework structure submerged or above water used to support pipelines, sewer lines, or outfalls.

English:	Crib
French:	Coffrage
German:	Stuetzgeruest
Italian:	Base di Appoggio Condutture (Traliccio)
Dutch:	Draagconstructie(In Water)
Spanish:	Armazón de sustentación

Withdrawn/Retirée

BD030

An area of sea water having a color distinctly different from the surrounding water.

English:	US—Discolored Water UK—Discoloured Water
French:	Eau décolorée
German:	Verfaerbtes Wasser
Italian:	Acqua di Diverso Colore
Dutch:	Verkleurd Zeewater
Spanish:	Agua decolorada

BD040

Circular movements of water running contrary to the main current.

English:	Eddies
French:	Remous/Tourbillons
German:	Stromwirbel/Strudel
Italian:	Vortici
Dutch:	Draaikolken/Warrelingen
Spanish:	Remolinos

BD050

A region of comparatively shallow water strewn with rocks, boulders, coral, wreckage, or other obstructions, making it unsuitable for anchoring, grounding, or ground fishing.

English:	US—Foul Ground UK—Foul
French:	Fond encombré
German:	Unreiner Grund
Italian:	Fondo Irregolare
Dutch:	Vuile Grond
Spanish:	Fondo irregular

BD060

A large seaweed.

English:	Kelp/Seaweed
French:	Varech/Algues
German:	Seetang/Seegras
Italian:	Sargassi
Dutch:	Zeewier
Spanish:	Algas

BD070

A danger to navigation, the exact nature of which is not specified, or has not been determined.

English:	Obstruction (Nautical)
French:	Obstruction (nautique)
German:	Schiffahrtshindenis
Italian:	Ostacolo (Navale)
Dutch:	Hindernis (Nautisch)
Spanish:	Obstáculo (Naútico)

Withdrawn/Retirée

BD071

A line of connected, floating timbers as across a river or enclosing a water area to keep logs ready for the sawmill from floating away; also, the enclosed area.

English:	Log Boom/Booming Ground
French:	Barrage de bois flottant/Zone encerclée
German:	TBD
Italian:	Barriera galleggiante di tronchi
Dutch:	Boomversperring/Balkenhaven
Spanish:	Estacada flotante/Cadena de troncos

BD072

A broad, flat-bottomed floating structure without sheer, rectangular in shape, resembling a barge.

English:	Pontoon
French:	Ponton
German:	Ponton
Italian:	Traghetto a cavo
Dutch:	Ponton
Spanish:	Pontón

BD073

A construction to dam oil flow on water.

English:	Oil Barrier
French:	Barrière antipollution
German:	Oelsperre
Italian:	Barriera galleggiante anti-olio
Dutch:	Oliescherm
Spanish:	Barrera petrolífera

BD074

A physical connection between two independent objects, e.g. between: anchor and mooring buoy; anchor and offshore platform; hulk and bollard on land.

English:	Chain/Wire
French:	Chaîne/Câble
German:	Kette/Trosse
Italian:	Catena
Dutch:	Ketting/(Stalen-) Meertros
Spanish:	Cadena/Cable

BD079

A tool in shallow water for fishing purposes which can be an obstruction to ships in general.

English:	Fishing Facility
French:	Installation de pêche
German:	TBD
Italian:	Dispositivo per la pesca
Dutch:	Visserijvoorziening
Spanish:	Instalación de pesca

Withdrawn/Retirée

BD080

Short, breaking waves occurring when a current passes over a shoal or other submarine obstruction or meets a contrary current or wind. Tide rips occur when one or more of the currents are tidal. (See also BD010.)

English:	Overfalls/Tide Rips
French:	Barre/Raz de courant
German:	Gezeitenstromkabbelung/Stromkabbelung
Italian:	Risucchio di Marea
Dutch:	Stroomrafeling/Getijderimpels
Spanish:	Intumescencia/Onda de marea/Hilera de corriente

BD100

A long, heavy timber or section of steel, concrete, etc., forced into the earth to serve as a support, as for a pier. (See also BC080 and BD140.)

English:	Pile/Piling/Post
French:	Pilotis
German:	Pfahlwerk
Italian:	Piloni
Dutch:	Paalwerk in Water (Onderbouw)
Spanish:	Pilón/Poste

BD110

A flat surface raised above the sea, as a working stage for conducting offshore operations.

English:	Platform
French:	Plateforme
German:	Plattform
Italian:	Piattaforma (Marittima)
Dutch:	Platform
Spanish:	Plataforma

BD111

A structure placed in the sea and used for production loading and discharge or observation/research facilities.

English:	Offshore Platform Site (cleared)
French:	Plate-forme offshore
German:	TBD
Italian:	Piattaforma
Dutch:	Platform
Spanish:	Plataforma marina

BD112

An installation for the exploitation of natural resources.

English:	Production Installation
French:	Installation de production
German:	TBD
Italian:	Industria di trasformazione
Dutch:	Produktie Installatie
Spanish:	Instalación de producción

Withdrawn/Retirée

BD119

A narrow, flat surface or shelf, especially one that projects, as from a wall of rock.

English:	Ledge
French:	Corniche
German:	Brandungsplattform/Schorre
Italian:	Scoglio affiorante
Dutch:	Richel
Spanish:	Saliente/Laja/Cordón costero

BD120

A rocky or coral elevation at or near enough to the surface of the sea to be a danger to surface navigation.

English:	Reef
French:	Récif
German:	Riff
Italian:	Scogliera o Barriera Corallina
Dutch:	(Koraal) Rif
Spanish:	Arrecife/Escollera/Barrera coralina

BD121

A cone or dome shaped mound or hill of peat or soil, usually with a core of ice. It is found in tundra regions and is produced by the pressure of water or ice accumulating underground and pushing upward.

English:	Pingo
French:	Pingo
German:	Pingo/Eislakkolith
Italian:	Collina di terreno gelato
Dutch:	Pingo
Spanish:	Pingo

BD130

An isolated rocky formation or a single large stone above or below the water surface.

English:	Rock
French:	Rocher
German:	Fels
Italian:	Scoglio
Dutch:	Rots/Steenrif
Spanish:	Escollos/Rocas

BD140

A stem or a trunk of a tree below the surface of water. (See also BC080 and BD100.)

English:	US—Snags/Stumps UK—Snags/Submerged Stumps
French:	Souches/branches
German:	Baumstumpf
Italian:	Ceppi/Pali
Dutch:	Boomstronk (Onder Water)
Spanish:	Copas de árboles/Tocón sumergido

Withdrawn/Retiree

BD180

The ruined remains of a vessel.

English:	Wreck
French:	Epave
German:	Wrack
Italian:	Relitto Navale
Dutch:	(Scheeps) Wrak
Spanish:	Naufragio

BD181

An unrigged hull condemned as unfit for the risks of the sea and used as a floating depot in a harbor or roadstead.

English:	Hulk
French:	Carcasse de navire
German:	Hulk
Italian:	Magazzino galleggiante
Dutch:	Scheepsromp
Spanish:	Barco viejo

BE — Hydrography—Depth Information

BE010

A navigational safety line indicating that no sounding of a lesser depth exists seaward of the line, but greater depths may occur on the shallow side of the line.

English:	Depth Curve
French:	Limite de profondeur
German:	TBD
Italian:	Linea di navigazione sicura con fosse adiacenti
Dutch:	Dieptelijn
Spanish:	Curva de profundidad

BE015

A line connecting points of equal depth at and below the hydrographic datum.

English:	Depth Contour
French:	Isobathe
German:	Tiefenlinie
Italian:	Isobata/Batimetrica
Dutch:	Dieptelijn
Spanish:	Curva batimétrica

BE019

Water area containing soundings within a defined range of values permanently at or below sounding datum.

English:	Depth Area
French:	Zone de profondeur
German:	TBD
Italian:	Area di navigazione con fondale di profonditÖ nota e costante
Dutch:	Dieptegebied
Spanish:	Area de profundidad

Withdrawn/Retiree

BE020

A measured water depth or spot depth which has been reduced to chart datum.

English:	Sounding
French:	Sonde
German:	Lotung
Italian:	Fondale Scandagliato
Dutch:	Loding
Spanish:	Sondeo

BE021

Delineates an area that covers and uncovers depending on the elevation of the surface above chart datum.

English:	Drying Line, Low Water Line-LWL
French:	Corde à linge
German:	TBD
Italian:	Limite delle acque basse
Dutch:	Laagwaterlijn
Spanish:	Línea de fondo que se descubre

BE022

Delineates an area of sand that covers and uncovers depending on the elevation of the surface above chart datum.

English:	Sand Line
French:	Limites de sables humides
German:	TBD
Italian:	Limite delle aree sabbiose ora emerse ora sommerse
Dutch:	Strandlijn
Spanish:	Línea de arena que se descubre

BE023

Delineates an area of mud that covers and uncovers depending on the elevation of the surface above chart datum.

English:	Mud Line
French:	Limites de zone de vase
German:	TBD
Italian:	Limite di fondale fangoso
Dutch:	Laagwaterlijn
Spanish:	Línea de fango que se descubre

Withdrawn/Retiree

BE029

An object identified from the bottom background by side-scan sonar.

English:	Bottom Return
French:	Echo du fond
German:	TBD
Italian:	Particolare del fondale visto dal sonar
Dutch:	Bodem Echo
Spanish:	Objeto identificado por sonar

BE030

Area of horizontal depth coverage recorded by SONAR array systems.

English:	Track Swath
French:	Andain de Trace
German:	Fahrwasserlinie
Italian:	Rotta/Percorso (Marittimo)
Dutch:	Sonar-gepeild Gebied
Spanish:	Sector de sondeo

BE040

The path of travel with respect to the earth as drawn on the chart and including the sounding information collected along the line.

English:	Track Line
French:	Tracé de sondage
German:	Lotlinie
Italian:	Canale Scandagliato
Dutch:	Gepeilde Route/Vaargeul
Spanish:	Traza de sondeo

BF — Hydrography—Bottom Features

BF010

Designations used on surveys and charts to indicate the consistency, color, and classification of the sea floor, as determined by sampling methods.

English:	US—Bottom Characteristics UK—Quality of the Bottom
French:	Caractéristique du fond
German:	Beschaffenheit des Seegrundes
Italian:	Caratteristiche del Fondale
Dutch:	Zeebodemgesteldheid
Spanish:	Características del fondo

BF011

A significant configuration of underwater bottom topography.

English:	Bottom Feature
French:	Element du fond
German:	TBD
Italian:	Particolare morfologico del fondale
Dutch:	Bodem Object
Spanish:	Entidad del fondo

Withdrawn/Retirée

BG — Hydrography—Tide and Current Information

BG010

The flow direction of a current.

English:	US—Current Flow UK—Current Flow/Tidal Stream Direction
French:	Direction du courant
German:	Stromrichtung/Fliessrichtung
Italian:	Freccia Corrente
Dutch:	Stroomrichting/Stroomrichtingspijl
Spanish:	Flujo de corriente

BG011

A natural watercourse in intertidal areas where water flows during the ebb and flow.

English:	Tideway
French:	Lit de la marée
German:	Priel
Italian:	Corso d'acqua litorale
Dutch:	Stroombed/Stroomgeul
Spanish:	Canal de marea

BG012

The disturbance of water caused by the interaction of any combination of waves, currents, eddies, tidal streams, wind, shoal patches and obstructions.

English:	Water Turbulence
French:	Turbulence
German:	TBD
Italian:	Zona di turbolenza (acqua)
Dutch:	Draaikolken
Spanish:	Turbulencia

BG020

An instrument for measuring the height of the tide.

English:	Tide Gauge
French:	Marégraphe
German:	Gezeitenpegel
Italian:	Mareografo
Dutch:	Getij Peilschaal/Getijmeter
Spanish:	Mareógrafo

BG030

Place for which tabulated tidal stream data are given.

English:	US—Tide Data Point UK—Tidal Stream Observation Station
French:	Point de données sur la marée
German:	Bezugsort fuer Gezeitenberechnungen
Italian:	Stazione di Rilevamento Mareografico
Dutch:	Getijseinstation/Getijmeetstation
Spanish:	Estación de observación mareográfica

Withdrawn/Retirée

BG040

A graph or chartlet showing the average speed of the flood and ebb currents at different periods of the current cycle.

English:	US—Current Diagram UK—Tidal Stream Diagram
French:	Diagramme des courants/carte des courants
German:	Stromdiagramm
Italian:	Diagramma di Corrente
Dutch:	Stroomtabel
Spanish:	Diagrama de corrientes

BH — Hydrography—Inland Water

BH000

Any known inland waterway body, such as: lake/pond, reservoir, river/stream, etc. requiring separation into individual features due to status/type grouping that is currently indeterminable.

English:	Inland Water
French:	Eaux continentales
German:	Binnengewässer
Italian:	Acque interne
Dutch:	Binnenwater
Spanish:	Agua interior

BH010

A pipe or artificial channel designed to transport water from a remote source, usually by gravity. (See also BH110.)

English:	Aqueduct
French:	Aqueduc
German:	Aquaedukt
Italian:	Acquedotto
Dutch:	Aquaduct
Spanish:	Acueducto/Canal/Tubería

BH015

A poorly drained or periodically flooded area, excluding tidal waters, with soil rich in plant residue.

English:	Bog
French:	Tourbière
German:	Moor/Moos
Italian:	Pantano
Dutch:	Drassig Veen
Spanish:	Terreno pantanoso/Ciénaga

BH020

A man-made or improved natural waterway used for transportation.

English:	Canal
French:	Canal
German:	Kanal (Wasserstrasse)
Italian:	Canale
Dutch:	Kanaal/Vaart
Spanish:	Canal navegable

Withdrawn/Retirée

BH030

A channel constructed for the purpose of irrigation or drainage.

English:	Ditch
French:	Fossé
German:	Graben
Italian:	Fosso
Dutch:	Sloot/Greppel
Spanish:	Acequia

BH040

An area containing layers of material used to filter or aerate water.

English:	Filtration Beds/Aeration Beds
French:	Bassin de filtrage/d'aération
German:	Filtrierschichten/Belueftungsschichten
Italian:	Strati di Filtrazione/Aerazione
Dutch:	Filtreerbed/Beluchtingsbassin
Spanish:	Lecho filtrante/Aireador

BH050

An enclosure of water used for the breeding and/or rearing of fish.

English:	Fish Hatchery/Fish Farm/Marine Farm
French:	Bassin de pisciculture/ferme piscicole
German:	Fischzuchtanlage/Fischfarm
Italian:	Vivaio di Pesci
Dutch:	Viskwekerij
Spanish:	Piscifactoría/Granja marina

BH060

An open, inclined channel which carries water for use in such operations as mining or logging.

English:	Flume
French:	Canal d'amenée
German:	kuenstliches Gerinne
Italian:	Condotta d'Acqua
Dutch:	Watergoot
Spanish:	Canal de conducción

BH070

A shallow place in a body of water used as a crossing. (See also AQ062.)

English:	Ford
French:	Gué
German:	Furt
Italian:	Guado
Dutch:	Doorwaadbare Plaats
Spanish:	Vado

BH075

An artificial spring with water.

English:	Fountain
French:	Fontaine
German:	Springbrunnen

Withdrawn/Retirée

Italian:	Fontana
Dutch:	Fontein
Spanish:	Fuente

BH077

An area of higher elevation within a swamp, bog, or marsh.

English:	Hummock
French:	Monticule
German:	Hummock
Italian:	Isola in Terreno Paludoso
Dutch:	Heuveltje in Moeras
Spanish:	Montecillo/Colina

BH080

A body of water surrounded by land. (See also BH130.)

English:	Lake/Pond
French:	Lac/etang
German:	See/Teich
Italian:	Lago/Stagno
Dutch:	Meer/Plas/Vijver
Spanish:	Lago/Laguna

BH090

An area periodically covered by flood water, excluding tidal waters. (See also BH095.)

English:	Land Subject to Inundation
French:	Terre sujette à inondation
German:	Ueberschwemmungsgebiet/Ueberflutungsgebiet
Italian:	Terreno Soggetto ad Innondazione
Dutch:	Uiterwaard/Overstromingsgebied/Inundatiegebied
Spanish:	Zona inundable

BH091

Land subject to controlled inundation (i.e. flooded by the regulation of the level of water impounded by a dam or beaver dam), and is normally associated with permanently flooded areas in which trees are still standing. Also known as inundated land.

English:	Flooded Area
French:	Zone inondable
German:	Überschwemmtes Gebiet
Italian:	Zona inondabile
Dutch:	Overstroomd Land
Spanish:	Area inundada

BH095

A saturated area, at times covered with water, supporting vegetation which may include trees. (See also BH090.)

English:	Marsh/Swamp
French:	Marais/Marécage
German:	Sumpfiges Gelaende, Sumpf
Italian:	Palude/Acquitrino
Dutch:	Moeras
Spanish:	Marisma

Withdrawn/Retirée

BH100

A trench usually filled with water, that surrounds a body of land.

English:	Moat
French:	Douve
German:	Ringgraben/Festungsgraben
Italian:	Fossato
Dutch:	Gracht
Spanish:	Foso

BH110

A pipeline or channel generally used by hydroelectric plants or water mills to transport water by gravity or under pressure. (See also BH010.)

English:	Penstock
French:	Conduite forcée
German:	Druckwasserleitung/Turbinenleitung
Italian:	Condotta Forzata
Dutch:	Turbinewaterleiding/Drukwaterleiding
Spanish:	Tubería de presión

BH115

Water situated underground but reachable by wells.

English:	Underground Water/Phreatic Water
French:	Eau souterraine/Nappe phréatique
German:	Grundwasser
Italian:	Falda Freatica
Dutch:	Grondwater
Spanish:	Aguas subterráneas/Capa freática

BH120

A place in a stream or river where the current is swift and the surface is usually broken by boulders and rocks.

English:	Rapids
French:	Rapides
German:	Stromschnelle
Italian:	Rapide
Dutch:	Stroomversnelling
Spanish:	Rápidos

BH130

A man-made enclosure or area formed for the storage of water. (See also BH080.)

English:	Reservoir
French:	Réservoir
German:	Stausee
Italian:	Bacino/Riserva d'Acqua
Dutch:	Stuwmeer/Spaarbekken/Waterreservoir
Spanish:	Estanque/Embalse

BH135

An area periodically covered with water used for growing rice.

English:	Rice Field

Withdrawn/Retiree

French:	Rizière
German:	Reisfeld
Italian:	Risaia
Dutch:	Rijstveld
Spanish:	Arrozal

BH140

A natural flowing watercourse.

English:	River/Stream
French:	Rivière/Cours d'eau
German:	Fluss/Strom/Wasserlauf
Italian:	Fiume/Torrente
Dutch:	Rivier/Stroom/Beek
Spanish:	Río/Torrente

BH141

The limit line between the water area of a river and the area of land.

English:	River Bank
French:	Berge de rivière
German:	Flußufer
Italian:	Sponda
Dutch:	Rivieroever
Spanish:	Ribera

BH145

Point at which a river or stream passes into the ground.

English:	River Stream Vanishing Point
French:	Point de fuite d' une rivière
German:	Flußschwinde
Italian:	Punto d'inizio di percorso sotterraneo
Dutch:	Rivier Verdwijnpunt
Spanish:	Ojo (ríos)

BH150

A flat area of natural surface salt deposits.

English:	Salt Pan
French:	Marais salants naturels
German:	Salzpfanne
Italian:	Saline
Dutch:	Zoutpan
Spanish:	Salina

BH155

Shallow pools, normally man-made, used for the natural evaporation of water for the collection of salt.

English:	Salt Evaporator
French:	Marais salants artificiels
German:	Saline/Salzgewinnungsanlage
Italian:	Salina
Dutch:	Zoutwinning
Spanish:	Evaporador salino

Withdrawn/Retirée

BH160

A natural depression in arid or semi-arid regions whose bed is covered with salt encrusted clayey soil.

English:	Sebkha
French:	Sebkha(pays arabes) , playa (amérique du nord, australie) etc.
German:	Sebcha/Salztonebene
Italian:	Palude Salmastra
Dutch:	Zoutlagune
Spanish:	Sebkha/Costra salina/Costra laterítica

BH165

A passage for surplus water to run over or around a dam.

English:	Spillway
French:	Canal de déverse
German:	Abflusskanal (Ueberlauf bei Damm)
Italian:	Canale di Scolo
Dutch:	Overlaat
Spanish:	Aliviadero

BH170

A natural outflow of water from below the ground surface. (See also AA050 and BH075.)

English:	Spring/Water-Hole
French:	Source/Trou d'eau
German:	Quelle/Wasserloch
Italian:	Sorgente/Polla d'Acqua
Dutch:	Waterbron/Wel
Spanish:	Manantial/Surgencia

BH175

A man-made open water container for animal drinking.

English:	Trough
French:	Auge
German:	Wassertrog
Italian:	Abbeveratoio
Dutch:	Drinkbak/Trog
Spanish:	Abrevadero

BH180

A vertical or nearly vertical descent of water.

English:	Waterfall
French:	Chute d'eau
German:	Wasserfall
Italian:	Cascata
Dutch:	Waterval
Spanish:	Cascada

BH190

Open body of water separated from the sea by sand bank or coral reef.

English:	Lagoon/Reef Pool
French:	Lagon/Lagune

Withdrawn/Retirée

German: Lagune
Italian: Laguna
Dutch: Lagune/Strandmeer
Spanish: Albufera

BH200

Surface drainage feature which is of a minor nature and which is not included in other feature codings in this specification.

English: Miscellaneous Surface Drainage Feature
French: Element du système hydrographique
German: Gewässer, sonstig
Italian: Generica superficie drenante
Dutch: Afwatering
Spanish: Entidad hidrográfica de importancia menor

BH210

The land-water boundary for all inland hydrographic features having shorelines, Lake/Pond (BH080) or Island (DB135), except for left and right banks of River/Stream (BH140) and Canal (BH020).

English: Inland Shoreline
French: Berge de lac/d'étang
German: Uferlinie (Seen)
Italian: Linea di costa entroterra
Dutch: Oeverlijn (Binnenwater)
Spanish: Límite de agua

BH501

The route in a river suitable for the largest allowed vessels. (See also FC168.)

English: River navigation route
French: Itinéraire de navigation fluviale
German: Fahrwasser (Fluß)
Italian: Via di navigazione fluviale
Dutch: Vaargeul/Vaarroute
Spanish: Ruta de navegación fluvial

BI — Hydrography—Miscellaneous Inland Water

BI005

A mechanical device for lifting vessels between two levels other than a lock. (See also BI030.)

English: Boat Lift
French: Ascenseur pour bateau
German: Schiffshebewerk
Italian: Sollevatore per Nave
Dutch: Scheepslift
Spanish: Ascensor de barcos

BI010

A man-made container used for collection or storage of rain water.

English: Cistern
French: Citerne

Withdrawn/Retirée

German: Zisterne
Italian: Cisterna
Dutch: Regenbak/Regenput
Spanish: Estanque/Alberca/Aljibe

BI020

A permanent barrier across a watercourse used to impound water or to control its flow. (See also BI040.)

English: Dam/Weir
French: Barrage/Retenue d'eau
German: Staudamm/Wehr
Italian: Diga/Briglia
Dutch: Stuwdam/Stuw
Spanish: Presa

BI030

An enclosure with a pair or series of gates used for raising or lowering vessels as they pass from one water level to another. (See also BI005.)

English: Lock
French: Ecluse
German: Schleuse
Italian: Chiusa
Dutch: Schutsluis
Spanish: Esclusa

BI039

An open, inclined conduit fitted with a gate (reference BI040 Sluice Gate) for regulating water flow and may be employed in mine ore washing operations.

English: Sluice
French: Conduite de régulation
German: TBD
Italian: Chiusa
Dutch: Waterinlaatkanaal
Spanish: Esclusa

BI040

A gate used to regulate the flow of water. (See also BI020 and BI040.)

English: Sluice gate
French: Vanne
German: Schieber
Italian: Saracinesca
Dutch: Sluisdeur
Spanish: Compuerta

BI041

A structure that may be swung, drawn, or lowered to block an entrance or passageway.

English: Gate (Nautical)
French: Porte (maritime)
German: TBD
Italian: Apertura,passaggio
Dutch: (Sluis-)Deur

Withdrawn/Retirée

Spanish: Puerta (naútica)

BI042

The gate at the end of a drydock which excludes the water after pumping out the dock. The pumping engines are often located in the caisson.

English: US—Caisson UK—Dry Dock Gate
French: Caisson
German: Senkkasten
Italian: Chiusa
Dutch: Caisson/Sluitstuk
Spanish: Barco-puerta

BI043

An artificial obstruction placed in a water course to increase the depth or to divert it.

English: Flood Barrage
French: Barrage de retenue
German: TBD
Italian: Paratoia
Dutch: Vloedkering
Spanish: Barrera de desbordamiento

BI050

A tower-like structure associated with a dam or water source and used for the intake of water.

English: Water Intake Tower
French: Château d' eau
German: Wasserueberlaufturm
Italian: Scolmatore
Dutch: Waterinlaattoren
Spanish: Torre de toma de agua

BI060

A series of ascending pools constructed to enable fish to swim upstream around or over a dam.

English: Fish Ladder
French: Echelle à poissons
German: Fischtreppe
Italian: Passagio per Pesci
Dutch: Vistrap
Spanish: Escaleras para peces/Escalera salmonera

BI070

A device which monitors stream flow.

English: Gauging Station
French: Station de contrôle du courant
German: Pegel
Italian: Stazione per Rilievo Livello di Guardia
Dutch: Peilschaal
Spanish: Control de flujo

Withdrawn/Retirée

BJ — Hydrography—Snow/Ice

BJ020

An accumulation of soil and stone debris deposited by a glacier.

English:	Moraine
French:	Moraine
German:	Moraene
Italian:	Morena
Dutch:	Morene
Spanish:	Morrena

BJ030

A large mass of snow and ice moving slowly down a slope or valley from above the snowline.

English:	Glacier
French:	Glacier
German:	Gletscher
Italian:	Ghiacciaio
Dutch:	Gletsjer
Spanish:	Glaciar

BJ040

The vertical face of a glacier or ice shelf.

English:	Ice Cliff
French:	Falaise de glace
German:	Eisabbruch
Italian:	Strapiombo di Ghiaccio
Dutch:	IJswand/Gletsjerwand
Spanish:	Glaciar colgado

BJ060

A rocky peak projecting above a surrounding ice field that may be perpetually covered with ice.

English:	Ice Peak/Nunatak
French:	Pic de glace/Nunatak
German:	Eisbedeckter Berggipfel/Nunataker
Italian:	Picco Ghiacciato/Collina Isolata in un Ghiacciaio
Dutch:	IJsbedekte Bergpiek/Nunatak
Spanish:	Pico de glaciar/Nunatak

BJ065

A sheet of thick ice, with level or undulating surface, attached to the land but mostly afloat which is bounded on the seaward side by an Ice Cliff (BJ040)

English:	Ice Shelf
French:	Plate-forme de glace flottante
German:	Schelfeis
Italian:	Piattaforma di ghiaccio
Dutch:	Begrenzing van Vast IJs
Spanish:	Hoja de hielo

Withdrawn/Retirée

BJ070

An area of ice formed by the drifting and crushing together of floating pieces of ice.

English:	Pack Ice
French:	Banquise
German:	Packeis
Italian:	Banchisa
Dutch:	Pakijs
Spanish:	Montón de hielo flotante

BJ080

The heaviest, thickest form of ice over land or water. (See also BJ100.)

English:	Polar Ice
French:	Glace polaire
German:	Polareis
Italian:	Ghiaccio Polare
Dutch:	Poolijs
Spanish:	Hielo Polar

BJ100

A large area permanently covered by snow or ice over land or water. (See also BJ080.)

English:	Snow Field/Ice Field
French:	Névé/Calotte de glace
German:	Schneefeld/Eisfeld
Italian:	Vedretta/Nevaio
Dutch:	Eeuwige Sneeuw/Landijs/IJskap
Spanish:	Nevero/Helero

BJ110

A prairie-like region in the Arctic and Subarctic zones which sustains a growth of low vegetation.

English:	Tundra
French:	Toundra
German:	Tundra
Italian:	Tundra
Dutch:	Toendra
Spanish:	Tundra

Withdrawn/Retiree

C—HYPSOGRAPHY

CA — Hypsography—Relief Portrayal

CA010

A line connecting points having the same vertical datum value.

English:	Contour Line (Land)
French:	Courbe de niveau
German:	Hoehenlinie
Italian:	Curve di Livello (Terreno)
Dutch:	Hoogtelijn
Spanish:	Curva de nivel (terreno)

CA020

A line representation of a ridge top.

English:	Ridge Line
French:	Ligne de crète
German:	Kammlinie
Italian:	Linea di Cresta
Dutch:	Kamlijn
Spanish:	Divisoria

CA025

A line representation of the lowest part of a valley.

English:	Valley Bottom Line
French:	Ligne de talweg
German:	Talsohlenlinie
Italian:	Linea di Fondo Valle
Dutch:	Dalbodemlijn
Spanish:	Vaguada

CA026

Line representing the demarcation of a sudden and significant change in the gradient of the terrain relief.

English:	Breakline
French:	Ligne de changement de pente
German:	TBD
Italian:	Linea di discontinuitÖ
Dutch:	Breuklijn
Spanish:	Línea de cambio de pendiente

CA030

A designated location with an elevation value relative to a vertical datum.

English:	Spot Elevation
French:	Point coté
German:	Hoehenpunkt
Italian:	Punto Quotato
Dutch:	Hoogtepunt
Spanish:	Punto de cota

Withdrawn/Retirée

CA035

A location with a generalized elevation value relative to a vertical datum associated with an inland, usually confined, water body.

English:	Inland Water Elevation
French:	Eaux continentales coté
German:	TBD
Italian:	Acque interne Quotato
Dutch:	Binnenwater Hoogte
Spanish:	Agua interior cota

CA040

An arbitrary area outline created to establish elevation as polygons.

English:	Contour Polygon (Land)
French:	Zone hypsométrique (contour)
German:	TBD
Italian:	Contorno di poligono
Dutch:	Hoogtelijn
Spanish:	Polígono de curva de nivel

Withdrawn/Retirée

D—PHYSIOGRAPHY

DA — Physiography— Exposed Surface Materials

DA005

A natural pool of liquid asphalt.

English:	Asphalt Lake
French:	Lac d' asphalte
German:	Asaphaltsee
Italian:	Pozza d'asfalto
Dutch:	Asfaltmeer
Spanish:	Lago de asfalto

DA006

A sterile plain containing an excess of alkali usually occurring in the bottom of an under drained basin in an arid or semi-arid region. The ground may be soft and have low shearing and bearing strength, and a high organic content.

English:	Alkali Flats
French:	Fond alcalin
German:	Natronsee
Italian:	Terreno fortemente alcalino
Dutch:	Zoutvlakte
Spanish:	LLano alcalino

DA010

The surface soil characteristics of the earth.

English:	Ground Surface Element
French:	Surface du sol
German:	Erdoberflaechenbeschaffenheit
Italian:	Natura della Superficie del Terreno
Dutch:	Bodemgesteldheid
Spanish:	Características del suelo

DA020

Ground so disturbed as to have no identifiable coverage.

English:	Barren Ground
French:	Terrain nu
German:	Unland/Oedgelaende
Italian:	Terreno arido
Dutch:	Kale Grond
Spanish:	Terreno baldío

Withdrawn/Retirée

DA030

An area not permanently or temporarily covered by water.

English:	Land Area
French:	Zone terrestre
German:	TBD
Italian:	Area periodicamente inondata
Dutch:	Land
Spanish:	Terreno inundable

DA031

An area of natural scenery on land. It is defined by its geographical characteristics and known by its proper name.

English:	Land Region
French:	Région
German:	Landschaft
Italian:	Regione geografica
Dutch:	Landstreek
Spanish:	Región

DB — Physiography—Landforms

DB010

A steep, vertical, or overhanging face of rock or earth. (See also DB110.)

English:	Bluff/Cliff/Escarpment
French:	Falaise/Abrupt/Escarpement
German:	Steilabfall/Kliff/Boeschung
Italian:	Scarpata/Dirupo
Dutch:	Steile Wand/Klif/Overhelling
Spanish:	Escarpado/Farallón/Precipicio

DB030

A natural subterranean chamber or series of chambers open to the Earth's surface.

English:	Cave
French:	Grotte
German:	Hoehle
Italian:	Caverna/Grotta
Dutch:	Grot
Spanish:	Cueva

DB031

A small, isolated elevation, smaller than a mountain.

English:	Hill
French:	Colline
German:	Hügel
Italian:	Collina
Dutch:	Heuvel
Spanish:	Colina

Withdrawn/Retiree

DB060

A narrow fissure, crack, or rift in the Earth's surface, snow or ice.

English:	Crevice/Crevasse
French:	Fissure/Crevasse
German:	Sprung/Riss/Spalte
Italian:	Fessura/Crepaccio
Dutch:	Spleet/Scheur/Gletsjerspleet
Spanish:	Grieta/Fisura

DB070

An excavation of the Earth's surface to provide passage for a road, railroad, canal, etc.

English:	Cut
French:	Déblai
German:	Einschnitt
Italian:	Sbancamento
Dutch:	Doorsnijding
Spanish:	Desmonte

DB080

A low area surrounded by higher ground.

English:	Depression
French:	Dépression
German:	Depression/Senke
Italian:	Depressione/Dolina
Dutch:	Depressie/Inzinking
Spanish:	Depresión/Sima/Torca/Dolima

DB090

A raised long mound of earth or other material. (See also BA051.)

English:	Embankment/Fill
French:	Remblai/Talus
German:	Damm/Aufschuettung
Italian:	Terrapieno/Argine
Dutch:	Dijk/Dam
Spanish:	Terraplén

DB100

A long, narrow ridge of sand and gravel deposited by a glacial stream.

English:	Esker
French:	Esker
German:	Os
Italian:	Dorsale di Detrito
Dutch:	Esker
Spanish:	Esker/Depósito glaciar

DB110

A fracture in the Earth's crust with displacement on one side of the fracture relative to the other. (See also DB010.)

English:	Fault
French:	Faille

Withdrawn/Retiree

German: Stoerung/Verwerfung
Italian: Faglia
Dutch: Breuk
Spanish: Falla

DB115

A terrain surface feature controlled by or derived from the heat of the Earth's interior.

English: Geothermal Feature
French: Activité géothermique
German: TBD
Italian: Installazione geotermica
Dutch: Geothermische locatie
Spanish: Entidad geotérmica

DB145

Obstacle feature which is of a minor nature and which is not covered by other feature codings in this specification.

English: Miscellaneous Obstacle
French: Obstacles divers
German: Hindernis, sonstig
Italian: Ostacolo generico
Dutch: Obstakel
Spanish: Obstáculo de importancia menor

DB150

A natural route through a low place in a mountain range.

English: Mountain Pass
French: Col
German: Gebirgspass
Italian: Passo/Valico
Dutch: Bergpas
Spanish: Puerto de montaña

DB160

A visual topographic outcrop, layers or beds of rock.

English: Rock Strata/Rock Formation
French: Formation de roches stratifiées/de roches
German: Gesteinsschichten/Gesteinspaket
Italian: Strati Rocciosi/Formazione Rocciosa
Dutch: Gesteentelaag/Gesteentepakket/Rotsformatie
Spanish: Estratos rocosos/Zona rocosa

DB170

Ridges or hills of sand.

English: Sand Dune/Sand Hills
French: Dune de sable/Colline de sable
German: Sandduene/Sandhuegel
Italian: Duna/Collina di Sabbia
Dutch: Duinen/Zandheuvels
Spanish: Dunas

Withdrawn/Retirée

DB176

An area enclosing a group of slope values falling within a set range.

English:	Slope Category
French:	Zone de pente homogène
German:	Fläche gleicher Neigungsklasse
Italian:	Categoria di pendenza
Dutch:	Helling
Spanish:	Categoría de pendientes

DB180

A mountain or hill, often conical, formed around a vent in the Earth's crust through which molten rock, ash, or gases are or have been expelled.

English:	Volcano
French:	Volcan
German:	Vulkan
Italian:	Vulcano
Dutch:	Vulkaan
Spanish:	Volcán

DB190

A steep ridge of igneous rock.

English:	Volcanic Dike
French:	Piton volcanique
German:	Vulkanischer Ruecken
Italian:	Filone Eruttivo Vulcanico
Dutch:	Vulkanische Dijk
Spanish:	Filón eruptivo/Dique eruptivo

DB200

A long, narrow, deep erosion with steep banks.

English:	US—Gully/Gorge UK—Gullies
French:	Goulet/Gorge
German:	Schlucht
Italian:	Calanco
Dutch:	Kloof/Ravijn
Spanish:	Barranco/Garganta/Cárcava/Rambla

DB210

A mass of land, with a high potential of slipping down from a mountain, hill, etc.

English:	US—Potential Landslide Area UK—Landslide/Scree
French:	Zone à risque de glissement de terrain
German:	Hangrutsch
Italian:	Frana
Dutch:	Aardverschuiving
Spanish:	Deslizamientos de tierra

DB211

The mass of earth or rock which has slipped down from a mountain or cliff.

English:	Landslide
French:	Eboulement

Withdrawn/Retiree

German:	Hangrutsch/Erdrutsch/Mure
Italian:	Frana
Dutch:	Aardverschuiving/Verzakking
Spanish:	Desprendimiento

DB230

A gently sloping fan shaped feature usually found near the lower termination of a canyon.

English:	Fan
French:	Cône d'alluvions
German:	Gesteinsschutt(Schwemmfaecher)
Italian:	Conoide
Dutch:	Puinwaaier
Spanish:	Cono de deyección

DB500

Bottomline of a steep slope.

English:	Bottomline of Cliff
French:	Base d'une falaise
German:	Böschungsunterkanto
Italian:	Piede del precipizio
Dutch:	Benedenrand van Klif
Spanish:	Línea de fondo de acantilado

DB501

Topline of a steep slope.

English:	Topline of Cliff
French:	Sommet d'une falaise
German:	Böschungsoberkante
Italian:	Ciglio del precipizio
Dutch:	Bovenrand van Klif
Spanish:	Divisoria de acantilado

Withdrawn/Retirée

E—VEGETATION

EA — Vegetation— Cropland

EA010

An area that has been tilled for the planting of crops. (See also EA040, EA050 and EA055.)

English:	Cropland
French:	Champs (cultivés)
German:	Landwirtschaftliche Anbauflaeche/Ackerland
Italian:	Terreno Coltivato
Dutch:	Akkerland/Bouwland
Spanish:	Tierra de cultivo

EA020

A continuous growth of shrubbery planted as a fence, a boundary, or a wind break.

English:	Hedgerow
French:	Haie
German:	Wallhecke/Knick
Italian:	Siepe/Barriera Frangivento
Dutch:	Heg/Haag
Spanish:	Seto

EA030

A place where shrubs, flowers, plants and trees are grown for transplanting, seed or grafting.

English:	Nursery
French:	Pépinière
German:	Baumschule/Gaertnerei
Italian:	Vivaio/Zona di Rimboschimento
Dutch:	Kwekerij
Spanish:	Vivero

EA031

A cultural area where plants and/or trees are displayed.

English:	Botanical Garden
French:	Jardin botanique
German:	Botanischer Garten
Italian:	Orto botanico
Dutch:	Botanische Tuin
Spanish:	Jardín botánico

EA040

An area covered by systematic plantings of trees which yield fruits, nuts or other products. (See also EA010, EA050 and EA055.)

English:	Orchard/Plantation
French:	Verger/Plantation
German:	Obstbaumanlage/Plantage
Italian:	Frutteto/Piantagione
Dutch:	Boomgaard/Plantage
Spanish:	Frutal/Plantación

Withdrawn/Retirée

EA050

An area covered by the systematic planting of grape vines. (See also EA010, EA040 and EA055.)

English:	Vineyards
French:	Vignoble
German:	Weingarten/Weinberg
Italian:	Vigneti
Dutch:	Wijngaard
Spanish:	Viñas

EA055

An area covered by the systematic planting of hop vines. (See also EA010, EA040 and EA050.)

English:	Hops
French:	Houblonnière
German:	Hopfenfeld
Italian:	Piantagioni di Luppolo
Dutch:	Hopplantage
Spanish:	Lúpulo

EB — Vegetation—Rangeland

EB010

Area composed of uncultured plants which have little or no woody tissue.

English:	Grassland
French:	Zone herbeuse/Pré
German:	Gruenland
Italian:	Terreno Erboso
Dutch:	Grasland
Spanish:	Pradera/Pastizal/Prado

EB015

Area composed of uncultured plants which may have some woody tissue.

English:	Grass/Scrub/Brush
French:	Jachère/Friche/Maquis/Garrigue
German:	Grasland/Buschland
Italian:	Macchia/radura
Dutch:	Grasland/Lage Struikjes
Spanish:	Césped/Matorral/Monte bajo

EB020

Low-growing woody plants. (See also EC030.)

English:	Scrub/Brush
French:	Arbustes/Buissons/Broussailles
German:	Buschwerk
Italian:	Macchia/Cespugliato
Dutch:	Struikgewas/Kreupelhout
Spanish:	Monte bajo/Matorral/Arbustos

Withdrawn/Retirée

EB030

Thematic classification of the predominant vegetation and land use characteristics of the land surface covers.

English:	Land Use/Land Cover (Vegetation)
French:	Zone d'occupation du sol homogène
German:	TBD
Italian:	Essenza boschiva
Dutch:	Overheersende Begroeiing
Spanish:	Uso del terreno/Vegetación (temático)

EC — Vegetation—Woodland

EC010

Woody, treelike grass.

English:	Bamboo/Cane
French:	Bambou/Roseau/Cane
German:	Bambus
Italian:	Canneto
Dutch:	Bamboe/Riet
Spanish:	Bambú/Caña

EC015

An area set aside as a woodland or recreational preserve.

English:	Forest
French:	Forêt
German:	Wald
Italian:	Foresta
Dutch:	Bos
Spanish:	Floresta/Parque

EC020

A small, isolated, fertile or green area in a desert region usually having a spring or well.

English:	Oasis
French:	Oasis
German:	Oase
Italian:	Oasi
Dutch:	Oase
Spanish:	Oasis

EC030

Woody-perennial plants, having a self-supporting main stem or trunk. (See also EA040, EB020 and EC015.)

English:	Trees
French:	Arbres
German:	Baeume
Italian:	Alberi/Bosco
Dutch:	Bomen
Spanish:	Bosque/Arboles

Withdrawn/Retirée

EC040

A man-made clearing in a cultural area or through a stand of trees, designed to provide access for a road, railroad, pipeline or power transmission line, or for boundary demarcation, survey line-of-sight, or to impede the progress of forest fires.

English:	US—Cleared Way/Cut Line/Firebreak UK—Cleared Way/Firebreak
French:	Trouée/Coupe-feu
German:	Schneise/Feuerschneise
Italian:	Linea di Tagliata/Antincendio
Dutch:	Open Strook/Brandgang
Spanish:	Cortafuegos

ED — Vegetation—Wetland

No Features are currently defined in this sub-category.

EE — Vegetation—Miscellaneous Features

EE000

A mixture of woody and non-woody vegetation types.

English:	Miscellaneous Vegetation
French:	Végétations mélangées
German:	Gemischte Vegetation
Italian:	Vegetazione mista
Dutch:	Begroeiing
Spanish:	Vegetación varia

Withdrawn/Retirée

F—DEMARCATION

FA — Demarcation— Boundaries/Limits/Zones (Topographic)

FA000

A line of demarcation between controlled areas.

English:	Administrative Boundary
French:	Limite administrative
German:	Staatsgrenze/Verwaltungsgrenze
Italian:	Confine/Limite Amministrativo
Dutch:	Staatkundige Grens/Administratieve Grens
Spanish:	Límite administrativo

FA001

An area controlled by administrative authority.

English:	Administrative Area
French:	Zone administrative
German:	Staatsgebiet/Verwaltungsgebiet
Italian:	Area/Zona Amministrativa
Dutch:	Staatkundig Gebied/Administratief Gebied
Spanish:	Zona administrativa

FA005

A zone between a contact zone and the first possible clearing line (road, towing path, passable road bank crest). (See also FA041.)

English:	Access Zone
French:	Zone d' accès
German:	Grenze Annaeherungszone
Italian:	Zona di Accesso all' Acqua
Dutch:	Naderingszone
Spanish:	Zona de acceso

FA015

An open area designated for the purpose of discharging or detonating firearms.

English:	Firing Range/Gunnery Range
French:	Polygone de tir
German:	Schiessgebiet/Schiessanlage
Italian:	Poligono di Tiro
Dutch:	Schietbaan/Schietkamp
Spanish:	Zona de caída de proyectiles

FA020

A line established by opposing political groups as a result of cessation of hostilities.

English:	Armistice Line
French:	Limite de la zone d'armistice
German:	Waffenstillstandslinie
Italian:	Linea di armistizio
Dutch:	Wapenstilstandslijn
Spanish:	Línea de armisticio

Withdrawn/Retirée

FA030

A line along which active hostilities are suspended.

English:	Cease-Fire Line
French:	Limite de la zone de cessez-le-feu
German:	Feuereinstellungslinie
Italian:	Linea di cessate il fuoco
Dutch:	Staakt-het-vuren Lijn
Spanish:	Línea de alto el fuego

FA040

A limit of an area which is unilaterally claimed by one political group without consent or negotiation with another.

English:	Claim Line
French:	Limite de la zone revendiquée
German:	Grenze der Gebietsforderung
Italian:	Limite di area contesa/rivendicata
Dutch:	Grens van Gevorderd Gebied
Spanish:	Línea de litigio

FA041

Terrain area 3 meters wide limited on the water side by the contact between land and water (under average level of water condition). (See also FA005.)

English:	Contact Zone
French:	Limite de zone de contact
German:	Kontaktzone
Italian:	Limite di Zona di Contatto con L'Acqua
Dutch:	Contactzone
Spanish:	Zona de contacto

FA050

A line established to regulate matters between nations or groups over a specific area or territory.

English:	Mandate Line/Convention Line
French:	Limite définie par convention
German:	Mandatsgrenze
Italian:	Confine concordato/negoziato
Dutch:	Verdragslijn
Spanish:	Línea de convención

FA060

An existing line of separation not officially recognized by various governments.

English:	Defacto Boundary
French:	Frontière de facto
German:	De facto-Grenzlinic
Italian:	Confine defacto
Dutch:	De Facto Grens
Spanish:	Límite de facto

Withdrawn/Retiree

FA070

An area where military activity is prohibited.

English:	Demilitarized Zone
French:	Zone démilitarisée
German:	Entmilitarisierte Zone
Italian:	Zona militarmente interdetta
Dutch:	Gedemilitariseerde Zone
Spanish:	Zona desmilitarizada

FA090

A grid established for the collection of geophysical data within an area.

English:	Geophysical Prospecting Grid
French:	Grille de prospection géophysique
German:	Geophysikalisches Explorationsgitter
Italian:	Grigliato Prospezione Geofisica
Dutch:	Geofysisch Onderzoeksgrid
Spanish:	Red de prospección geofísica

FA110

A line generally coinciding with the 180th meridian, modified to avoid land, and designated as the place where each calendar day begins.

English:	International Date Line
French:	Ligne de changement de date internationale
German:	Datumsgrenze
Italian:	Linea Data Internazionale
Dutch:	Internationale Datumgrens
Spanish:	Línea de cambio de fecha

FA165

An area reserved for training.

English:	Training Area
French:	Zone d' entraînement/Zone de manoeuvres
German:	Standortuebungsplatz/Truppenuebungsplatz
Italian:	Area Addestrativa
Dutch:	Oefenterrein
Spanish:	Campo de maniobras

FA170

An area temporarily held and controlled by a foreign military force.

English:	Zone of Occupation
French:	Zone occupée
German:	Besetztes Gebiet
Italian:	Zona di occupazione
Dutch:	Bezet Gebied
Spanish:	Zona de ocupación

FB — Demarcation—Boundaries/Limits/Zones (Aeronautical)

No Features are currently defined in this sub-category. See sub-category GA.

Withdrawn/Retirée

FC — Demarcation—Boundaries/Limits/Zones (Hydrographic)

FC021

A line where on either side certain activities or factors of significance to navigation and/or operation apply.

English:	Maritime Limit Boundary
French:	Limite maritime
German:	Nautische Grenze
Italian:	Limite marittimo
Dutch:	Maritieme Grens
Spanish:	Límite marítimo

FC031

An area in which certain activities or factors of significance to navigation and/or operation apply.

English:	Maritime Area
French:	Zone maritime
German:	Maritime Zone
Italian:	Area/Zona Marittima
Dutch:	Maritiem Gebied
Spanish:	Zona marítima

FC035

A structure separating the basins of a fish pound, a reservoir or a liquid waste pond.

English:	Pond Partition
French:	Séparateur de bassin
German:	TBD
Italian:	Divisorio di una peschiera
Dutch:	Visvijvers
Spanish:	Compartimentación de estanques

FC036

An area in which certain aspects of navigation are restricted.

English:	Restricted Area
French:	Zone réglementée
German:	TBD
Italian:	Area ristretta alla navigazione
Dutch:	Gebied met beperking van Toegang en/of Gebruik
Spanish:	Area restringida

FC040

Complex Feature with possible components made of many simple features and complex features BC099, BC098 and FC166.

English:	Traffic Separation Scheme System
French:	Dispositif de séparation du trafic
German:	TBD
Italian:	Sistema spartitraffico
Dutch:	Verkeersscheidingsstelsel/Routeringssysteem
Spanish:	Sistema de separación de tráfico

Withdrawn/Retirée

FC041

A routing measure aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes.

English:	Traffic Separation Scheme (TSS)
French:	Dispositif de séparation du trafic
German:	Verkehrstrennungsgebiet
Italian:	Dispositivo di Separazione del Traffico
Dutch:	Verkeersscheidingsstelsel
Spanish:	Dispositivo separador de tráfico

FC100

A course whose length has been accurately measured and is used in conjunction with ranges ashore. It is used by vessels to calibrate logs, engine revolution counters, etc., and determine speed.

English:	Measured Distance Line
French:	Route de longueur définie
German:	TBD
Italian:	Percorso misurato
Dutch:	Gemeten Afstand/Gemeten Mijl
Spanish:	Línea de distancia medida

FC130

A line shown on a chart in proximity to a shipping route, along which ships are guided by a traffic control center located in a radar station. (See also BC032.)

English:	Radar Reference Line
French:	Route de guidage radar
German:	TBD
Italian:	Linea di riferimento radar
Dutch:	Radar Referentielijn
Spanish:	Línea de referencia radar

FC165

A track or lane established for the safe passage of ships.

English:	Route (Maritime)
French:	Route maritime
German:	Schiffahrtsweg
Italian:	Rotta (Marittima)
Dutch:	Scheepvaartroute
Spanish:	Ruta (Marítima)

FC166

Complex Feature with possible components: FC165 & RTT098, FC165 & RTT099, BC099, BC098.

English:	Deep Water Route
French:	Route en eau profonde
German:	TBD
Italian:	Via di acque profonde
Dutch:	Diep Water Route
Spanish:	Ruta de aguas profundas

Withdrawn/Retirée

FC167

Complex Feature with possible components: FC165 & RTT008, FC165 & RTT012, AT060 & STA032, AT050 & STA033, GA055, BB011, BC051, BC099, BC098, BC029, BB007.

English:	Defined Water
French:	Eaue à usage défini
German:	TBD
Italian:	Acque in genere
Dutch:	Nader Omschreven Watergebied
Spanish:	Agua definida

FC168

A navigable channel in lakes or other waterways.

English:	Canal Route
French:	Chenal
German:	TBD
Italian:	Canale navigabile
Dutch:	Vaargeul
Spanish:	Ruta navegable

FC170

A route established for the safe passage of vessels through offshore oil and gas fields and minefields.

English:	Safety Fairway
French:	Chenal de sécurité
German:	TBD
Italian:	Rotta di pió probabile sicurezza
Dutch:	Safety Fairway
Spanish:	Ruta de seguridad

FC177

An area of water cleared by a wire drag to ensure an area is free of navigational dangers.

English:	Swept Area
French:	Chenal dragué
German:	TBD
Italian:	Area navigabile bonificata
Dutch:	Gedregd Gebied
Spanish:	Area dragada

Withdrawn/Retirée

G—AERONAUTICAL INFORMATION

GA — Aeronautical Information—Air Routes

GA005

Designated airspace within which some or all aircraft may be subjected to air traffic control.

English:	Airspace
French:	Espace aérien
German:	Luftraum
Italian:	Spazio Aereo
Dutch:	Luchtruim
Spanish:	Espacio aéreo

GA010

A portion of an Air Traffic Service (ATS) Route identified by two electronic NAVAIDS at the extremities and/or reporting points.

English:	ATS Route Segment/Leg
French:	Tronçon de route aérienne
German:	Flugstreckenabschnitt
Italian:	Tratto di Aerovia
Dutch:	Luchtwegsector/Luchtcorridorsector
Spanish:	Tramo de aerovía

GA015

Airspace of defined dimension identified by area on the Earth's surface where activities must be confined because of their nature and/or where limitations may be imposed on aircraft operations not associated with those activities.

English:	Special Use Airspace
French:	Zone aérienne réglementée
German:	Besonderer Luftraum
Italian:	Spazio Aereo Regolamentato
Dutch:	Bijzonder Luchtruim
Spanish:	Espacio aéreo de uso especial

GA020

Single segment of an Airspace (GA005).

English:	Airspace Boundary Segment
French:	Limite d'espace aérien
German:	Grenzensegment
Italian:	Singolo lato di uno spazio aereo
Dutch:	Luchtruim-gedeelte
Spanish:	Límite de sector de espacio aéreo

GA025

Single segment of a Special Use Airspace (GA015).

English:	Special Use Airspace Segment
French:	Limite d' espace aérien à usage particulier
German:	TBD
Italian:	Singolo lato di uno spazio aereo regolamentato

Withdrawn/Retirée

Dutch: Bijzonder Luchtruim
Spanish: Sector de espacio aéreo de uso especial

GA030

Captures the Off Route Radials/Bearings (directions and distance from a NAVAID to a Waypoint).

English: Off Route Radial/Bearing
French: Distance/Gisement hors réseau
German: TBD
Italian: Radiale fuori rotta
Dutch: Off Route Radial/Bearing
Spanish: Punto de rumbo/distancia

GA035

Any visual or electronic device which provides point-to-point guidance information or position data.

English: NAVAIDS (Aeronautical)
French: Aide à la navigation (aéronautique)
German: Luftfahrtnavigationshilfe
Italian: Aiuto alla Navigazione (Aerea)
Dutch: Luchtvaartnavigatiemiddelen
Spanish: Ayuda a la navegación

GA045

A specific route designated for channeling the flow or traffic as necessary for the provision of air traffic services.

English: Route (Air)
French: Route ATS
German: Flugstrecke
Italian: Rotta Aerea
Dutch: Vliegroute
Spanish: Ruta (Aérea)

GA055

A predetermined geographical position, used for route instrument approach definition or progress reporting purposes or to change frequency etc.

English: Waypoint/Reporting-Calling in Point
French: Point de cheminement/Point de compte-rendu
German: Wegepunkt/Meldepunkt
Italian: Punto di Transito/Riporto/Chiamata
Dutch: Meldingspunt/En-Route Punt bij RNAV
Spanish: Punto de paso/Punto de referencia/Punto de llamada

GB — Aeronautical Information—Aerodrome

GB005

A defined area of land or water used for landing, take-off, and movement of aircraft including associated buildings and facilities.

English: US—Airport/Airfield UK—Airport/Airfield/Airstrip
French: Aéroport/terrain d'aviation

Withdrawn/Retirée

German: Flughafen
Italian: Aeroporto/Aerodromo
Dutch: Vliegveld/Vliegbasis/Luchthaven
Spanish: Aeropuerto/Aeródromo

GB006

A land aerodrome with limited facilities.

English: US—Airfield UK—Airstrip
French: Terrain d' aviation
German: Flugplatz/Behelfslandeplatz
Italian: Campo di fortuna
Dutch: Vliegstrip
Spanish: Campo de aviación

GB007

A tract of land used for landing, take-off, and movement of aircraft not including associated buildings, runways and other facilities.

English: Airport Area
French: Zone de décollage/d'atterrissage
German: TBD
Italian: Zona aeropotuale
Dutch: Luchthaven
Spanish: Area de aeropuerto

GB010

Lights used to: define and outline perimeters, runways, taxiways, etc.; guide aircraft while on the ground; and to provide guidance to aircraft on approach for landing.

English: Airport Lighting
French: Eclairage d'aéroport
German: Flughafenbefeuerung
Italian: Luci Aeroporto
Dutch: Vliegveldverlichting/Luchthavenverlichting
Spanish: Luces de pista

GB015

A defined paved or hard-packed area at an airport or heliport intended for aircraft parking.

English: Apron/Hardstand
French: Aire de trafic/Parking avions
German: Vorfeld/Befestigter Abstellplatz
Italian: Piazzale di Parcheggio Aerei
Dutch: Platform
Spanish: Zona de estacionamiento de aeronaves

GB020

Devices such as cables or barriers that can be used to stop aircraft immediately upon landing or aborted takeoff.

English: Arresting Gear
French: Dispositif d'arrêt
German: Fanganlage
Italian: Barriera d'Arresto
Dutch: Afrem-/Vangfaciliteit

Withdrawn/Retirée

Spanish: Dispositivo de detención

GB025

A barrier used to divert or dissipate jet or propeller blast.

English: Blast Barrier
French: Ecran anti-souffle
German: Abgasstrahlabweiser/Luftstromabweiser
Italian: Barriera Rompigetto
Dutch: Propellerwindscherm/Straalgasscherm
Spanish: Barrera antirrebufo

GB030

An improved area used for take-off, and landing, by helicopters and other vertical take-off and landing aircraft.

English: Helicopter Landing Pad
French: Zone d' atterrissage d'hélicoptères
German: Hubschrauberlandeplatz
Italian: Piazzola Atterraggio Elicotteri
Dutch: Helilandingsplaats
Spanish: Pista de aterrizaje para helicópteros

GB035

A place designated for the landing and take-off of helicopters, including its buildings and facilities.

English: Heliport
French: Héliport
German: Hubschrauberflugplatz
Italian: Eliporto
Dutch: Helihaven
Spanish: Helipuerto

GB040

A designated area or structure from which a rocket or missile is launched.

English: Launch Pad
French: Aire de lancement
German: Startplatz/Startrampe
Italian: Piazzola di Lancio
Dutch: Lanceerplaats/Lanceerplatform
Spanish: Zona de lanzamiento

GB045

An area beyond the take-off runway designated as able to support an airplane during an aborted take-off.

English: Overrun/Stopway
French: Bout de piste/Prolongement d'arrêt
German: Ueberrollstrecke/Stoppflaeche
Italian: Fine Pista/Testata Sicurezza
Dutch: Uitrolbaan
Spanish: Pista de frenado

Withdrawn/Retirée

GB050

A barricade which protects an aircraft from hostile action.

English:	Revetment (Airfield)
French:	Merlon
German:	Schutzwall/Splitterbox
Italian:	Ricovero (Aeroporto)
Dutch:	Beschermingswal/Beschermingswand (Vliegveld)
Spanish:	Muro de protección

GB055

A defined area, usually rectangular, used for the conventional landing and take-off of aircraft. (Excludes GB045.)

English:	Runway
French:	Piste
German:	Startbahn/Landebahn/Piste
Italian:	Pista di Volo
Dutch:	Startbaan/Landingsbaan
Spanish:	Pista de despegue

GB057

Adjacent area along either side of a road or runway not normally used by vehicles or aircraft, but provided as an allowable margin in case of emergency situations.

English:	Shoulder
French:	Bande d' arrêt d' urgence
German:	Standspur/Rollbahnschulter
Italian:	Fascia di Sicurezza
Dutch:	Berm/Vluchtstrook (Op Vliegveld)
Spanish:	Arcén

GB060

A device, normally placed near the threshold of a runway, used for reflecting radar signals.

English:	Runway Radar Reflector
French:	Réflecteur radar de piste
German:	Startbahnradarreflektor/Landebahnradarreflektor
Italian:	Riflettore Radar di Pista
Dutch:	Start-, Landingsbaanradarreflector
Spanish:	Radar de pista

GB065

An installation supporting aircraft capable of taking off and landing on water.

English:	Seaplane Base
French:	Hydrobase
German:	Wasserflugzeugstuetzpunkt
Italian:	Idroscalo
Dutch:	Watervliegtuigbasis
Spanish:	Base de hidroaviones

GB070

A designated portion of water outlined by visual surface markings.

English:	Seaplane Landing/Seaplane Take-Off Area

Withdrawn/Retiree

French:	Zone d' amerrissage/de décollage
German:	Wasserflugzeugstartfläche/Wasserflugzeuglandefläche
Italian:	Canale Decollo/Ammaraggio
Dutch:	Landings-, startgebied voor Watervliegtuigen
Spanish:	Zona de amerizaje y despegue

GB075

A prepared surface providing access to/from runways and the aircraft parking area, terminal area, or service area, etc.

English:	Taxiway
French:	Piste de circulation
German:	Taxiway/Rollweg
Italian:	Pista Rullaggio
Dutch:	Taxibaan/Rolbaan
Spanish:	Pista de rodadura

GB080

A visual device used to provide wind information.

English:	Wind Indicator
French:	Manche à air
German:	Windanzeiger/Windsack
Italian:	Manica a Vento
Dutch:	Windzak/Windwijzer
Spanish:	Manga de viento/Anemómetro

GB160

A designated area where a Nuclear, Biological, or Chemical (NBC) contaminated aircraft, checked at landing, is sent to be decontaminated by special teams.

English:	Decontamination Pad
French:	Aire de décontamination
German:	Dekontaminationsplatz
Italian:	Piazzola di Decontaminazione
Dutch:	NBC-Ontsmettingsplaats
Spanish:	Area de descontaminación

GB170

A designated area where the automated navigation instruments of aircraft are reset before taking-off.

English:	INS Alignment Pad
French:	Aire de compensation INS
German:	Koordinateneingabepunkt für Flugzeugnavigationsanlage
Italian:	Piazzola di Allineamento Strumenti
Dutch:	Plaats voor Inregelen/Controle van Navigatiesysteem
Spanish:	Area de calibración de instrumentos

GB220

An existing object of natural growth, or terrain at a fixed location within prescribed area with reference to which vertical clearance is or must be provided during flight operations.

English:	Air Obstruction
French:	Obstacle à la navigation aérienne
German:	Luftfahrthindernis

Withdrawn/Retirée

Italian:	Ostacolo naturale alle procedure aeree
Dutch:	(Natuurlijk) Luchtvaartobstakel/Hindernis
Spanish:	Obstáculo para navegación aérea

GB221

A generic man-made air obstruction.

English:	Miscellaneous Air Obstruction
French:	Obstructions aériennes diverses
German:	TBD
Italian:	Ostacolo alla navigazione aerea
Dutch:	Vliegobstakel
Spanish:	Obstrucción aérea genérica

Withdrawn/Retirée

I—CADASTRAL

IA — Cadastral—Areas

IA010

A line which encloses all water, streets, parcels and buildings.

English:	Map Boundary
French:	Limite cartographique
German:	TBD
Italian:	Bordo di mappa
Dutch:	Kaartbladgrens
Spanish:	Límite de hoja cartográfica

IA040

Land use and/or land property.

English:	Parcel
French:	Parcelle
German:	TBD
Italian:	Particella catastale
Dutch:	Perceel
Spanish:	Parcela

IA050

Constructions with unique characteristics.

English:	Cadastral Constructions
French:	Construction cadastrale
German:	TBD
Italian:	Unità immobiliare
Dutch:	Constructie (kadastraal)
Spanish:	Construcciones catastrales

ID — Cadastral— Reference Points

ID010

A reference point used for a cadastral map orientation.

English:	Cadastral Control Points
French:	Pointe de contrôle cadastral
German:	TBD
Italian:	Punto catastale
Dutch:	Kadastrale Controlepunten
Spanish:	Puntos de control catastrales

ID020

Used for topographic survey.

English:	Fiducial Points
French:	Borne cadastrale
German:	TBD
Italian:	Punto Topografico
Dutch:	Vast Punt

Withdrawn/Retirée

Spanish: Marcas fiduciales

IE — Cadastral— Special Characteristics

IE010

Contains drawing frames and map parameters.

English: Map Sheet Frame
French: TBD
German: TBD
Italian: Cornice
Dutch: TBD
Spanish: TBD

IE020

Contains topographical details and other information.

English: Miscellaneous
French: Divers
German: TBD
Italian: Punto Fiduciario
Dutch: Miscellaneous
Spanish: Miscelánea

IE040

Contains auxiliary information about each map.

English: Map-Info
French: information cartographique
German: TBD
Italian: Punto di informazione
Dutch: Kaarttechnische-informatie
Spanish: Información cartográfica

Withdrawn/Retirée

S—SPECIAL USE (Dataset Specific)

SA — Terrain Analysis Dataset

SA010

An area containing any surface water that is flowing or free standing such as lakes, rivers, oceans, reservoirs, etc.

English:	Common Open Water
French:	Surface en eau
German:	TBD
Italian:	Specchio d'acqua
Dutch:	Open Water
Spanish:	Aguas abiertas en general

SA020

An area that has been so disturbed by human activity that no single soil type can be accurately identified. These areas may include built-up areas, strip mines, landfills, railroad yards, etc.

English:	Disturbed Soil
French:	Sol recouvert par diverses constructions artificielles
German:	Künstliche Aufschüttung
Italian:	Area antropizzata
Dutch:	Bewerkte grond
Spanish:	Suelo diverso

SA030

Areas that contain no or little soil (less than 10%) containing bare rock or other extrusive material such as lava.

English:	Exposed Bedrock
French:	Roche à nu
German:	Felsfreiflächen
Italian:	Roccia affiorante
Dutch:	Vast Gesteente
Spanish:	Rocas al descubierto

SA040

An area permanently covered by snow or ice that covers a land mass, such as glaciers and snowfields.

English:	Permanent Snowfield
French:	Névé permanent
German:	Schneeregion
Italian:	Area permanentemente ghiacciata o innevata
Dutch:	Sneeuwveld
Spanish:	Nieves perpetuas

SA050

An area enclosing a group of slope values falling within a set range.

English:	Slope Polygon
French:	Zone de pente homogène
German:	TBD

Withdrawn/Retirée

Italian:	Poligono delimitante un'area con definita classe di pendenza
Dutch:	Helling
Spanish:	Polígono de pendientes

SA060

A natural watercourse or man-made waterway that is covered preventing its observation or further classification.

English:	Covered Drainage
French:	Cours d'eau ou conduit souterrain
German:	TBD
Italian:	Alveo coperto
Dutch:	Overdekte Sloot
Spanish:	Hidrografía cubierta

SB — Background Display Dataset

No Features are currently defined in this sub-category.

SC — Transportation and Logistics Dataset

No Features are currently defined in this sub-category.

SD — Aeronautical Information Dataset

No Features are currently defined in this sub-category.

SE — Toponymic Dataset

No Features are currently defined in this sub-category.

SF — Simulation Dataset

No Features are currently defined in this sub-category.

SU — Dataset Development

SU001

A center of operations for a military organization.

English:	Military Base
French:	Base militaire
German:	Militärischer Stützpunkt
Italian:	Base militare
Dutch:	Militair Terrein
Spanish:	Base militar

SU002

An underground, metropolitan electric railway or the tunnel through which it travels.

English:	US—Subway UK—Underground railway/Metro
French:	Métro
German:	Untergrundbahn

Withdrawn/Retirée

Italian:	Metropolitana
Dutch:	Metro
Spanish:	Metro

SU003

A building or section of building that is established to serve a particular purpose for water vehicles.

English:	Port Facility
French:	Installation portuaire
German:	TBD
Italian:	Struttura portuale
Dutch:	Havenfaciliteit
Spanish:	Instalación portuaria

Withdrawn/Retirée

Z—GENERAL

ZA — General — Annotation

No Features are currently defined in this sub-category.

ZB — General — Control Points

ZB020

A reference mark on a permanent object indicating elevation relative to an established datum.

English:	Benchmark
French:	Repère de nivellement
German:	Hoehenmarke
Italian:	Caposaldo di Livellazione
Dutch:	Waterpaspunt
Spanish:	Cota de nivelación

ZB030

A marker identifying the location of a surveyed boundary line.

English:	US—Boundary Monument UK—Boundary Monument/Boundary Mark
French:	Monument frontière (borne)
German:	Grenzmarke
Italian:	Cippo/Termine di Confine
Dutch:	Grenspaal/Grenssteen
Spanish:	Mojón/Muga

ZB035

A temporary object or mark on the ground of known position, elevation, or both.

English:	Control Point/Control Station
French:	Point de repère/Point de contrôle
German:	Kontrollpunkt/Passpunkt
Italian:	Punto di Appoggio/Punto di Controllo
Dutch:	Paspunt/Controlepunt
Spanish:	Punto de apoyo

ZB036

A mark which indicates the value of distance measured from an origin and consists of either a solid visible structure or a distinct location without special installation.

English:	Distance Mark
French:	Borne kilométrique
German:	TBD
Italian:	Segnale di distanza
Dutch:	Afstandsmerk/Kilometerpaal
Spanish:	Marca de distancia

ZB040

A point used to check system accuracy.

English:	Diagnostic Point
French:	Point de diagnostic

Withdrawn/Retirée

German: Diagnostischer Punkt
Italian: Punto Diagnostico
Dutch: Diagnostisch Punt
Spanish: Punto de control

ZB060

A physical point on the Earth's surface having a surveyed position (e.g. Trig Points).

English: Geodetic Point
French: Point géodésique
German: Lagefestpunkt
Italian: Punto Geodetico
Dutch: Getrianguleerd Punt
Spanish: Vértice geodésico/Punto geodésico

ZC — General — Magnetic Variation

ZC040

A localized anomaly in the Earth's magnetic field.

English: US—Magnetic Disturbance Area UK—Local Magnetic Anomaly
French: Limite de zone d'anomalie magnétique
German: Grenze eines Magnetischen Stoerfeldes
Italian: Limite dell'Area di Perturbazione Magnetica
Dutch: Magnetisch Stoorveld
Spanish: Zona de perturbaciones magnéticas

ZC050

Lines connecting points of equal magnetic variation.

English: Isogonic Lines
French: Isogone
German: Linien gleicher magnetischen Feldstärke
Italian: Isogone
Dutch: Isogoon
Spanish: Líneas isógonas

ZC051

Either of the two places on the Earth's surface where the magnetic dip is 90 degrees.

English: Magnetic Pole
French: Pôle magnétique
German: Magnetischer Pol
Italian: Polo magnetico
Dutch: Magnetische Pool
Spanish: Polo magnético

ZD — General — Miscellaneous

ZD001

A system of inter-connected real world objects of the same type or directly related types.

English: Network
French: Réseau
German: Netz

Withdrawn/Retirée

Italian:	Sistema/Rete
Dutch:	Net/Netwerk
Spanish:	Red

ZD003

An indicator which identifies incomplete or illogical data at a specific location (node), used for data processing only.

English:	Artifact Location
French:	Position d'un artéfact
German:	Artifact
Italian:	Indicatore Artificiale
Dutch:	Artifact
Spanish:	Indicador artificial

ZD012

A location where geographic information or statistics may apply.

English:	Geographic Information Point
French:	Point d'information géographique
German:	Geographischer Informationspunkt
Italian:	Punto di Indormazione Geografica
Dutch:	Geografisch Informatiepunt
Spanish:	Punto de información geográfica

ZD015

The location/position on a linear feature where the characteristics of the feature change significantly.

English:	Point of Change
French:	Changement de caractéristique
German:	TBD
Italian:	Punto di cambio caratieristico
Dutch:	Wijzigingspunt
Spanish:	Punto de cambio

ZD020

An area lacking suitable source coverage, or where data is not required.

English:	Void Collection Area
French:	Zone de non recueil
German:	Nicht Erfasstes Gebiet
Italian:	Area senza Informazioni
Dutch:	Gebied Zonder Informatie
Spanish:	Zona sin información

ZD040

A geographic place on the Earth, not normally appearing as a feature on a map, but having a name that is required to be placed on a map.

English:	Named Location
French:	Lieu-dit non habité/Position d'un toponyme
German:	TBD
Italian:	Localit geografica
Dutch:	Geografische Naam
Spanish:	Lugar con nombre propio

Withdrawn/Retirée

ZD045

An area in which a characteristic or an activity pertaining to the area can be described and possibly labeled on a product if deemed important at the time the product is being produced.

English:	Text Description
French:	Description textuelle/Toponyme
German:	Testbeschreibung
Italian:	Testo cartografico
Dutch:	Beschrijving
Spanish:	Descripción de texto

ZE — General — Background Features

No Features are currently defined in this sub-category.

Withdrawn/Retirée

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Withdrawn/Retirée

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Withdrawn/Retirée

Annex B — Attribute and Value Codes

AAH Absolute Horizontal Accuracy

Absolute horizontal accuracy integer value used in the ISO 8211 encapsulation. Units shall be described by reading the UNIaah field.

AAH 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer	0±32,767	1 Unit	

AAV Absolute Vertical Accuracy

Absolute vertical accuracy integer value used in the ISO 8211 encapsulation. Units shall be described by reading the UNIaav field.

AAV 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer	0±32,767	1 Unit	

ACC Accuracy Category

Accuracy of geographic position.

ACC	0	Unknown
ACC	1	Accurate
ACC	2	Approximate
ACC	3	Doubtful
ACC	5	Disputed
ACC	6	Undisputed
ACC	7	Precise
ACC	8	Abrogated

AFA Available Facilities

Facilities available at or in the near vicinity.

AFA	0	Unknown
AFA	1	Visitors Berth
AFA	2	Visitors Mooring
AFA	3	Sailmaker
AFA	4	Chandler
AFA	5	Provisions
AFA	6	Physician/Doctor
AFA	7	Pharmacy/Chemist
AFA	8	Drinking Water
AFA	9	Fuel Station
AFA	10	Electricity
AFA	11	Bottle Gas/LPG
AFA	12	Showers
AFA	13	Laundrette

Withdrawn/Retiree

AFA	14	Toilets
AFA	15	Post Box
AFA	16	Public Telephone
AFA	17	Refuse Bin
AFA	18	Water Police
AFA	19	Helipad
AFA	20	Ticket Sales
AFA	21	No Ticket Sales
AFA	22	Yatch Club
AFA	23	Boat Hoist
AFA	24	Boat Yard
AFA	25	Public Inn
AFA	26	Restaurant
AFA	999	Other

AGC Arresting Gear Category

Device used to stop an uncontrolled aircraft at the end of a runway.

AGC	0	Unknown
AGC	1	Net
AGC	2	Cable
AGC	999	Other

AHC Associated Hydrographic Category

The annual water content of the associated hydrographic feature as defined by the Inland Shoreline.

AHC	0	Unknown
AHC	1	Perennial
AHC	2	Intermittent
AHC	3	Ephemeral

AIA Airspace Identification Attribute

A set of characters which enables an individual airspace to be uniquely identified.

AIA	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			15 Characters

ALN Air route segments Length

Length, in nautical miles, of individual air route segments.

ALN	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0+32,767	1 NM	

Withdrawn/Retirée

AOO Angle of Orientation

The angular distance measured from true north (0 deg) clockwise to the major axis of the feature. If the feature is square, the axis 0 through 89 deg shall be recorded. If the feature is circular, 360 deg shall be recorded.

AOO 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-360	1 DEG	

APT Airfield Type

Unique airfield type.

APT	0	Unknown
APT	1	Major Airfield
APT	2	Minor Airfield
APT	3	Light/General Aviation Aircraft Operating Only
APT	4	Seaplane Base
APT	5	Glider Site
APT	6	Microlight/Ultralight Site
APT	7	Hang Glider Site
APT	8	Winch Launched Hang Glider Site
APT	9	Heliport
APT	10	Helicopter Site
APT	11	Heliport at Hospitals
APT	12	Emergency
APT	13	Parascending/Parasailing Site
APT	14	Airport/Airfield
APT	999	Other

ARA Area Coverage Attribute

The absolute area within the delineation of the feature.

ARA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Sq. Meters	Short Integer	0±32,767	1 M2	

ARH Area Coverage Attribute Hectares

The absolute area within the delineation of the feature in hectares.

ARH 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Hectares	Short Integer	0±32,767	1 HA	

Withdrawn/Retirée

ARR Angle of Radar Reflector

If DIR = 3 then ARR is the angular distance measured from true north (0 deg) clockwise to the reflective side of the feature.

ARR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-360	1 DEG	

ATC Aqueduct Type Category

Type of aqueduct.

ATC 0 Unknown
ATC 1 Qanat/Kanat/Karez Shaft
ATC 2 Other
ATC 3 Underground Aqueduct

ATL ATS Route Level

Defines the ATS Route Structure of which this route is effective.

ATL 0 Unknown
ATL 1 Both
ATL 2 High Level (FL195)
ATL 3 Low Level (FL195)
ATL 4 Night Low Flying
ATL 999 Other

ATN Aids to Navigation

Indicates whether a feature is marked or unmarked by an aid to navigation.

ATN 0 Unknown
ATN 1 Marked
ATN 2 Unmarked
ATN 3 Lit
ATN 4 Unlit
ATN 999 Other

AUA ATS Use Attribute

The particular use of the designated airspace.

AUA 0 Unknown
AUA 1 Advisory Area (ADA)
AUA 2 Air Defense Identification Zone (ADIZ)
AUA 3 Air Route Traffic Control Center (ARTCC)
AUA 4 Alert Area
AUA 5 Area Control Center (ACC)
AUA 6 Buffer Zone (BZ)
AUA 7 Canadian Air Defense Identification Zone (CADIZ)
AUA 8 Control Area (CTA)
AUA 9 Control Zone (CTLZ)

Withdrawn/Retirée

AUA	10	Danger Area
AUA	11	Dew East Military Identification Zone(DEMIZ)
AUA	12	Distant Early Warning Identification Zone (DEWIZ)
AUA	13	Flight Information Region (FIR)
AUA	14	French Peripheral Identification Zone(LIP)
AUA	15	Military Aerodrome Traffic Zone (MAIZ)
AUA	16	Military Common Area Control (MCAC)
AUA	17	Military Climb Corridor (MCC)
AUA	18	Military Flying Area (Canada, MFA)
AUA	19	Mid-Canada Identification Zone (MIDIZ)
AUA	20	Military Operations Area (MOA)
AUA	21	Military Terminal Control Area (MTCA)
AUA	22	Military Upper Control Area (MUCA)
AUA	23	Oceanic Control Area (non-FAA) (OCA)
AUA	24	Operating Area (OPAREA)
AUA	25	Prohibited Area
AUA	26	Positive Control Area (PCA)
AUA	27	Positive Control Zone (PCZ)
AUA	28	Radar Area
AUA	29	Restricted Area
AUA	30	Security Identification Zone (SIZ)
AUA	31	Special Air Traffic Rules Area
AUA	32	Special Rules Zone
AUA	33	Transition Area (For Chart Use Only - TA)
AUA	34	Terminal Control Area (TCA)
AUA	35	Continental Control Area (CCA)
AUA	37	Terminal Radar Service Area (TRSA)
AUA	38	Upper Advisory Area (UDA)
AUA	39	Upper Control Area (UTA)
AUA	40	Upper Flight Information Region (UIR)
AUA	41	Warning Area
AUA	42	Zone of Interior (ZI)
AUA	43	VALUE INTENTIONALLY LEFT BLANK
AUA	44	Korea Limited Identification Zone(KLIZ)
AUA	45	Uncontrolled Airspace
AUA	46	Controlled Airspace
AUA	47	Airport Traffic Area (ATA)
AUA	48	Airport Radar Service Area (ARSA)
AUA	49	Controlled Firing Area
AUA	50	Parachute Jump Area
AUA	51	Airport Advisory Area
AUA	52	Designated Mountainous Area
AUA	54	Non-Free Flying Area
AUA	55	Control Zone - No Fixed Wing Special VFR Permitted
AUA	56	Altimeter Change Boundary
AUA	57	Defense Area
AUA	58	Aerodrome Control Zone
AUA	59	Class C Control Zone
AUA	60	Sparsely Settled Area
AUA	62	ICAO
AUA	63	Upper Airspace Centers Operational Air Traffic
AUA	64	Controlled Visual Flight Rules (CVFR)
AUA	65	Bird Hazard Areas
AUA	66	Temporary Reserved Airspace (TRA)
AUA	67	Air Route Traffic Control Center Sector or Discrete
AUA	68	Sub-Flight Information Region (SUB FIR)
AUA	69	Radar Area Sector Boundary

Without WT/Retirée

AUA	70	Oceanic Control Area (FAA) (CTA)
AUA	74	Refueling/Track Area
AUA	75	Berlin Control Zone
AUA	76	Helicopter Protection Area
AUA	77	Traffic Information Zone
AUA	78	Low Flying Area
AUA	999	Other

AUB Airspace Use Boundary

Designated airspace within which some or all aircraft may be subject to air traffic control.

AUB	0	Unknown
AUB	1	Flight Information Region (FIR)
AUB	2	Sub-FIR
AUB	3	Control Zone (CTZ/CTR)
AUB	4	Military CTZ/CTR
AUB	5	VALUE INTENTIONALLY LEFT BLANK
AUB	6	Special Rules Zone (SRZ)
AUB	7	Advisory Area (ADA)
AUB	8	Terminal Control Area (TCA)/Military TCA (MTMA)
AUB	9	VALUE INTENTIONALLY LEFT BLANK
AUB	10	Military Climb Corridor
AUB	11	Altimetric Setting Region (ASR)
AUB	12	Designated Mountainous Area
AUB	13	Area Control Center (ACC)
AUB	14	Radar Area
AUB	15	Radar Area Sector Boundary
AUB	16	Radar Service Area
AUB	17	Terminal Radar Service Area (TRSA)
AUB	18	Transition Area (TA)
AUB	19	Upper Information Region (UIR)
AUB	20	Upper Control Area
AUB	21	Military Upper
AUB	22	Upper Advisory Area (UDA)
AUB	23	Control Area (CTA)
AUB	24	Special Rules Area
AUB	25	Mandatory Radar Service Area
AUB	26	Training Airspace
AUB	27	Air-to-Air Refueling Area/Track/Route
AUB	28	Continental Control Area (CCA)
AUB	29	Oceanic Control Area (non-FAA) (OCA)
AUB	30	Oceanic Control Area (FAA) (OCA)
AUB	31	Upper Airspace Centers Operational Air Traffic
AUB	32	Air Defense Identification Zone (ADIZ)
AUB	33	Buffer Zone
AUB	34	Distant Early Warning Military Identification Zone (DEWMIZ)
AUB	35	DEW Identification Zone (DEWIZ)
AUB	36	French Peripheral Identification Zone (LIP)
AUB	37	Canadian Air Defense Identification Zone (CADIZ)
AUB	38	Mid-Canada Identification Zone (MIDIZ)
AUB	39	Security Identification Zone (SIZ)
AUB	40	Zone of Interior
AUB	41	Korea Limited Identification Zone
AUB	42	VALUE INTENTIONALLY LEFT BLANK
AUB	43	Aerodrome Traffic Zone (ATZ)

Withdrawn/Retirée

AUB	44	Aerodrome Control Zone
AUB	45	Military ATZ
AUB	46	Airport Radar Service Area (ARSA)
AUB	47	Airport Advisory Area
AUB	48	Uncontrolled Airspace
AUB	49	Controlled Airspace
AUB	50	Controlled Visual Flight Rules (CVFR)
AUB	51	Positive Control Area (PCA)
AUB	52	Positive Control Zone (PCZ)
AUB	53	Mandatory Radio Area
AUB	54	Special Access Lane Entry
AUB	55	Special Access Lane Exit
AUB	56	Flight Information Center (FIC)/Flight Service Station (FSS)
AUB	57	Military Sector Control Center (SCC-AM)
AUB	58	Air Route Traffic Control Center (ARTCC)
AUB	59	ARTCC Sector Discrete
AUB	60	VFR Sector Boundary
AUB	61	Military Common Area Control (MCAC)
AUB	62	Traffic Information Zone
AUB	63	Low Flying Area (LFA)
AUB	64	LFA Sub-Boundary
AUB	65	Low Flying Tactical Training Area (TTA)
AUB	66	Low Flying Tactical Route Boundary
AUB	67	Low Flying Flow Arrow
AUB	68	Low Flying Dividing Line
AUB	69	Low Flying Flow Corridor Boundary
AUB	70	Low Flying Dedicated User Area
AUB	71	Low Flying Weather Corridor
AUB	72	Maximum Elevation Figure
AUB	999	Other

AUL Airspace Use Limitations

Airspace wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations.

AUL	0	Unknown
AUL	1	Danger Area
AUL	2	Prohibited Area
AUL	3	Restricted Area
AUL	4	Prohibited VFR
AUL	5	Alert Area
AUL	6	Warning Area
AUL	7	Defense Area
AUL	8	Controlled Firing Area
AUL	9	Temporary Reserved Airspace (TRA)
AUL	10	Parachute Drop Zone
AUL	11	Hazard to Aircraft
AUL	12	Gas Venting Station
AUL	13	Town to be Avoided
AUL	14	Nature Reserves, Parks, Conservation Areas
AUL	15	Helicopter Protection
AUL	16	Air Exercise Area
AUL	17	Area of Intense Air Activity
AUL	18	Bird Sanctuary
AUL	19	Bird Hazard Area

Withdrawn/Retirée

AUL	20	Industrial Hazards/Object needing protection
AUL	21	Health Resorts/Medical Establishments
AUL	22	Low Flying Avoidance Area
AUL	23	Mink Farm
AUL	24	Low Flying Tactical Training Avoidances
AUL	25	Low Flying Dedicated User Area
AUL	26	Area of Intensive Microlight/Ultralight Flying
AUL	27	Provost Marshal
AUL	28	Military Operating Area (MOA)
AUL	29	High Intensity Radio Transmission Area (HIRTA)
AUL	30	Military Flying Area (MFA)
AUL	31	Operating Area (OPAREA)
AUL	32	Non-free Flying Area
AUL	33	Sparsely Settled Area
AUL	34	Caution Area
AUL	999	Other

AUR Airspace Use Routes

A specified route designed for channeling the flow of traffic as necessary for the provision of air traffic services.

AUR	0	Unknown
AUR	1	Airway
AUR	2	Air Route
AUR	3	Purple Airway
AUR	4	Royal Low Level Corridor
AUR	5	Corridor
AUR	6	Atlantic
AUR	7	Bahama
AUR	8	Advisory
AUR	9	Direct
AUR	10	Military
AUR	11	Oceanic
AUR	12	Area Navigation (RNAV)
AUR	13	SUBS
AUR	14	TACAN
AUR	15	Helicopter Route
AUR	16	Helicopter Routes not available to single engine
AUR	17	Low Flying Route
AUR	18	Royal Helicopter Route
AUR	999	Other

AUS Airspace/Facility Operating Times

Status of Air Space and any restrictions that are applicable.

AUS	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

Withdrawn/Retirée

AV1 Lowest Airspace Height

Height (AGL - above ground level) above surface level to the lowest portion of the feature (used only for Air Information).

AV1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

AV2 Highest Airspace Height

Height (AGL - above ground level) above surface level to the highest portion of the feature (used only for Air Information).

AV2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

AWD Air route segments Width

Width of individual air route segments.

AWD 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

AZ1 Lowest Airspace Z-value

Measurement to specify lowest vertical limits.

AZ1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

AZ2 Highest Airspace Z-value

Measurement to specify highest vertical limits.

AZ2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

BAC Built-up Area Classification

The indication of the relative density of the Built-Up Area.

BAC 0 Unknown
BAC 1 Sparse to Moderate
BAC 2 Dense

Withdrawn/Retirée

BCC Bypass Condition Category

The ease or ability to circumvent a destroyed section of bridge, tunnel or pass within a 2 kilometer distance on each side of the feature. Bypass condition will not consider other bridges in bypass determination.

BCC	0	Unknown
BCC	1	Easy (Obstacle can be crossed within 2 KM of feature, no work)
BCC	2	Difficult (Obstacle can be crossed within 2 KM of feature, work required).
BCC	3	Impossible (Obstacle cannot be bypassed within 2 KM of feature)

BCR Bottom Return Rock Classification

Tabulates bottom return rock.

BCR	1	Classified
BCR	2	Detected
BCR	3	Identified

BCT Bottom Configuration Type

The type of configuration of underwater bottom topography.

BCT	1	Double Break in Slope
BCT	2	Break in Slope
BCT	3	Depression, Flat Bottom
BCT	4	Depression, Steep Sided
BCT	5	Depression, V-Shaped
BCT	6	Depression, Sediment Filled
BCT	7	Elevation, Flat Topped
BCT	8	Elevation, Peaked
BCT	9	Elevation, Rounded
BCT	10	Slumped Blocks
BCT	11	Scarp, Probably Faulted
BCT	12	Slump Debris
BCT	13	Step
BCT	14	Terrace

BDC Bridge Design Category

Structural design characteristics of the bridge or bridge segment.

BDC	0	Unknown
BDC	1	Arch
BDC	2	Cantilever
BDC	3	Deck
BDC	4	Slab
BDC	5	Floating Bridge
BDC	6	Girder
BDC	7	Stringer (Beam)
BDC	8	Truss
BDC	9	Suspension
BDC	11	Other
BDC	12	Transporter (Ferry Bridge)

Withdrawn/Retirée

BER Berth Identifier

The designated number or letter used to identify this feature.

BER	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

BFC Building Function Category

Type or purpose of the building.

BFC	0	Unknown
BFC	1	Fabrication Structures
BFC	2	Government Building
BFC	3	Capitol Building
BFC	4	Castle
BFC	5	Government Administration Building
BFC	6	Hospital
BFC	7	House of Worship
BFC	8	Military Administration /Operations Building
BFC	9	Museum
BFC	10	Observatory
BFC	11	Palace
BFC	12	Police Station
BFC	13	Prison
BFC	14	Ranger Station
BFC	15	School
BFC	16	House
BFC	17	Multi Unit Dwelling
BFC	18	Cemetery Building
BFC	19	Farm Building
BFC	20	Greenhouse
BFC	21	Garage
BFC	22	Watermill /Gristmill
BFC	23	Wind Tunnel
BFC	24	Warehouse
BFC	25	Roundhouse
BFC	26	Railroad Storage /Repair Facility
BFC	27	Depot Terminal
BFC	28	Administration Building
BFC	29	Aircraft Maintenance Shop
BFC	30	Hangar
BFC	31	Customs House
BFC	33	Health Office
BFC	34	Firing Range
BFC	35	Post Office
BFC	36	Barracks/Dormitory
BFC	37	Fire Station
BFC	38	Jail
BFC	39	Guardhouse
BFC	40	Telephone Switching Station
BFC	50	Church
BFC	51	Market
BFC	52	Town Hall

Withdrawn/Retirée

BFC	53	Bank
BFC	54	Service/Refueling Station
BFC	55	Yacht Club/Sailing Club
BFC	56	Public Inn
BFC	57	Restaurant
BFC	58	Observation
BFC	59	Research and Development Lab/Research Facility
BFC	60	University/College
BFC	61	Courthouse
BFC	62	Legation
BFC	63	Mission
BFC	64	Chancery
BFC	65	Ambassadorial Residence
BFC	66	Embassy
BFC	67	Consulate
BFC	68	Guard House
BFC	69	Guard Shack/Guard Room
BFC	70	Kennel
BFC	71	Oil Mill (Vegetable)
BFC	72	Aerator
BFC	73	Carpentry
BFC	74	Saw-mill
BFC	75	Kiln/Oven
BFC	76	Signal Box/Railway Signalman's House
BFC	77	Harbor Masters Office
BFC	78	Marine Police
BFC	79	Rescue
BFC	80	Port Control
BFC	81	Maritime Station
BFC	82	Lighthouse
BFC	83	Power Generation
BFC	84	Filtration Plant
BFC	85	News Paper Plant
BFC	86	Telephone Exchange (Main)
BFC	87	Auditorium
BFC	88	Opera House
BFC	89	Processing/Treatment
BFC	90	Pumphouse
BFC	91	Mobile Home
BFC	92	Weather Station
BFC	93	Dependents Housing/Bivouac Area
BFC	94	Railroad Station
BFC	95	Hotel
BFC	96	Diplomatic Building
BFC	97	Trading Post
BFC	98	Shed
BFC	99	Battery
BFC	100	Medical Center
BFC	101	Municipal Hall
BFC	102	Oil/Gas Facilities Building
BFC	103	Outbuilding
BFC	104	Paper/Pulp Mill
BFC	105	Reformatory
BFC	106	Sanitorium
BFC	107	Satellite Tracking Station
BFC	108	Seminary
BFC	109	Senior Citizen's Home

Withdrawn/Retirée

BFC	110	Shipyard
BFC	111	Sportsplex
BFC	112	Steel Mill
BFC	113	Weigh Scale (Highway)
BFC	114	Non-Christian Place of Worship
BFC	115	Hostel
BFC	116	Factory
BFC	117	Motel
BFC	118	Community Center
BFC	119	City Hall
BFC	120	Automobile Plant
BFC	121	Armory
BFC	122	Shopping Center
BFC	123	Correctional Institute
BFC	124	Repair Facility
BFC	125	Barn/Machinery Shed
BFC	126	Astronomical Station
BFC	127	Theater
BFC	128	Library
BFC	723	Combined Fire and Police Station
BFC	999	Other

BGL **Bank Gradient Left**

Slope of the left bank (facing downstream) above water level.

BGL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short integer	±90	1 %	

BGR **Bank Gradient Right**

Slope of the right bank (facing downstream) above water level.

BGR	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short integer	±90	1 %	

BHL **Bank Height Left**

Height of the left bank above the water level (facing downstream) to the average water level.

BHL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeter	Short integer	0±32,767	1 DM	

Withdrawn/Retirée

BHR Bank Height Right

Height of the right bank above the water level (facing downstream) to the average water level.

BHR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeter	Short integer	0±32,767	1 DM	

BIT Beach Indicator Type

Indicates the relative portion of a beach.

BIT	0	Unknown
BIT	1	Nearshore
BIT	2	Foreshore
BIT	3	Backshore

BMC Bottom Materials Composition

Predominant material composition of the bottom of a body of water.

BMC	0	Unknown
BMC	1	Clay and Silt
BMC	2	Silty Sands
BMC	3	Sand and Gravel
BMC	4	Gravel and Cobble
BMC	5	Rocks and Boulders
BMC	6	Bedrock
BMC	7	Paved
BMC	8	Peat
BMC	9	Sand over mud
BMC	10	Mixed qualities
BMC	11	Coral
BMC	12	Slash
BMC	13	Seamount
BMC	14	Sand

BOC Bog Category

Tabulates the components or structure of a bog.

BOC	0	Unknown
BOC	1	Palsa
BOC	2	String
BOC	999	Other

BOT Bridge Opening Type

The type of structure or mechanism by which a portion of a bridge is moved to allow passage of a vessel.

BOT	0	Unknown
BOT	4	Draw/Bascule
BOT	10	Swing

Withdrawn/Retirée

BOT	11	Lift
BOT	12	Retractable
BOT	13	Not Applicable

BR2 Broadcast Frequency 2

The frequency on which a station broadcasts (second occurrence).

BR2	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Hertz	Long Integer		1 HZ	

BRA Bottom Return Attributes Classification

Tabulates bottom return attributes.

BRA	1	Classified
BRA	2	Detected
BRA	3	Identified

BRC Bottom Return Classification

Tabulates bottom return types.

BRC	1	Classification of Bottom Return Identity
BRC	2	Bottom Return Track Number
BRC	3	Classification of Bottom Return Seabed Inst.
BRC	4	Classification of Bottom Return Rock
BRC	5	Classification of Bottom Return Obstacles
BRC	6	Classification of Bottom Return Wreck

BRF Broadcast Frequency

Broadcast frequency of a communications device.

BRF	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Hertz	Long Integer		1 HZ	

BRG Bearing of Object

The bearing of an object from an observer (on any point along the line) towards the object or feature, expressed in degrees and tenths (e.g. 3.0 DEG).

BRG	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Floating Point	0.0-359.9	0.1 DEG	

Withdrawn/Retiree

BRI Bottom Return Identity Classification

Tabulates bottom return identity.

BRI	1	Unknown
BRI	2	Neutral

BRN Bridge Reference Number

A unique number relating information to bridge and bridge spans.

BRN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			24 Characters

BRO Bottom Return Obstacles Classification

Tabulates bottom return obstacles.

BRO	1	Classified
BRO	2	Detected
BRO	3	Identified

BRR Bearing and Reciprocal Category

True course of a vessel in 0.1 degree increments, when proceeding along a track or route, followed by its reciprocal bearing (ie. 053.1-233.1).

BRR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			5 Characters

BRS Bearing From Seaward

True course of a vessel when proceeding from seaward along a track or course.

BRS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Floating Point	0-360	0.1 DEG	

BRT Bottom Return Track Number

Identifies track number.

BRT 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer		1 unit	4 digits

Withdrawn/Retirée

BRW Bottom Return Wreck Classification

Tabulates bottom return wreck.

BRW	1	Classified
BRW	2	Detected
BRW	3	Identified

BSC Bridge/Bridge Superstructure Category

Structural design characteristics.

BSC	0	Unknown
BSC	1	Arch (assume open spandrel)
BSC	2	Cantilever
BSC	3	Deck
BSC	4	Drawbridge
BSC	5	Floating Bridge/Pontoon
BSC	6	Girder
BSC	7	Tower Suspension
BSC	8	Truss
BSC	9	Suspension
BSC	10	Swing
BSC	11	Lift
BSC	12	Transporter
BSC	13	Bascule
BSC	14	Unspecified Fixed
BSC	15	Slab
BSC	16	Stringer (beam)
BSC	17	Arch Suspension
BSC	18	Retractable
BSC	19	Suspension, bow string
BSC	20	Suspension, cable stayed
BSC	21	Moveable Surface
BSC	22	Covered
BSC	23	Opening
BSC	24	Footbridge
BSC	25	Fixed
BSC	26	Arch (closed spandrel)
BSC	27	Cable Stayed
BSC	999	Other

BSM Bridge Span Mobility

Identifies bridge spans that move in some manner allowing passage underneath the span.

BSM	0	Unknown
BSM	1	Moveable Span
BSM	2	Fixed Span

Withdrawn/Retirée

BSN Bridge Serial Number

Unique number associated with a bridge which is used to identify the bridge in other national or intelligence databases.

BSN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			80 Characters

BSP Bridge Span Category

Identifies type of moveable span (used for AQ045 when BSM=1).

BSP	0	Unknown
BSP	1	Truss
BSP	2	Truss, moveable or swing
BSP	3	Plate girder
BSP	4	Plate girder moveable as vertical lift
BSP	5	Plate girder moveable as draw bridge
BSP	6	Plate girder moveable as bascule
BSP	7	Stringer, beam
BSP	8	Stringer, moveable as vertical lift
BSP	9	Stringer, moveable as draw bridge
BSP	10	Slab
BSP	11	Arc, closed span
BSP	12	Arc, open span
BSP	13	Floating bridge, pontoon bridge
BSP	14	Culvert
BSP	15	Frame structure
BSP	16	Vault structure
BSP	17	Unspecified fixed
BSP	18	Retractable
BSP	999	Other

BSR Bottom Return Seabed Inst.

True course of a vessel when proceeding from seaward along a track or course.

BSR	1	Classified
BSR	2	Detected
BSR	3	Identified

BST Boundary Status Type

Identifies the status of a boundary.

BST	0	Unknown
BST	1	Definite
BST	2	Indefinite
BST	3	In Dispute
BST	4	No Defined Boundary

Withdrawn/Retirée

BTC Beacon/Buoy Type Category

Type buoy or beacon.

BTC	0	Unknown
BTC	1	Cardinal
BTC	2	Float
BTC	3	Isolated Danger
BTC	4	Large Navigational Buoy (LANBY)
BTC	5	Lateral
BTC	6	Light Float
BTC	7	Mooring
BTC	8	Mooring with Telegraph
BTC	9	Mooring with Telephone
BTC	10	Ocean Data Acquisition System (ODAS)
BTC	11	Outer, Landfall
BTC	12	Port (From Seaward or According to Dir. of Buoyage)
BTC	13	Preferred Channel to Port
BTC	14	Preferred Channel to Starboard
BTC	15	Special Purpose
BTC	16	Starboard (From Seaward per Dir. of Buoyage)
BTC	17	Tanker
BTC	18	Safe Water
BTC	19	Anchorage
BTC	20	Fairway
BTC	21	Mid-Channel
BTC	22	Bifurcation
BTC	23	Junction
BTC	24	Wreck
BTC	25	Obstruction
BTC	26	Telegraph Cable
BTC	27	Warping
BTC	28	Quarantine
BTC	29	Practice Area
BTC	30	Explosive Anchorage
BTC	31	Aeronautical Anchorage
BTC	32	Compass Adjustment
BTC	33	Fish Trap
BTC	34	Spoil Ground
BTC	35	Articulated Lights
BTC	36	Floating Beacon
BTC	37	Dan
BTC	38	Floodlit/Illuminated
BTC	39	Trot
BTC	81	Diving
BTC	82	Information
BTC	83	DND Buoy (Canadian Department of National Defence)
BTC	85	Caution
BTC	86	Private
BTC	87	Swim
BTC	88	Control
BTC	89	Keep-Out
BTC	90	Daybeacon
BTC	91	Lateral preferred channel to port mark
BTC	92	Lateral preferred channel to starboard mark
BTC	93	Lateral starboard-hand mark

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BTC	94	Lateral port-hand mark
BTC	95	Cardinal West Mark
BTC	96	Cardinal South Mark
BTC	97	Cardinal East Mark
BTC	98	Cardinal North Mark
BTC	99	Installation
BTC	999	Other

BUD Brush/Undergrowth Density Code

Density of brush or undergrowth.

BUD	0	Unknown
BUD	1	Open (≤5%)
BUD	2	Sparse (>5%≤15%)
BUD	3	Medium (>15%≤50%)
BUD	4	Dense (>50%)
BUD	5	Not Applicable

BVL Bank Vegetation Left

Density of vegetation found on the downstream left bank.

BVL	0	Unknown
BVL	1	Open (≤5%)
BVL	2	Sparse (>5%≤15%)
BVL	3	Medium (>15%≤50%)
BVL	4	Dense (>50%)

BVR Bank Vegetation Right

Density of vegetation found on the downstream right bank.

BVR	0	Unknown
BVR	1	Open (≤5%)
BVR	2	Sparse (>5%≤15%)
BVR	3	Medium (>15%≤50%)
BVR	4	Dense (>50%)

BWL Below Water Bank Slope (Left)

Slope (in percent) of the left bank under the water facing downstream.

BWL	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	±90	1 %	

Withdrawn/Retirée

BWR Below Water Bank Slope (Right)

Slope (in percent) of the right bank under the water facing downstream.

BWR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	±90	1 %	

C80 Rate of Current

Rate of current flow at high water.

C80 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C81 Rate of Current(1)

Rate of current flow 1 hour after high water.

C81 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C82 Rate of Current(2)

Rate of current flow 2 hours after high water.

C82 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C83 Rate of Current(3)

Rate of current flow 3 hours after high water.

C83 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C84 Rate of Current(4)

Rate of current flow 4 hours after high water.

C84 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

Withdrawn/Retirée

C85 Rate of Current(5)

Rate of current flow 5 hours after high water.

C85 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C86 Rate of Current(6)

Rate of current flow 6 hours after high water.

C86 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C87 Rate of Current(7)

Rate of current flow 7 hours after high water.

C87 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C88 Rate of Current(8)

Rate of current flow 8 hours after high water.

C88 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C89 Rate of Current(9)

Rate of current flow 9 hours after high water.

C89 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

C90 Rate of Current(10)

Rate of current flow 10 hours after high water.

C90 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

Withdrawn/Retirée

C91 Rate of Current(11)

Rate of current flow 11 hours after high water.

C91 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

CAB Cable Classification

Tabulates the kind of transmission.

CAB	1	Undefined
CAB	2	Power Line
CAB	3	Telephone
CAB	4	Telegraph

CAC Collection Attribute Category

Classifies the collection criteria.

CAC	0	Unknown
CAC	1	Data Not Requested By User
CAC	2	Area Too Rough to Collect
CAC	3	No Available Imagery
CAC	4	Different Height Threshold Within Data Block
CAC	5	Low Data Collection Criteria
CAC	6	No Available Map Source
CAC	7	No Suitable Imagery
CAC	8	Data Not Required
CAC	9	Collected
CAC	10	Derived
CAC	999	Other

CAP Capacity

The capacity of a feature. Units will be qualified using a structured text approach, e.g. 100(cars)[per hour] where the unit is in parentheses ( ) and a unit qualifier is in brackets [ ].

CAP 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Structured Text	ASCII Text			80 Characters

CCA Constriction/Expansion Category

The type of a constriction or expansion.

CCA	0	Unknown
CCA	1	Gateway
CCA	2	A narrow pass between rocks
CCA	3	Road siding on narrow roads
CCA	4	A passage through a building

Withdrawn/Retirée

CCA	999	Other

CCC Color Code Category

Color of the sea floor, light, buoy, structure, etc.

CCC	0	Unknown
CCC	1	Black
CCC	2	Blue
CCC	3	Brown
CCC	4	Gray
CCC	5	Green
CCC	7	Chocolate
CCC	8	VALUE INTENTIONALLY LEFT BLANK
CCC	9	Orange
CCC	10	VALUE INTENTIONALLY LEFT BLANK
CCC	11	VALUE INTENTIONALLY LEFT BLANK
CCC	12	Red
CCC	13	VALUE INTENTIONALLY LEFT BLANK
CCC	14	Violet
CCC	15	White
CCC	16	VALUE INTENTIONALLY LEFT BLANK
CCC	17	VALUE INTENTIONALLY LEFT BLANK
CCC	18	VALUE INTENTIONALLY LEFT BLANK
CCC	19	Yellow
CCC	20	Red & White (RW)
CCC	21	Red & Green (RG)
CCC	22	Red & Black (RB)
CCC	23	Red-Green-Red (RGR)
CCC	24	Green & White (GW)
CCC	25	Green & Red (GR)
CCC	26	Green & Black (GB)
CCC	27	Green-Red-Green (GRG)
CCC	28	Green-Yellow-Black (GYB)
CCC	29	Yellow & Black (YB)
CCC	30	Yellow-Black-Yellow (YBY)
CCC	31	Yellow & Red (YR)
CCC	32	Yellow & Green (YG)
CCC	33	Yellow-Red-White (YRW)
CCC	34	Black & Yellow (BY)
CCC	35	Black-Yellow-Black (BYB)
CCC	36	Black-Red-Black (BRB)
CCC	37	Black & White (BW)
CCC	38	Black & Red (BR)
CCC	39	Black & Green (BG)
CCC	40	White & Red (WR)
CCC	41	White & Orange (W Or)
CCC	42	White & Green (WG)
CCC	43	White & Black (WB)
CCC	44	White & Yellow (WY)
CCC	45	White-Red-Green (WRG)
CCC	46	White-Green-White (WGW)
CCC	47	Magenta
CCC	48	Amber
CCC	49	Buff
CCC	50	Nautical Purple

Withdrawn/Retirée

CCC	999	Other

CDA Covered Drain Attribute

Condition where an artificial or improved natural drainage way is completely covered over and connects open drainage ways at each end.

CDA	1	Uncovered
CDA	2	Covered
CDA	3	Not Applicable

CDL Covered Drain Length

Length of covered drainage way.

CDL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

CDP Calendar Date Type

The type of report or activity.

CDP	0	Unknown
CDP	1	Aerial Photography
CDP	2	Air Information
CDP	3	Approximate
CDP	4	Field Classification
CDP	5	Compilation
CDP	6	Copyright
CDP	7	Creation
CDP	8	Digitizing
CDP	9	Distribution/Dispatching
CDP	10	Downgrading
CDP	11	Drafting/Scribing/Drawing
CDP	12	Edition
CDP	13	Field Examination
CDP	14	Intelligence
CDP	15	Date Interpretable
CDP	16	Processing
CDP	17	Print/Publication
CDP	18	Receipt
CDP	19	Source
CDP	20	Earliest Date of Source
CDP	21	Latest Date of Source
CDP	22	Specifications
CDP	23	Survey
CDP	24	Up-to-dateness/revision
CDP	25	Map Edit
CDP	26	Information as of ---
CDP	27	Perishable Information Date
CDP	28	Cycle Date
CDP	29	Significant Date
CDP	30	Date of Magnetic Information
CDP	999	Other

Withdrawn/Retirée

CDV Calendar Date Value

The calendar date as specified by ISO 8601.

CDV 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			8 Digits

CET Cut/Embankment Type Category

Identifies the number of sides that are used as a cut or an embankment.

CET 0 Unknown
CET 1 One Side
CET 2 Both Sides
CET 999 Other

CFD Cultural Feature Density

The measure of the concentration of buildings and other cultural features within the delineation of this feature.

CFD 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

CHA Light Characteristic Category

The sequence, grouping, and distinctive character of light.

CHA 0 Unknown
CHA 1 Alternating
CHA 2 Composite Group Flashing
CHA 3 Composite Group Occulting
CHA 4 Ultra Quick
CHA 5 Fixed
CHA 6 Fixed and Flashing
CHA 7 Fixed and Group Flashing
CHA 8 Flashing
CHA 9 Group Flashing
CHA 10 Group Occulting
CHA 11 Interrupted Quick Flashing
CHA 12 Interrupted Ultra Quick
CHA 13 Interrupted Very Quick
CHA 14 Isophase
CHA 15 Long-Flashing
CHA 16 Morse Code
CHA 17 Occulting
CHA 19 VALUE INTENTIONALLY LEFT BLANK
CHA 20 VALUE INTENTIONALLY LEFT BLANK
CHA 21 Lighted
CHA 22 VALUE INTENTIONALLY LEFT BLANK
CHA 23 Unlighted

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CHA	24	VALUE INTENTIONALLY LEFT BLANK
CHA	25	VALUE INTENTIONALLY LEFT BLANK
CHA	26	VALUE INTENTIONALLY LEFT BLANK
CHA	27	VALUE INTENTIONALLY LEFT BLANK
CHA	28	Group Quick Flashing
CHA	29	Group Very Quick
CHA	30	Very Quick
CHA	31	Quick
CHA	32	VALUE INTENTIONALLY LEFT BLANK
CHA	33	Intensified
CHA	34	VALUE INTENTIONALLY LEFT BLANK
CHA	35	VALUE INTENTIONALLY LEFT BLANK
CHA	36	Directional
CHA	37	VALUE INTENTIONALLY LEFT BLANK
CHA	38	VALUE INTENTIONALLY LEFT BLANK
CHA	39	VALUE INTENTIONALLY LEFT BLANK
CHA	40	VALUE INTENTIONALLY LEFT BLANK
CHA	41	VALUE INTENTIONALLY LEFT BLANK
CHA	42	VALUE INTENTIONALLY LEFT BLANK
CHA	43	Directional Moiré
CHA	44	Quick flashing
CHA	45	very quick flashing
CHA	46	Flash / long flash
CHA	47	Occulting / flash
CHA	48	Fixed / long flash
CHA	49	Occulting alternating
CHA	50	Long flash alternating
CHA	51	Flash alternating
CHA	52	Group alternating
CHA	53	2 fixed (vertical)
CHA	54	2 fixed (horizontal)
CHA	55	3 fixed (vertical)
CHA	56	3 fixed (horizontal)
CHA	999	Other

CHL Channel Number

The Channel representing the frequency assigned by the controlling authority.

CHL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			80 Characters

CIC Color Intensity Category

Identifies the intensity of color.

CIC	0	Unknown
CIC	1	Dark
CIC	2	Light
CIC	999	Other

Withdrawn/Retirée

COC Conspicuous Category

A conspicuous object is easily identifiable and plainly visible under varying conditions of light from harbors, approach channels, or offshore because of its size, shape, or height.

COC	0	Unknown
COC	1	Conspicuous from sea
COC	2	VALUE INTENTIONALLY LEFT BLANK
COC	3	Radar Conspicuous from sea
COC	4	Conspicuous from land
COC	5	Conspicuous from air
COC	6	Inconspicuous
COC	7	Generally Conspicuous
COC	8	Not visual conspicuous
COC	9	Visual conspicuous
COC	10	Not radar conspicuous
COC	999	Other

COD Certainty of Delineation

Indicates knowledge of the feature's limits or information.

COD	0	Unknown
COD	1	Limits and Information Known
COD	2	Limits and Information Unknown

COE Certainty of Existence

Indicates knowledge of the feature's existence.

COE	0	Unknown
COE	1	Definite
COE	2	Doubtful
COE	3	Reported

COL Character of Light

Any identifier composed of the class, number and color(s) of flashes or occultations, of a light or lights at one geographic position [e.g. Q(6)+L F1, VQ G, L F1 (3+2)WR].

COL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

COT Contour Type Category

Classifies the type of contour.

COT	0	Unknown
COT	1	Depression
COT	999	Other

Withdrawn/Retirée

CPA Control Point Attribute

Type of control point.

CPA	0	Unknown
CPA	1	Bench Mark
CPA	2	Horizontal
CPA	3	Horizontal with Bench Mark
CPA	4	Astronomic position
CPA	5	Vertical

CRA Crane Type Category

Type of crane.

CRA	0	Unknown
CRA	1	VALUE INTENTIONALLY LEFT BLANK
CRA	2	Bridge/Gantry
CRA	3	Rotating
CRA	4	Floating
CRA	5	Fixed
CRA	6	Traveling
CRA	99	Container
CRA	999	Other

CRC Crossing Category

Shape attributed to the crossing of two or more lines of communication.

CRC	0	Unknown
CRC	1	Junction
CRC	2	Intersection
CRC	3	Star shaped branching (more than 4 roads)
CRC	999	Other

CRN Current Rate Minimum

Minimum speed of current.

CRN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

CRS Current Rate (Speed)

Current speed in knots.

CRS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

Withdrawn/Retirée

CRV Depth Curve or Contour Value

A specified value assigned to a particular depth curve or contour.

CRV 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

CRX Current Rate Maximum

Maximum speed of current.

CRX 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Knots	Floating Point		0.1 KNOT	

CSM Secondary Material Characteristics

Characteristics of secondary material composition of feature.

CSM	0	Unknown
CSM	1	Broken
CSM	2	Coarse
CSM	3	Decayed
CSM	4	Fine, Minute Particles
CSM	5	Gritty
CSM	6	Hard
CSM	7	Rotten
CSM	8	Soft
CSM	9	Sticky
CSM	10	Stiff
CSM	11	Streaky
CSM	12	Tenacious
CSM	13	Uneven
CSM	17	Calcareous
CSM	18	Flinty
CSM	19	Glacial
CSM	20	Ground
CSM	21	Large
CSM	22	Rocky
CSM	23	Small
CSM	24	Speckled
CSM	25	Varied
CSM	26	Volcanic
CSM	27	Medium

Withdrawn/Retirée

CTL Cumulative Track Length

Total cumulative length of track contained within confines of the feature, exclusive of the branch or main trunk lines running into and/or out of the feature.

CTL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

CUR Current Type Category

The horizontal movement of a body of water.

CUR	0	Unknown
CUR	1	Ebb
CUR	2	Flood
CUR	3	General Flow
CUR	4	River Flow
CUR	5	Ocean Flow
CUR	999	Other

CVH Depth Curve or Contour Value High

The maximum value of a depth curve polygon.

CVH 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

CVL Depth Curve or Contour Value Low

The minimum value of a depth curve polygon.

CVL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

D80 Direction of Current

Direction of current flow at high water.

D80 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

Withdrawn/Retirée

D81 Direction of Current (1)

Direction of current flow 1 hour after high water.

D81 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D82 Direction of Current (2)

Direction of current flow 2 hours after high water.

D82 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D83 Direction of Current (3)

Direction of current flow 3 hours after high water.

D83 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D84 Direction of Current (4)

Direction of current flow 4 hours after high water.

D84 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D85 Direction of Current (5)

Direction of current flow 5 hours after high water.

D85 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D86 Direction of Current (6)

Direction of current flow 6 hours after high water.

D86 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

Withdrawn/Retirée

D87 Direction of Current (7)

Direction of current flow 7 hours after high water.

D87 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D88 Direction of Current (8)

Direction of current flow 8 hours after high water.

D88 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D89 Direction of Current (9)

Direction of current flow 9 hours after high water.

D89 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D90 Direction of Current (10)

Direction of current flow 10 hours after high water.

D90 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

D91 Direction of Current (11)

Direction of current flow 11 hours after high water.

D91 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DAN Description of Aids to Navigation

Textual description of aids to navigation marking a feature, e.g. Marked by buoys.

DAN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

Withdrawn/Retirée

DEP Depth Below Surface Level

Distance measured from the highest point at surface level to the lowest point of the feature below the surface. Recorded values are positive numbers.

DEP 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

DF1 Direction of Traffic - 1

Direction of traffic, first occurrence.

DF1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DF2 Direction of Traffic - 2

Direction of traffic, second occurrence.

DF2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DF3 Direction of Traffic - 3

Direction of traffic, third occurrence.

DF3 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DF4 Direction of Traffic - 4

Direction of traffic, fourth occurrence.

DF4 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DIR Directivity

The side or sides of a feature which produces the greatest reflectivity potential..

DIR 0 Unknown
DIR 1 Uni
DIR 2 Bi
DIR 3 Omni

Withdrawn/Retirée

DIR 999 Other

DMB Density Measure (Brush/Undergrowth)

Actual percent (%) of ground covered by undergrowth.

DMB 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

DMF Density Measure (Feature Count)

Indicates the number of features of this type within an area.

DMF 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Features	Short Integer	0±32,767	1 FEATURE	

DMR Density Measure (% of Roof Cover)

Roof cover measured by percent within area of feature.

DMR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

DMS Density Measure (Structure Count)

Density of structures within a square kilometer (1000m x 1000m).

DMS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Structures	Short Integer	0±32,767	1 STRUCTURE	

DMT Density Measure (% of Tree/Canopy Cover)

Canopy cover measured by percent within area of feature during the summer season.

DMT 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

Withdrawn/Retirée

DOF Direction of Flow

Bearing of movement or direction of the flow.

DOF 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

DP1 Highest level of ground water

Highest annual average level of ground water.

DP1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32767	1 M	

DP2 Lowest level of ground water

Lowest annual average level of ground water.

DP2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32767	1 M	

DR1 Depth Range Value 1

Minimum value of a depth range.

DR1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

DR2 Depth Range Value 2

Maximum value of a depth range.

DR2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

DRP Description of Reference Point

Description of the feature(s) which form a Leading Line or Clearing Line.

DRP 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

Withdrawn/Retirée

DRW Density of Woody Vegetation Range

Range indicating percentage of total ground surface covered by Trees (EC030) and Scrub Brush (EB015) within delineated area of feature.

DRW	1	>0 %and ≤ 5 %
DRW	2	>5 % and ≤1 5 %
DRW	3	>15 %
DRW	4	not applicable

DW1 Depth of Water (1)

Predominant water depth within delineation of feature, determined in meters at the greatest depth along a cross section of the feature (First Range).

DW1	0	Unknown
DW1	1	≤ 0.8 M
DW1	2	> 0.8 M and ≤ 1.6 M
DW1	3	> 1.6 M and ≤ 2.4 M
DW1	4	> 2.4 M
DW1	5	NA

DW2 Depth of Water (2)

Predominant water depth within delineation of feature, determined in meters at the greatest depth along a cross section of the feature (Second Range).

DW2	0	Unknown
DW2	1	≤ 1.6 M
DW2	2	> 1.6 M and ≤ 2.4 M
DW2	3	> 2.4 M
DW2	4	NA

EBT Educational Building Type

Identifies type of educational building.

EBT	0	Unknown
EBT	1	Academy
EBT	2	College
EBT	3	Educational Center
EBT	4	Lyceum
EBT	5	University
EBT	6	Seminary
EBT	7	Other
EBT	8	Not Applicable

ELA Elevation Accuracy

Indicates whether the ZVL value is accurately known.

ELA	0	Unknown
ELA	1	Accurate
ELA	2	Approximate

Withdrawn/Retirée

EOL Elevation of Light

The elevation of a light.

EOL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

EPW Electrical Power Capacity

Electrical Power capacity of a feature expressed in megawatts.

EPW 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Megawatts	Short Integer	0±32,767	1 MW	

EXS Existence Category

The state or condition of the feature.

EXS	0	Unknown
EXS	1	Definite
EXS	2	Doubtful
EXS	3	Reported
EXS	4	VALUE INTENTIONALLY LEFT BLANK
EXS	5	Under Construction
EXS	6	Abandoned/Disused
EXS	7	Destroyed
EXS	8	Dismantled
EXS	10	Proposed
EXS	11	Temporary
EXS	12	Alternate
EXS	13	VALUE INTENTIONALLY LEFT BLANK
EXS	16	VALUE INTENTIONALLY LEFT BLANK
EXS	17	VALUE INTENTIONALLY LEFT BLANK
EXS	18	Permanent
EXS	19	VALUE INTENTIONALLY LEFT BLANK
EXS	20	Corresponds to Recommended Track
EXS	21	Does Not Correspond to Recommended Track
EXS	22	One-Way
EXS	23	Two-way
EXS	25	Not Maintained
EXS	26	Maintained
EXS	27	Closed/Locked
EXS	28	Operational
EXS	29	VALUE INTENTIONALLY LEFT BLANK
EXS	30	VALUE INTENTIONALLY LEFT BLANK
EXS	30	Not Isolated
EXS	31	Isolated
EXS	32	Navigable
EXS	33	Ruined
EXS	34	VALUE INTENTIONALLY LEFT BLANK
EXS	35	Other

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EXS	36	Commissioned and Operational
EXS	37	Commissioned and on Test
EXS	38	Commissioned and out of service
EXS	39	Not commissioned and operational
EXS	40	Not commissioned and on test
EXS	41	Not commissioned and out of service
EXS	42	Continuous operation
EXS	43	Intermittent operation
EXS	44	Approximate/About
EXS	45	Natural
EXS	46	Man-made
EXS	47	Swept
EXS	48	Controlled
EXS	49	Non-Controlled
EXS	50	Non-Tidal
EXS	51	Tidal/Tidal Fluctuation
EXS	52	Dissipating
EXS	53	Incomplete
EXS	54	Antique/Ancient
EXS	55	Unexamined/Unsurveyed
EXS	56	Unattended/Unwatched
EXS	57	Sonar Confirmed
EXS	58	Sonar not Confirmed
EXS	59	Not Usable
EXS	60	Indefinite (Shoreline)
EXS	61	Not Isolated
EXS	61	Definite Shoreline
EXS	62	Partially Destroyed
EXS	65	Inactive
EXS	723	Navigable and abandoned
EXS	724	Navigable and operational
EXS	998	Not Applicable
EXS	999	Other

FCL Ferry Crossing Length

Length of crossing between shore points.

FCL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

FCO Feature Configuration

Configuration of feature.

FCO	0	Unknown
FCO	1	Dispersed
FCO	2	Multiple
FCO	3	Single
FCO	4	Inclined
FCO	5	Divided same widths
FCO	6	Divided different widths
FCO	7	Non-divided

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FCO	8	Poorly defined
FCO	9	Well-defined
FCO	11	Double
FCO	12	Justaxposition
FCO	999	Other

FEO Feature Element Orientation

The angular distance measured from true north (0 deg) clockwise to the predominant linear pattern of the elements within a feature.

FEO	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

FER Ferry Type

Indicates whether or not ferry travels along cables.

FER	0	Unknown
FER	1	With cables/chains
FER	2	Without cables/chains
FER	999	Other

FFC Fishing Facility Classification

Encodes the various types of fishing facilities.

FFC	0	Undefined
FFC	1	Fishing stake
FFC	2	Fish trap
FFC	3	Fish weir
FFC	4	Tunny/Tuna net

FHC Harbor Facility Classification

Tabulates the kind of operation/service.

FHC	0	Undefined
FHC	1	Ro-Ro terminal (Roll on, Roll off)
FHC	2	Timber yard
FHC	3	Ferry Terminal
FHC	4	Fishing harbor
FHC	5	Yacht harbor/marina
FHC	6	Naval base
FHC	7	Tanker terminal
FHC	8	Passenger terminal
FHC	9	Shipyard
FHC	10	Container terminal

Withdrawn/Retirée

FL1 Flight Level 1

A minimum surface of constant atmospheric pressure which is related to a specific pressure datum, (1,013.2 hectopascal (hPa) or 29.92 inches) and is separated from the consecutive flight levels by a pressure interval corresponding to 500 feet (152.4 m.) i

FL1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

FL2 Flight Level 2

A maximum surface of constant atmospheric pressure which is related to a specific pressure datum, (1,013.2 hectopascal (hPa) or 29.92 inches) and is separated from the consecutive flight levels by a pressure interval corresponding to 500 feet (152.4 m.).

FL2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Feet	Short Integer	0±32,767	1 FT	

FRQ Frequency of Signal

Audio frequency of acoustical signal.

FRQ 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Hertz	Long Integer		1 HZ	

FRT Firing Range Type

Type of firing range.

FRT	0	Unknown
FRT	1	Rifle/Small Arms
FRT	2	Tank
FRT	3	Artillery
FRT	4	Grenade
FRT	5	Demolition Area
FRT	6	Impact Area
FRT	999	Other

FTC Farming Type Category

Type of field pattern

FTC	0	Unknown
FTC	1	Slash & Burn-Shifting cultivation
FTC	2	Permanent field
FTC	3	Terraced
FTC	4	Ditch Irrigation
FTC	5	Grazing
FTC	6	Regular (planting pattern)

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FTC	7	Linear (planting pattern)
FTC	8	Shifting Cultivation/Crop Rotation
FTC	9	Not Applicable
FTC	98	Type of field Pattern
FTC	999	Other

FTI Fence Type Indicator

Type of fence.

FTI	0	Unknown
FTI	1	Metal
FTI	2	Wood
FTI	3	Stone
FTI	4	Rock
FTI	5	Barbed Wire
FTI	6	Chain link
FTI	999	Other

FTR Feature Rate

A quantified rate associated with a featue (e.g. Cars crossing a Bridge—AQ040). Units will be qualified using a structured text approach (e.g. 100(cars)[crossing bridge per hour] where the type of unit is in parentheses ( ) and a unit qualifier is in brackets [ ].

FTR	0	Actual value

Units	Format	Range	Increment	Maximum Characters
Structured Text	ASCII Text			80 Characters

FVO Feature Vertical Orientation

Describes the orientation of the usual axis of a feature relative to the vertical.

FVO	0	Unknown
FVO	1	Upright
FVO	2	On side
FVO	3	Leaning
FVO	4	Inverted
FVO	5	Horizontal
FVO	999	Other

GAW Gauge Width

The width of a single pair of rails, measured along the shortest distance from inside rail to inside rail.

GAW	0	Actual Width

Units	Format	Range	Increment	Maximum Characters
Centimeter	Short Integer	0±32,767	1 CM	

Withdrawn/Retirée

GEN Generation of Fog Signal Category

Type of mechanism of fog signal generating.

GEN	0	Undefined
GEN	1	Automatically
GEN	2	By wave action
GEN	3	By hand
GEN	4	By wind

GEO Geographic Location Category

Describes the general geographic location of the feature.

GEO	0	Unknown
GEO	1	Arctic
GEO	999	Other

GNC Gate (Nautical) Classification

Tabulation of various types of nautical gates.

GNC	0	Undefined
GNC	1	Gate in general
GNC	2	Tidal gate (flood barrage)
GNC	3	Caisson
GNC	4	Lock gate

GRP Group of Signals Definition

Encodes the number of signals, the combination of signals or the Morse character(s) within one full period of sequence.

GRP	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

GSC Ground Slope Category

Range indicating the slope of ground within delineated area of feature usually manually derived, reported in percent.

GSC	1	0->45 Culturally or Naturally Dissected Land
GSC	2	≤ 30
GSC	3	>3 and <10
GSC	4	>10 and ≤20
GSC	5	>20 and ≤30
GSC	6	>30 and ≤45
GSC	7	>45
GSC	8	>10 and ≤15
GSC	9	>15 and ≤20
GSC	10	>45 and ≤60
GSC	11	>60
GSC	12	>60 and ≤85

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GSC	13	>85

GTC Gate Type Category

The classification of the type of barrier or gate.

GTC	1	Tollgate
GTC	99	Other

GUG Guyed or Unguyed Category

Presence of support wires.

GUG	0	Unknown
GUG	1	Guyed
GUG	2	Unguyed
GUG	999	Other

GW1 Gap Width Range (1)

Predominant horizontal gap width range (1) in meters, measured between the top of the first accessible break in slope above mean water level on each bank.

GW1	0	Unknown
GW1	1	≤ 3
GW1	2	> 3 and ≤ 18
GW1	3	> 18 and ≤ 30
GW1	4	> 30 and ≤ 50
GW1	5	> 50 and ≤ 75
GW1	6	> 75 and ≤ 100
GW1	7	> 100 and ≤ 142
GW1	8	> 142
GW1	9	NA

GW2 Gap Width Range (2)

Predominant horizontal gap width range (2) in meters, measured between the top of the first accessible break in slope above mean water level on each bank.

GW2	0	Unknown
GW2	1	> 18 and ≤ 142
GW2	2	> 142 and ≤ 1000
GW2	3	> 1000
GW2	4	NA

HCA Horizontal Clearance Attribute

The distance available to pass a load that extends laterally beyond the wheels of a vehicle.

HCA	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeters	Short Integer	0±32,767	1 DM	

Withdrawn/Retirée

HDH Hydrographic Drying Height

The height of the feature, which tidal waters cover and uncover, referenced to a specified vertical datum.

HDH 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

HDI Hydrographic Depth/Height Information

Information about the accuracy or availability of depth or uncovering height of a feature.

HDI	9	Depth Known by Other Than Wire Drag
HDI	10	Depth Known by Wire Drag
HDI	12	Depth Unknown
HDI	13	Uncovering Height Known
HDI	14	Uncovering Height Unknown
HDI	15	Not Applicable

HDP Hydrographic Depth

The depth of the feature below water, measured from the top or surface of the feature, referenced to a specified vertical datum. Recorded values are positive numbers.

HDP 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

HFC Hydrological Form Category

Form or configuration of the hydrological feature.

HFC	0	Unknown
HFC	1	Channelized Stream
HFC	2	Disappearing
HFC	7	Non-Tidal
HFC	8	Normal Channel
HFC	10	Tidal /Tidal Fluctuating
HFC	14	Braided
HFC	16	Dissipating
HFC	19	Gorge
HFC	21	Wadi/Wash
HFC	30	Disappearing in sinkhole
HFC	31	Disappearing in other than sinkhole
HFC	32	Oxbow
HFC	33	Split stream
HFC	999	Other

Withdrawn/Retirée

HGT Height Above Surface Level

Distance measured from the lowest point of the base at ground or water level (downhill side/downstream side) to the tallest point of the feature.

HGT 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

HGU Height 2/Depth 2

Height above water level on upstream side.

HGU 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

HL1 Bank Height Left (1)

Predominant height range (1) of the left bank (facing downstream) in meters, measured from mean water level to the first break in slope above the mean water level.

HL1	0	Unknown
HL1	1	≤ .5
HL1	2	> .5 and ≤ 1.0
HL1	3	> 1.0 and ≤ 5.0
HL1	4	> 5.0
HL1	5	NA

HL2 Bank Height Left (2)

Predominant height range (2) of the left bank (facing downstream) in meters, measured from mean water level to the first break in slope above the mean water level.

HL2	0	Unknown
HL2	1	≤ 1
HL2	2	> 1 and ≤ 5
HL2	3	> 5
HL2	4	NA

HLT Hydrographic Light Type

The type of light used for marine navigation.

HLT	0	Unknown
HLT	1	Sectored Light
HLT	2	Other
HLT	3	Moiré Effect Light
HLT	4	Strip Light
HLT	5	Occasional

Withdrawn/Retirée

HOC Hydrographic Origin Category

Origin of the feature.

HOC	1	Controlled
HOC	4	Man-made
HOC	5	Natural

HOD Horizontal Datum Classification

Horizontal datum. (This attribute should only be used for a feature whose datum is different from that of the geo data set (see Part 3—10).)

HOD	0	Undefined
HOD	1	Adindan
HOD	2	Afgooye
HOD	3	Ain el Abd 1970
HOD	4	Anna 1 Astro 1965
HOD	5	Antigua Island Astro 1943
HOD	6	Arc 1950
HOD	7	Arc 1960
HOD	8	Ascension Island 1958
HOD	9	Astro beacon "E" 1945
HOD	10	Astro DOS 71/4
HOD	11	Astro Tern Island (FRIG) 1961
HOD	12	Astronomical Station 1952
HOD	13	Australian Geodetic 1966
HOD	14	Australian Geodetic 1984
HOD	15	Ayabelle Lighthouse
HOD	16	Bellevue (IGN)
HOD	17	Bermuda 1957
HOD	18	Bissau
HOD	19	Bogota Observatory
HOD	20	Bukit Rimpah
HOD	21	Camp Area Astro
HOD	22	Campo Inchauspe
HOD	23	Canton Astro 1966
HOD	24	Cape
HOD	25	Cape Canaveral
HOD	26	Carthage
HOD	27	Chatam Island Astro 1971
HOD	28	Chua Astro
HOD	29	Corrego Alegre
HOD	30	Dabola
HOD	31	Djakarta (Batavia)
HOD	32	DOS 1968
HOD	33	Easter Island 1967
HOD	34	European 1950 (European Datum)
HOD	35	European 1979
HOD	36	Fort Thomas 1955
HOD	37	Gan 1970
HOD	38	Geodetic Datum 1949
HOD	39	Graciosa Base SW 1948
HOD	40	Guam 1963
HOD	41	Gunung Segara
HOD	42	GUX 1 Astro

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HOD	43	Herat North
HOD	44	Hjorsey
HOD	45	Hong Kong 1963
HOD	46	Hu-Tzu-Shan
HOD	47	Indian
HOD	48	Indian 1954
HOD	49	Indian 1975
HOD	50	Ireland 1965
HOD	51	ISTS 061 Astro 1968
HOD	52	ISTS 073 Astro 1969
HOD	53	Johnston Island 1961
HOD	54	Kandawala
HOD	55	Kerguelen Island 1949
HOD	56	Kertau 1948
HOD	57	Kusaie Astro 1951
HOD	58	L. C. 5 Astro 1961
HOD	59	Leigon
HOD	60	Liberia 1964
HOD	61	Luzon
HOD	62	Mahe 1971
HOD	63	Massawa
HOD	64	Merchich
HOD	65	Midway Astro 1961
HOD	66	Minna
HOD	67	Montserrat Island Astro 1958
HOD	68	M'Poraloko
HOD	69	Nahrwan
HOD	70	Naparima, BWI
HOD	71	North American 1927
HOD	72	North American 1983
HOD	73	Observatorio Meteorologico 1939
HOD	74	Old Egyptian 1907
HOD	75	Old Hawaiian
HOD	76	Oman
HOD	77	Ordnance Survey of Great Britain 1936
HOD	78	Pico de las Nieves
HOD	79	Pitcairn Astro 1967
HOD	80	Point 58
HOD	81	Pointe Noire 1948
HOD	82	Porto Santo 1936
HOD	83	Provisional South American 1956
HOD	84	Provisional South Chilean 1963 (also known as Hito XVIII 1963)
HOD	85	Puerto Rico
HOD	86	Qatar National
HOD	87	Qornoq
HOD	88	Reunion
HOD	89	Rome 1940
HOD	90	Santo (DOS) 1965
HOD	91	Sao Braz
HOD	92	Sapper Hill 1943
HOD	93	Scharzeck
HOD	94	Selvagem Grande 1938
HOD	95	South American 1969
HOD	96	South Asia
HOD	97	Tananarive Observatory 1925
HOD	98	Timbalai 1948
HOD	99	Tokyo

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HOD	100	Tristan Astro 1968
HOD	101	Viti Levu 1916
HOD	102	Wake-Eniwetok 1960
HOD	103	Wake Island Astro 1952
HOD	104	WGS-72
HOD	105	WGS-84
HOD	106	Yacare
HOD	107	Zanderij

HQC Hypsography Portrayal Category

Type of line shown.

HQC	0	Unknown
HQC	1	Index
HQC	2	Intermediate
HQC	3	Supplementary (1/2)
HQC	4	Form Lines
HQC	5	Depression Index
HQC	6	Depression Intermediate
HQC	7	Approximate Index
HQC	8	Mound Index
HQC	9	Mound Intermediate
HQC	12	Intermediate Approximate
HQC	13	Supplementary Approximate
HQC	14	Supplementary (1/4)
HQC	15	Depression approximate
HQC	16	Auxiliary
HQC	18	Intermediate Depression Approximate
HQC	19	Carrying Contour (coincident contours)
HQC	20	Supplemental Carrying Contour
HQC	20	Carrying contour
HQC	22	Supplemental Depression
HQC	23	Supplemental Depression Approximate
HQC	98	Transition or erroneous
HQC	99	Connector

HR1 Bank Height Right (1)

Predominant height range (1) of the right bank (facing downstream) in meters, measured from mean water level to the first break in slope above the mean water level.

HR1	0	Unknown
HR1	1	≤ .5
HR1	2	> .5 and ≤ 1.0
HR1	3	> 1.0 and ≤ 5.0
HR1	4	> 5.0
HR1	5	NA

HR2 Bank Height Right (2)

Predominant height range (2) of the right bank (facing downstream) in meters, measured from mean water level to the first break in slope above the mean water level.

HR2	0	Unknown

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HR2	1	≤ 1
HR2	2	> 1 and ≤ 5
HR2	3	> 5
HR2	4	NA

HS1 Current Information (1)

Month of appearance of the current.

HS1	0	Unknown /NA
HS1	1	Jan
HS1	2	Feb
HS1	3	Mar
HS1	4	Apr
HS1	5	May
HS1	6	Jun
HS1	7	Jul
HS1	8	Aug
HS1	9	Sep
HS1	10	Oct
HS1	11	Nov
HS1	12	Dec

HS2 Current Information (2)

Month of disappearance of the current , if different from HS1.

HS2	0	Unknown /NA
HS2	1	Jan
HS2	2	Feb
HS2	3	Mar
HS2	4	Apr
HS2	5	May
HS2	6	Jun
HS2	7	Jul
HS2	8	Aug
HS2	9	Sep
HS2	10	Oct
HS2	11	Nov
HS2	12	Dec

HSB Height Above Sea Bottom

Vertical distance from sea bottom to lowest portion of feature.

HSB	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

Withdrawn/Retirée

HSC Hospital Capacity

Number of beds within a hospital.

HSC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Beds	Short Integer	0±32,767	1 BED	

HWT House of Worship Type

Type of house of worship used.

HWT	0	Unknown
HWT	2	Cathedral
HWT	3	Chapel
HWT	4	Church
HWT	5	Marabout
HWT	6	Minaret
HWT	7	Monastery, Convent
HWT	9	Mosque
HWT	11	Pagoda
HWT	14	Shrine
HWT	15	Tabernacle
HWT	16	Temple
HWT	20	Synagouge
HWT	21	Stupa
HWT	22	Not Applicable
HWT	23	Any

HYC Hydrological Category

Identifies the annual water content of the feature.

HYC	0	Unknown
HYC	2	Not Applicable
HYC	3	Dry
HYC	6	Non-Perennial /Intermittent /Fluctuating
HYC	8	Perennial /Permanent
HYC	999	Other

IAC IALA Aid Category

Conformity of a navigational aid to the IALA system of navigational aids.

IAC	0	Unknown
IAC	1	Non-IALA Aid
IAC	2	IALA Aid

IAS IMO Approval Status

Status of International Maritime Organization approval.

IAS	1	Approved
IAS	2	Not Approved

Withdrawn/Retirée

IBC Installation Buoy Classification

Tabulates the various types of installation buoys.

IBC	0	Undefined
IBC	1	Catenary anchor leg mooring (CALM)
IBC	2	Single buoy mooring (SBM)

ICC Ice Classification

Tabulates the kind of ice.

ICC	0	Undefined
ICC	1	Fast ice
ICC	2	Sea ice
ICC	3	Growler area
ICC	4	Pancake ice
ICC	5	Glacier (see BJ030)
ICC	6	Ice Peak (see BJ060)
ICC	7	Pack ice (see BJ070)
ICC	8	Polar ice (see BJ080)
ICC	9	Debris-covered
ICC	999	Other

ICL ICAO Airspace Classification

ICAO designated airspace classification.

ICL	0	Unknown
ICL	1	Class A
ICL	2	Class B
ICL	3	Class C
ICL	4	Class D
ICL	5	Class E
ICL	6	Class F
ICL	7	Class G

IDN Identification Number

A unique number relating specific interior map/chart features to border information.

IDN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer	0±32,767	1 Unit	

IKO ICAO Designator

International Civil Aviation Organization location identifier as designated in ICAO document 7910.

IKO 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			256 Characters

Withdrawn/Retirée

KVA Kilovolt Capacity Attribute

Maximum voltage available on the line, as reported in kilovolts.

KVA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Kilovolts	Short Integer		1 KV	

LAB Label of Feature

Label applied to the feature.

LAB 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

LAF Line Associated Features

The type and/or number of features associated with a leading or clearing line.

LAF 1 One Object (Other Than a Directional Light)
LAF 2 Directional Light
LAF 3 Two or More Lights
LAF 4 Two or More Beacons
LAF 5 Two or More Objects (Other Than Two Lights or Beacons)
LAF 6 Measured Distance Markers
LAF 7 Directional Radiobeacon
LAF 8 Moiré Effect Light

LC1 Load Class Type 1

Military load classification (weight bearing capacity) Type 1.

LC1 0 Weight bearing capacity for one-way traffic of wheeled vehicles (from STANAG 2253).

LC2 Load Class Type 2

Military load classification (weight bearing capacity) Type 2.

LC2 0 Weight bearing capacity for two-way traffic of wheeled vehicles (from STANAG 2253).

LC3 Load Class Type 3

Military load classification (weight bearing capacity) Type 3.

LC3 0 Weight bearing capacity for one-way traffic of tracked vehicles (from STANAG 2253).

Withdrawn/Retirée

LC4 Load Class Type 4

Military load classification (weight bearing capacity) Type 4.

LC4	0	Weight bearing capacity for two-way traffic of tracked vehicles (from STANAG 2253).

LCN Light Characteristic Number

Number of flashes/occultations in a group flashing/occulting light character.

LCN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Occults	Short Integer	0±32,767	1 OCCULT	

LEC Length of Cab

A measurement of the longer of two linear axes in meters of the pedestal or cab. For a square feature, measure either axis. For a round feature, measure the diameter.

LEC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

LEN Length

A measurement of the longer of two linear axes in meters. For a square feature, measure either axis. For a round feature, measure the diameter. For a bridge, the length is the distance between the bridge abutments.

LEN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

LFA Light Function Aeronautical

Type of lighting provided or type of lighting system used.

LFA	0	Unknown
LFA	1	Airport Terminal Lights
LFA	2	Apron Flood
LFA	3	Boundary Lights
LFA	4	Runway Centerline Lighting
LFA	5	Runway End Identification Lighting(REIL)
LFA	6	Runway Lights /Runway Edge Lights
LFA	7	Sequenced Strobe
LFA	8	Taxiway Lighting
LFA	9	Visual Approach Slope Indicator (VASI)
LFA	10	Rotating Beacon
LFA	11	Obstruction Lighting
LFA	12	Threshold Light(s)
LFA	13	Touchdown Zone Lighting

Withdrawn/Retirée

LFA	14	Other Airport Lighting
LFA	15	ALSF-1 (Approach Lighting System. with seq. flashing)
LFA	16	ALSF-II
LFA	17	(SSALF)
LFA	18	(SSALR)
LFA	19	(MALSF)
LFA	20	(MALSR)
LFA	21	Landing Direction Indicator (LDIN)
LFA	22	RAIL (Runway Alignment Indicator Lights)
LFA	23	ODALS (Omni Directional Approach Landing System).
LFA	24	Other Approach Lighting
LFA	25	Precision Approach Path Indicator (PAPI)
LFA	26	Strobe
LFA	27	Runway Flood
LFA	28	Variable Intensity Runway Lights
LFA	29	Portable Runway Lights
LFA	30	Flares
LFA	31	Wind Indicator Lights
LFA	32	Visual Approach Slope Indicator (3 bar)
LFA	33	Optical Landing System
LFA	51	Aeronautical
LFA	52	Auxiliary
LFA	53	Beacon
LFA	54	VALUE INTENTIONALLY LEFT BLANK
LFA	55	Fishing
LFA	56	Fog Detector
LFA	57	Harbor
LFA	58	Horizontal
LFA	59	Obstruction
LFA	60	Occasional
LFA	61	Private
LFA	62	Range
LFA	63	Seasonal
LFA	64	Tidal
LFA	65	Vertical
LFA	66	Articulated
LFA	67	Primary
LFA	68	Secondary
LFA	69	Major
LFA	70	Minor
LFA	71	Visual Approach Slope Indicator (2 bar)
LFA	72	Identification Beacon
LFA	999	Other

LFC Light Function Classification

Tabulates the various functions of a light.

LFC	0	Undefined
LFC	1	Direction function
LFC	2	Rear / upper light
LFC	3	Front / lower light
LFC	4	Leading light
LFC	5	Aerolight
LFC	6	Air obstruction light
LFC	7	Fog detector light

Withdrawn/Retirée

LFC	8	Flood light
LFC	9	Strip light
LFC	10	Subsidiary light

LNC Line Characteristic

The characteristics of a line used during interpolation between two points.

LNC	0	Unknown
LNC	1	Rhumb or Loxodrome Line
LNC	2	Geodesic or Great Circle Line

LOC Location Category

Status of feature relative to surrounding area or water.

LOC	0	Unknown
LOC	1	Above Surface/Does not Cover (Height Known)
LOC	2	Awash at Chart Datum
LOC	3	Dries/Covers (Height Unknown)
LOC	4	Below Surface /Submerged/Underground
LOC	5	Covered < 20 Meters
LOC	6	Covered ≥ 20 Meters but < 30 Meters
LOC	7	Covered > = 30 Meters
LOC	8	On Ground Surface
LOC	9	Depth Known
LOC	10	Depth Known (Cleared by Drag Wire)
LOC	11	Depth Unknown But Safe to Depth Shown
LOC	12	VALUE INTENTIONALLY LEFT BLANK
LOC	13	Hull Showing
LOC	14	Masts Showing
LOC	15	On Water Surface/Floating
LOC	16	Partially Submerged
LOC	17	Sunken/on sea bottom
LOC	19	Above Surface/Does not Cover (Height Unknown)
LOC	20	Funnel Showing
LOC	21	Superstructure showing
LOC	22	Off Shore
LOC	23	Below sea bottom
LOC	24	Suspended or elevated above sea bottom
LOC	25	Suspended/Elevation above Ground or Water Surface
LOC	28	Masts and Funnel Showing
LOC	30	Non-Floating
LOC	31	Elevated
LOC	32	Depressed
LOC	33	Not submerged
LOC	34	Inland
LOC	35	Overhead
LOC	36	Height Above Bottom
LOC	37	Exact Position Known
LOC	38	Exact Position Unknown
LOC	39	Depth Unknown
LOC	998	Not applicable
LOC	999	Other

Withdrawn/Retirée

LOG Length of Gradient

The length of a segment having a gradient ≥ 7 percent for a Road (AP030) or ≤ 3 percent for a Railroad Track (AN010).

LOG 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

LOR Length of Range

Length of range, in nautical miles, established by aids to navigation on the shore.

LOR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

LSA Light Sector Angle

Angular limits of light visibility. Limits of sectors and arcs of visibility are arranged clockwise and shall be given from seaward toward the light.

LSA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

LTN Track/Lane Number

The number of track(s) or lanes of the feature, including both directions.

LTN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Lanes/tracks	Short Integer	0±32,767	1 LANE/TRACK	

LVG Light Range, Geographical

The maximum distance at which light can theoretically reach an observer, as only at the curvature.

LVG 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

Withdrawn/Retirée

LVL Light Range, Luminous

The maximum distance at which a light can be seen by the intensity of the light and meteorological visibility.

LVL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

LVN Light Range, Nominal

The luminous range when the meteorological range is 10 sea miles.

LVN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

MAA Maximum authorized altitude

The highest altitude in an airway or route at which adequate reception of navigation aid signals is assured.

MAA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			256 Characters

MAC Maritime Area Category

Area in which certain activities or factors of significance to navigation or operations apply.

MAC 0 Unknown
MAC 1 Customs Area
MAC 2 Dredged Channel/ Dredged Area
MAC 3 Harbor Area
MAC 4 Mine Danger Area
MAC 5 Prohibited Shipping Area/Entry Prohibited.
MAC 6 Reclamation Area
MAC 7 Restricted Area
MAC 9 Works in progress area
MAC 10 Wire Drag Area/Swept Area
MAC 11 Anchorage (general)
MAC 12 Anchoring Berths
MAC 13 Explosive anchorage
MAC 14 Large Vessel/Deep Water/Deep Draft anchorage.
MAC 15 Anchoring Prohibited
MAC 16 Quarantine anchorage
MAC 17 Reserved Anchorage
MAC 18 Small Vessel Anchorage/Marina
MAC 19 Tanker Anchorage
MAC 20 Submarine Cable Area
MAC 21 Pipeline Area
MAC 22 Fishing Prohibited

Withdrawn/Retirée

MAC	23	Cable and Pipeline Area
MAC	24	Turning Area / Swinging Circle
MAC	25	Spoil Area / Spoil Ground
MAC	26	Unsurveyed Area
MAC	27	Submarine Exercise Area
MAC	28	Mine Laying Practice Area
MAC	29	Firing Danger Area
MAC	30	Dumping Ground for Hazardous Materials
MAC	31	Incineration Area
MAC	32	Oil field
MAC	33	Gas Field
MAC	34	Historic Wreck
MAC	35	Explosive Dumping Ground
MAC	36	Former Mine Danger Area
MAC	37	Safety Zone
MAC	38	Chemical field
MAC	39	Separation Zone
MAC	40	Roundabout Zone (TSS)
MAC	41	Inshore Traffic Zone (TSS)
MAC	42	Precautionary Area
MAC	43	Areas to be avoided
MAC	44	Degaussing Range
MAC	45	Outfall area
MAC	46	Intake area
MAC	47	Fish Haven/Protected Area
MAC	48	Pilot Boarding Area
MAC	49	Cargo Transshippment Area
MAC	50	Red Rocks
MAC	51	Laterite
MAC	52	Evaporites
MAC	53	Seaplane
MAC	54	Time Limited
MAC	55	Fairway
MAC	56	Fish Trap Area
MAC	57	Marine farm
MAC	58	Dredging area
MAC	61	Sewer Area
MAC	79	Free Port Area
MAC	80	Fish Sanctuary
MAC	81	Degaussing Range
MAC	82	Development Area
MAC	83	Diving prohibited zone
MAC	84	Danger of stranding area
MAC	85	Navigational aid safety zone
MAC	86	Historic wreck restricted area
MAC	87	Seal sanctuary
MAC	88	Game preserve
MAC	89	Bird sanctuary
MAC	90	Nature preserve
MAC	91	Practice area in general
MAC	92	Torpedo practice area
MAC	93	Anchorage for up to 24 hours
MAC	94	Small craft mooring area
MAC	95	Seaplane anchorage
MAC	96	Unrestricted anchorage
MAC	97	Crossing (TSS)
MAC	98	Offshore Production Area

Withdrawn/Retirée

MAC	99	Dock Area
MAC	999	Other
MAC	999	Other

MAG Magnetic Variation

Horizontal angle between true north and magnetic north measured East (positive value) or West (negative value) according to whether magnetic north lies east or west of true north.

MAG 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Floating Point	±180		

MAR Color of Navigation Mark Classification

Tabulates colors of navigation marks.

MAR	0	Undefined
MAR	1	Green
MAR	2	Black
MAR	3	Red
MAR	4	Yellow
MAR	5	White
MAR	6	Orange
MAR	7	Black / yellow
MAR	8	Black / yellow / black
MAR	9	Yellow / black
MAR	10	Yellow / black / yellow
MAR	11	Red / white/
MAR	12	Green / red / green
MAR	13	Red / green / red
MAR	14	Black / red / black
MAR	15	Yellow / red / yellow
MAR	16	Green / red
MAR	17	Red / green

MAS Maintenance Status

Indicates whether the feature is maintained.

MAS	1	Maintained
MAS	2	Not Maintained

MAT Mine Attributes Classification

Defines subsidiary mine attribute classifications and tabulates mine attributes.

MAT	1	Classification of mine identity (MID)
MAT	2	Classification of mine status (MSC)
MAT	3	Classification of mine position (MPC)
MAT	4	Classification of mine special information (MSI)

Withdrawn/Retirée

MBI Military Bridge Information

A free text field used to indicate if the bridge is subject to preplanned military interdiction.

MBI 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

MBL Maritime Boundary Limit

A line where on either side certain activities or factors of significance to navigation or operations apply.

MBL	0	Unknown
MBL	1	Colregs Demarcation Line
MBL	2	Customs Boundary
MBL	3	Fishing Zone Boundary
MBL	4	Harbor Limit
MBL	5	Separation Line (TSS)
MBL	6	Territorial Waters -Limit of Sovereignty
MBL	7	Territorial Waters Baseline
MBL	8	Maritime Limit (General)
MBL	9	International Boundary (at sea)
MBL	10	Continental Shelf Boundary
MBL	11	Limit of Exclusive Economic Zone
MBL	12	Limit of Contiguous Zone
MBL	13	Clearing Line
MBL	14	Danger Line
MBL	15	Armistice Boundary
MBL	98	Traffic Services Limit
MBL	999	Other

MCA Morse Code

The ASCII (ISO 646) letter that is being emitted by either the Navigation System Types (NST), Sound Signal (SST), Light characteristics (CHA), or electronic beacon type.

MCA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			80 Characters

MCC Material Composition Category

Characteristics of primary material composition of feature.

MCC	0	Unknown
MCC	1	Aircraft
MCC	2	Aluminum
MCC	3	Ammunition
MCC	4	Ash
MCC	5	Asphalt
MCC	6	Basalt
MCC	7	Bedrock

Withdrawn/Retirée

MCC	8	Boulders
MCC	9	Brick
MCC	10	Calcareous
MCC	11	Cement
MCC	12	Chalk
MCC	13	Chemical
MCC	14	Cinders
MCC	15	Cirripedia
MCC	16	Clay
MCC	17	Coal
MCC	18	Cobble
MCC	19	Coke
MCC	20	Composition
MCC	21	Concrete
MCC	22	Conglomerate
MCC	23	Copper
MCC	24	Coral
MCC	25	Coral Head
MCC	26	Desalinated Water
MCC	27	Diamonds
MCC	28	Diatoms
MCC	29	Dolomite
MCC	30	Earthen
MCC	31	Electric
MCC	32	Eroded Lands
MCC	33	Explosives
MCC	34	Flynch
MCC	35	Food
MCC	36	Foraminifera
MCC	37	Fucus
MCC	38	Gas
MCC	39	Gasoline
MCC	40	Glass
MCC	41	Globigerina
MCC	42	Gold
MCC	43	Granite
MCC	44	VALUE INTENTIONALLY LEFT BLANK
MCC	45	Grass/Thatch
MCC	46	Gravel
MCC	47	Green Rocks
MCC	48	Ground
MCC	49	Ground (Shells)
MCC	50	Heat
MCC	51	Iron
MCC	52	Lava
MCC	53	VALUE INTENTIONALLY LEFT BLANK
MCC	54	Lead
MCC	55	Loess
MCC	56	Lumber
MCC	57	Macadam
MCC	58	Madrepores
MCC	59	Manganese
MCC	60	Marble
MCC	61	Marl
MCC	62	Masonry (Brick/Stone)
MCC	63	Mattes
MCC	64	Metal

Withdrawn/Retirée

MCC	65	Mud
MCC	66	Mussels
MCC	67	Oil
MCC	68	Oil Blister
MCC	69	Ooze
MCC	70	Oysters
MCC	71	Paper
MCC	72	Part Metal
MCC	73	Pebbles
MCC	74	Plastic
MCC	75	Polyzoa
MCC	76	Porphyry
MCC	77	Prestressed Concrete
MCC	78	Pteropods
MCC	79	Pumice
MCC	80	Quartz
MCC	81	Radiolaria
MCC	82	Radioactive Material
MCC	83	Reinforced Concrete
MCC	84	Rock/Rocky
MCC	85	Rubber
MCC	86	Rubble
MCC	87	Salt
MCC	88	Sand
MCC	89	Sandstone
MCC	90	Schist
MCC	91	Spoils/Tailings
MCC	92	Scoria
MCC	93	Sea Tangle
MCC	94	Seaweed
MCC	95	Sewage
MCC	96	Shells
MCC	98	Shingle
MCC	99	Silt
MCC	100	Silver
MCC	101	Slag
MCC	102	Sludge
MCC	103	Snow/Ice
MCC	104	Soil
MCC	105	Spicules
MCC	106	Sponge
MCC	107	Steel
MCC	108	Stone
MCC	109	Sugar
MCC	110	Travertin
MCC	111	Tufa
MCC	112	Uranium
MCC	113	Vegetation Products
MCC	114	Volcanic
MCC	115	Volcanic Ash
MCC	116	Water
MCC	117	Wood
MCC	118	Zinc
MCC	119	Evaporites
MCC	999	Other

Withdrawn/Retirée

MCS Material Composition Secondary

Secondary material composition of feature.

MCS	0	Unknown
MCS	4	Ash
MCS	8	Boulders
MCS	12	Chalk
MCS	14	Cinders
MCS	15	Cirripedia
MCS	16	Clay
MCS	18	Cobble
MCS	24	Coral
MCS	25	Coral Head
MCS	28	Diatoms
MCS	36	Foraminifera
MCS	37	Funus
MCS	41	Globigerina
MCS	45	Grass /Thatch
MCS	46	Gravel
MCS	48	Ground
MCS	52	Lava
MCS	58	Madrepores
MCS	59	Manganese
MCS	61	Marl
MCS	63	Mattes
MCS	65	Mud
MCS	66	Mussels
MCS	69	Ooze
MCS	70	Oysters
MCS	73	Pebbles
MCS	75	Polyzoa
MCS	78	Pteropods
MCS	79	Pumice
MCS	80	Quartz
MCS	81	Radiolaria
MCS	84	Rock /Rocky
MCS	88	Sand
MCS	90	Schist
MCS	92	Scoria
MCS	93	Sea Tangle
MCS	94	Seaweed
MCS	96	Shells
MCS	98	Shingle
MCS	99	Silt
MCS	105	Spicules
MCS	106	Sponge
MCS	108	Stone
MCS	111	Tufa

MCU Material Composition Underlying

Underlying material composition of feature.

MCU	0	Unknown
MCU	4	Ash

Withdrawn/Retirée

MCU	8	Boulders
MCU	12	Chalk
MCU	14	Cinders
MCU	15	Cirripedia
MCU	16	Clay
MCU	18	Cobble
MCU	24	Coral
MCU	25	Coral Head
MCU	28	Diatoms
MCU	36	Foraminifera
MCU	37	Fucus
MCU	41	Globigerina
MCU	45	Grass /Thatch
MCU	46	Gravel
MCU	48	Ground
MCU	52	Lava
MCU	58	Madrepores
MCU	59	Manganese
MCU	61	Marl
MCU	63	Mattes
MCU	65	Mud
MCU	66	Mussels
MCU	69	Ooze
MCU	70	Oysters
MCU	73	Pebbles
MCU	75	Polyzoa
MCU	78	Pteropods
MCU	79	Pumice
MCU	80	Quartz
MCU	81	Radiolaria
MCU	84	Rock /Rocky
MCU	88	Sand
MCU	90	Schist
MCU	92	Scoria
MCU	93	Sea Tangle
MCU	94	Seaweed
MCU	96	Shells
MCU	98	Shingle
MCU	99	Silt
MCU	105	Spicules
MCU	106	Sponge
MCU	108	Stone
MCU	111	Tufa

MEA Minimum Enroute Altitude

The lowest altitude published by the host country between radio fixes which assures acceptable navigational signal coverage and meets obstacle clearing clearance requirements.

MEA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Structured Text	ASCII Text			80 Characters

Withdrawn/Retirée

MED Median Category

Presence of a divider between multiple lanes/rails.

MED	0	Unknown
MED	1	With Median
MED	2	Without Median
MED	998	Not Applicable
MED	999	Other

MIA Mine Actuation Independent Influence Acoustic Classification

Tabulates mine actuation independent influence acoustic types.

MIA	1	Low freq.
MIA	2	Audio freq.
MIA	3	High freq.
MIA	4	Multiple freq.

MIC Mine Actuation Independent Contact Classification

Tabulates attributes of independent contact mine actuation.

MIC	1	Plain
MIC	2	Snagline
MIC	3	Antenna

MID Mine Identity Classification

Tabulates mine identity attributes.

MID	1	Unknown
MID	2	Friend
MID	3	Hostile
MID	4	Neutral

MII Mine Actuation Independent Influence Classification

Defines subsidiary mine actuation independent influence classifications and tabulates mine actuation independent influence types.

MII	1	Pressure
MII	2	Combined
MII	3	Classif. of mine actuation independent influence magnetic (MIM)
MII	4	Classif. of mine actuation independent influence acoustic (MIA)

MIM Mine Actuation Independent Influence Magnetic Classification

Tabulates mine actuation independent influence magnetic types.

MIM	1	Sensitive
MIM	2	Mid-sensitive
MIM	3	Course

Withdrawn/Retirée

MIN **Mining Category**

Unique mining characteristic.

MIN	0	Unknown
MIN	1	Borrow
MIN	2	Horizontal Shaft
MIN	3	Open Pit
MIN	4	Placer
MIN	5	Prospect
MIN	6	Strip
MIN	7	Vertical Shaft
MIN	8	Peat Cuttings
MIN	9	Below Surface Mine
MIN	998	Not Applicable
MIN	999	Other

MIO **Mine Actuation Independent Other Classification**

Tabulates mine actuation independent other types.

MIO	1	Electric fields
MIO	2	Laser sensors
MIO	3	Seismic
MIO	4	Cosmic ray
MIO	5	Infra red
MIO	6	Redistribution
MIO	7	Velocity field
MIO	8	other

MLR **Multiple Light Ranges**

A set of two numbers for light ranges of visibility (at a light) expressed in nautical miles; the numbers are separated by a slash (/) if only two visibilities exist, or by a dash (-) separating the greatest and least visibilities if three or more exist.

MLR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			256 Characters

MMT **Mine Special Information Special Mine Types Classification**

Tabulates mine special information special mine types.

MMT	1	Anti-sweeper
MMT	2	Anti-hunter
MMT	3	Anti-hovercraft
MMT	4	Drill
MMT	5	Explosive filled
MMT	6	Exercise filled
MMT	7	Exercise
MMT	8	Practice
MMT	9	Disposal charge

Withdrawn/Retirée

MNA Mine Actuation Classification

Defines subsidiary mine actuation classifications and tabulates the Mine Actuation types.

MNA	1	Classif. of mine actuation controlled (MNC)
MNA	2	Classif. of mine actuation independent (MNI)
MNA	3	Mine actuation no information

MNC Mine Actuation Controlled Classification

Defines subsidiary mine actuation classification controlled methods and classification.

MNC	1	Mine actuation controlled cable
MNC	2	Classif. of mine actuation controlled cableless (MNL)

MNI Mine Actuation Independent Classification

Defines subsidiary mine actuation independent classifications.

MNI	1	Classif. of mine actuation independent contact (MIC)
MNI	2	Classif. of mine actuation independent influence (MII)
MNI	3	Classif. of mine actuation independent other (MIO)

MNL Mine Actuation Controlled Cableless Classification

Tabulates the types of cableless controlled methods and classification.

MNL	1	Frequency Communications. Link
MNL	2	Explicit Communications Link
MNL	3	Alternating Current Communications Link

MOC Minimum Obstruction Clearance

The lowest published altitude in effect between radio fixes on VOR airways, off fairway routes, or route segments which meets obstacle clearance requirement for the entire route segment and which assures acceptable navigation signal.

MOC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 Meter	

MPC Mine Position Classification

Defines subsidiary mine position classifications and tabulates mine position types.

MPC	1	Classif. of mine position ground (MPG)
MPC	2	Classif. of mine position moored (MPM)
MPC	3	Classif. of mine position other (MPO)
MPC	4	Mine position no information.

Withdrawn/Retiree

MPG Mine Position Ground Classification

Tabulates ground mine charge size.

MPG	1	≤ 500 kg/charge
MPG	2	> 500 kg

MPM Mine Position Moored Classification

Tabulates mine moored position types.

MPM	1	Deep moored
MPM	2	Short tethered

MPO Mine Position Other Classification

Tabulates other mine position types.

MPO	1	Drifting
MPO	2	Oscillating
MPO	3	Creeping
MPO	4	Mobile
MPO	5	Homing
MPO	6	Rising
MPO	7	Bouquet
MPO	8	Active

MSC Mine Status Classification

Tabulates types of mine status.

MSC	1	Afloat
MSC	2	Sunk
MSC	3	Disposed
MSC	4	Fouled
MSC	5	Exploded
MSC	6	Countermined
MSC	7	Neutralized
MSC	8	Rendered safe
MSC	9	Recovered
MSC	10	Removed

MSD Mine Special Information Special Devices Classification

Tabulates mine special information special devices types and subsidiary mine special information special devices classifications.

MSD	1	Arming delay
MSD	2	Ship count
MSD	3	Intermittent arming
MSD	4	Delayed rising
MSD	5	Obstructors
MSD	6	Sterilizers
MSD	7	Flooders
MSD	8	Anti-watching

Withdrawn/Retirée

MSD	9	Classif. -mine special info special devices anti-sweep wire (MSW)
MSD	10	Classif. -mine special info special devices anti-recovery (MSR)
MSD	11	Classif. -mine special info special devices anti-hunting (MSH)

MSH Mine Special Information Special Devices Anti-Hunting Classification

Tabulates mine special information special devices anti-hunting types.

MSH	1	Anechoic coating
MSH	2	Automatic mine burial
MSH	3	Irregular shaping
MSH	4	Acoustic impedance
MSH	5	Acoustic transparency
MSH	6	Non-metallic case
MSH	7	Sonar decoys
MSH	8	Other

MSI Mine Special Information Classification

Defines subsidiary mine special information classifications.

MSI	1	Classif. of mine special info usefulness (MSU)
MSI	2	Classif. of mine special info special mine types (MMT)
MSI	3	Classif. of mine special info special devices (MSD)

MSR Mine Special Information Special Devices Anti-Recovery Classification

Tabulates mine special information special devices anti-recovery types.

MSR	1	Switch
MSR	2	Mooring level switch
MSR	3	Stripping equipment
MSR	4	Other

MST Missile Site Type

Class of missile at site.

MST	0	Unknown
MST	1	ABM
MST	2	ICBM
MST	3	IRBM
MST	4	SA1
MST	5	SA2
MST	6	SA3
MST	7	SA4
MST	8	SA5
MST	9	SA6
MST	10	SA7
MST	11	SA8
MST	12	SA9
MST	13	MRBM
MST	14	SSM
MST	15	SAM
MST	999	Other

Withdrawn/Retirée

MSU Mine Special Information Usefulness Classification

Tabulates mine special information usefulness types.

MSU	1	General purpose ground
MSU	2	Deep water
MSU	3	Medium depth anti-submarine
MSU	4	Continental shelf
MSU	5	Maritime anti-invasion
MSU	6	Anti-surface effect vehicle

MSW Mine Special Information Special Devices Anti-Sweep Wire Classification

Tabulates mine special information special devices anti-sweep wire types.

MSW	1	Chain moorings
MSW	2	Sprocket
MSW	3	Grapnel
MSW	4	Cutters
MSW	5	Sensitive tubing
MSW	6	Other

MTN Mine Track Number

Mine track number.

MTN	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer			4 Digits

MTT Maritime Track Type

Defines restrictions, direction and other characteristics of maritime tracks.

MTT	1	Based on Fixed Marks
MTT	2	Not Based on Fixed Marks
MTT	3	Maximum Authorized Draft
MTT	4	Mandatory Direction
MTT	5	Recommended Direction

MVC Maximum Vertical clearance

The greatest distance between the traveled way and any obstruction vertically above it.

MVC	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

MWF Mooring / Warping Facility Classification

Tabulates mooring/warping facility types.

MWF	1	Undefined

Withdrawn/Retirée

MWF	2	Dolphin
MWF	3	Deviation dolphin
MWF	4	Bollard

NA2 Second Name

Fundamentally a touristic name for a feature which exists in addition to a geographic name.

NA2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

NA3 Classification Name

Fundamentally a grammalogue, index number, order or classification number for a feature.

NA3 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

NAM Name

Any Identifier or code.

NAM 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

NAS Native Settlement Type

The distribution of native dwellings within the delineated area of the feature.

NAS	0	Unknown
NAS	1	Centralized Habitation
NAS	2	Continuous Habitation

NLC Navigation Line Classification

Tabulates navigation line types.

NLC	1	Undefined
NLC	2	Clearing line
NLC	3	Transit line

Withdrawn/Retiree

NM3 Name 3

Name of the political entity on one side (relative to NM3) of a boundary line.

NM3 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

NM4 Name 4

Name of the political entity on the other side of the boundary line.

NM4 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

NMS Navigation Mark System

Indicates the specific navigation marks system.

NMS	0	Undefined
NMS	1	IALA A
NMS	2	IALA B
NMS	3	Modified U.S.
NMS	4	old U.S.
NMS	5	U.S. Intracoastal waterway
NMS	6	U.S. uniform state
NMS	7	U.S. Western rivers
NMS	8	SIGNI

NOS Number of spans

Number of spans in a bridge or aqueduct.

NOS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Spans	Short Integer	0±32,767	1 SPAN	

NPL Number of Parallel Lines

Total number of parallel lines within the feature.

NPL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Lines	Short Integer	0±32,767	1 LINE	

Withdrawn/Retirée

NS2 Navigation System Types (2)

Type of equipment or system used in electronic navigation (secondary system).

NS2	0	Unknown
NS2	1	Circular Radio Beacon
NS2	2	CONSOL
NS2	3	DECCA
NS2	4	Radio Direction Finding
NS2	5	Directional Radio Beacon
NS2	6	Distance Finding
NS2	7	Long Range Air Navigation System (LORAN)
NS2	8	OMEGA
NS2	9	Other
NS2	10	Radar Responder Beacon (RACON)
NS2	11	Radar
NS2	12	Radio
NS2	13	Radio Telephone
NS2	14	VALUE INTENTIONALLY LEFT BLANK
NS2	15	TV
NS2	16	Microwave
NS2	17	Non-Directional Radio Beacon (NDB)
NS2	18	NDB/Distance Measuring Equipment (NDB/DME)
NS2	19	Radio Range (RNG)
NS2	20	VHF Omni Directional Radio Range (VOR)
NS2	21	VHF Omni Directional (VOR /DME)
NS2	22	VHF Omni Directional (VORTAC)
NS2	23	Tactical Air Navigation Equipment (TACAN)
NS2	24	Instrument Landing System (ILS)
NS2	25	Instrument Landing System/Distance Measuring Equipment (ILS/DME)
NS2	26	Localizer (LOC)
NS2	27	Localizer/Distance Measuring Equipment (LOC/DME)
NS2	28	Simplified Directional Facility (SDF)
NS2	29	Landing Distance Available (LDA)
NS2	30	Microwave Landing System (MLS)
NS2	31	Fan Marker
NS2	32	Bone Marker
NS2	33	Radio Telegraph
NS2	34	Ground Controlled Approach (GCA)
NS2	35	Radar Antenna
NS2	37	Precision Approach Radar (PAR)
NS2	38	Aeronautical Radio
NS2	39	VALUE INTENTIONALLY LEFT BLANK
NS2	40	Radio Beacon
NS2	41	Rotating Loop Radio Beacon
NS2	42	Visual Flight Rules (VFR) Test Signal Maker
NS2	43	VALUE INTENTIONALLY LEFT BLANK
NS2	44	Console Radio Beacon
NS2	45	Radar Station
NS2	46	Aeronautical Radio Range
NS2	47	Hifix
NS2	48	Hyperfix
NS2	49	Tricolor Panel
NS2	50	Radio station
NS2	51	Radiobeacon, Type Unknown
NS2	52	None

Withdrawn/Retirée

NS2	53	QTG Station (R)
NS2	54	Ramark (Ramark)
NS2	55	Radar reflector
NS2	56	LO (Locator)
NS2	57	LLZ (Localizer)
NS2	58	DME (Distance Measuring Equipment)
NS2	999	Other

NST Navigation System Types

Type of equipment or system used in electronic navigation (primary system).

NST	0	Unknown
NST	1	Circular Radio Beacon
NST	2	CONSOL
NST	3	DECCA
NST	4	Radio Direction Finding
NST	5	Directional Radio Beacon
NST	6	Distance Finding
NST	7	Long Range Air Navigation System (LORAN)
NST	8	OMEGA
NST	9	Other
NST	10	Radar Responder Beacon (RACON)
NST	11	Radar
NST	12	Radio
NST	13	Radio Telephone
NST	14	VALUE INTENTIONALLY LEFT BLANK
NST	15	TV
NST	16	Microwave
NST	17	Non-Directional Radio Beacon (NDB)
NST	18	NDB/Distance Measuring Equipment (NDB/DME)
NST	19	Radio Range (RNG)
NST	20	VHF Omni Directional Radio Range (VOR)
NST	21	VHF Omni Directional (VOR /DME)
NST	22	VHF Omni Directional (VORTAC)
NST	23	Tactical Air Navigation Equipment (TACAN)
NST	24	Instrument Landing System (ILS)
NST	25	Instrument Landing System/Distance Measuring Equipment (ILS/DME)
NST	26	Localizer (LOC)
NST	27	Localizer/Distance Measuring Equipment (LOC/DME)
NST	28	Simplified Directional Facility (SDF)
NST	29	Landing Distance Available (LDA)
NST	30	Microwave Landing System (MLS)
NST	31	Fan Marker
NST	32	Bone Marker
NST	33	Radio Telegraph
NST	34	Ground Controlled Approach (GCA)
NST	35	Radar Antenna
NST	37	Precision Approach Radar (PAR)
NST	38	Aeronautical Radio
NST	39	VALUE INTENTIONALLY LEFT BLANK
NST	40	Radio Beacon
NST	41	Rotating Loop Radio Beacon
NST	42	Visual Flight Rules (VFR) Test Signal Maker
NST	43	VALUE INTENTIONALLY LEFT BLANK
NST	44	Consol Radio Beacon

Without Own/Retiree

NST	45	Radar Station
NST	46	Aeronautical Radio Range
NST	47	Hifix
NST	48	Hyperfix
NST	49	Tricolor Panel
NST	50	Radio station
NST	51	Radiobeacon, Type Unknown
NST	52	None
NST	53	QTG Station (R)
NST	54	Ramark (Ramark)
NST	55	Radar reflector
NST	56	LO (Locator)
NST	57	LLZ (Localizer)
NST	58	DME (Distance Measuring Equipment)
NST	999	Other

OBC Oil Barrier Classification

Tabulates types of oil barriers.

OBC	0	Undefined
OBC	1	Oil retention (high pressure pipe)
OBC	2	Floating oil barrier

ODF Opposite Direction of Flow

Opposite direction of flow value of air route segments.

ODF	0	Opposite direction of flow value of air route segments.

OHB Overall Height of Bridge

Vertical distance measured from the lowest point at ground or water level to the highest portion of bridge (including superstructure).

OHB	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

OHC Overhead Clearance Category

The least distance between the traveled way and any obstruction vertically above it. (Ref. STANAG 2253)

OHC	0	Actual Value

Meters	Floating Point	0.1 M

OHD Derived Obstacle Height/Depth Category

Categorized maximum height or depth of an obstacle feature, in meters, with delineated segment of area.

OHD	0	Unknown

Withdrawn/Retirée

OHD	1	>1.5 and ≤5.0
OHD	2	>5.0 and ≤10.0
OHD	3	>10.0 and ≤20.0
OHD	4	>20.0 and ≤40.0
OHD	5	>40.0

OLQ Obstruction Light Quality

Indicates whether single or multiple obstruction lights are present.

OLQ	0	Unknown
OLQ	1	One Light Present
OLQ	2	Multiple lights Present

OOC Overhead Obstruction Category

Type of overhead obstruction.

OOC	0	Unknown
OOC	1	Viaduct, frame construction
OOC	2	Viaduct, arc construction
OOC	3	Roof
OOC	4	Powerline of railway
OOC	5	High-tension powerline
OOC	6	Bridge superstructure

OPC Offshore Platform Classification

Tabulates types of offshore platforms.

OPC	0	Undefined
OPC	1	Oil derrick / rig
OPC	2	Production platform
OPC	3	Observation / research platform
OPC	4	Articulated loading platform (ALP)
OPC	5	Single anchor leg mooring (SALM)
OPC	6	Mooring tower
OPC	7	Artificial island

OPS Operational Status

Indicates whether or not the feature is in operation.

OPS	1	Operational
OPS	2	Non-Operational

OPT Operations Times

The operating times for facilities, airspace, etc.

OPT	0	Unknown
OPT	1	Daytime (Sunrise/Sunset)
OPT	2	Nighttime
OPT	3	Continuous
OPT	4	Summertime (April-October)

Withdrawn/Retirée

OPT	5	Wintertime (November-March)
OPT	999	Other

OR2 Operating Range Category (2)

The secondary range of the NAVAID beyond which the capture of the signal is not completely assured.

OR2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

ORC Operating Range Category

The range of the NAVAID beyond which the capture of the signal is not completely assured.

ORC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

OWO Over Water Obstruction

Indicates the presence of an obstruction over an area of navigable water.

OWO	1	Feature crosses navigable water
OWO	2	Feature does not cross navigable water

PAT Buoy Pattern Category

The color breakdown of pattern of buoy.

PAT	0	Unknown
PAT	1	Checkered
PAT	2	Diagonal Bands
PAT	3	Single Color
PAT	4	Horizontal Bands
PAT	5	VALUE INTENTIONALLY LEFT BLANK
PAT	6	Vertical Stripes
PAT	98	Squared
PAT	99	Horizontal bands from top to bottom
PAT	999	Other

PBP Pilot Boarding Place Classification

Tabulates types of pilot boarding place.

PBP	0	Undefined
PBP	1	Boarding by pilot-cruising vessel
PBP	2	Boarding by helicopter
PBP	3	Pilot comes out from shore

Withdrawn/Retiree

PBV Pilot Boarding Vehicle

The method by which pilots are transferred to and from ships using pilot services.

PBV 1 By boat
PBV 2 By helicopter

PCC Percentage Content

Percentage of total composition.

PCC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0±32,767	1 %	

PCU Pedestrian Capacity

Number of pedestrians a feature can accommodate.

PCU 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Persons	Short Integer	0±32,767	1 PERSON	

PDR Pedestrian Rate

Number of pedestrians per time unit (this attribute utilizes the structured text approach), e.g. 10(persons)[per hour].

PDR 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Structured Text	ASCII Text			80 Characters

PER Period of Light

The time occupied by an entire cycle of intervals of light and eclipse.

PER 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Seconds	Floating Point			

PFD Predominant Feature Depth

Predominant Depth within delineation of feature.

PFD 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

Withdrawn/Retirée

PFH Predominant Feature Height

Predominant height within delineation of feature.

PFH 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

PH4 Predominant Height (10 m Range)

Predominant height range of a specified urban area (reported in 10 meter ranges).

PH4	0	Unknown
PH4	1	≤ 10
PH4	2	> 10 and ≤ 20
PH4	3	> 20 and ≤ 30
PH4	4	> 30 and ≤ 40
PH4	5	> 40 and ≤ 50
PH4	6	> 50 and ≤ 60
PH4	7	> 60 and ≤ 70
PH4	8	> 70 and ≤ 80
PH4	9	> 80 and ≤ 90
PH4	10	> 90 and ≤ 100
PH4	11	> 100
PH4	12	NA

PHT Predominant Height

Height of 51% or more of the feature. If not obtainable, then the average height of the feature will be used.

PHT 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

PIC Pictorial Representation

Specifies whether a pictorial representation of the object is available.

PIC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

PIL Pilot District

Specifies the pilot district for which a pilot is responsible.

PIL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

Withdrawn/Retirée

PLC Pile Classification

Tabulates types of piles.

PLC	0	Undefined
PLC	1	Stake
PLC	2	Snag
PLC	3	Post

PLT Pipeline Type

Identifies function of pipeline.

PLT	0	Undefined
PLT	1	Transport
PLT	2	Outfall
PLT	3	Intake
PLT	4	Sewer
PLT	5	Valve
PLT	6	Pipeline in general

POI Point of Interest

Place determined to be of interest or importance.

POI	1	Historic Battlefield

POP Pond Partition Category

Classifies the kinds of ponds that the partitions separate.

POP	0	Unknown
POP	1	Fish Pound
POP	2	Reservoir
POP	3	Waste Pond
POP	999	Other

PPC Power Plant Category

Energy source used to generate power.

PPC	0	Unknown
PPC	1	Hydro-electric
PPC	2	Nuclear
PPC	3	Solar
PPC	4	Thermal
PPC	5	Wind
PPC	6	Tidal
PPC	7	Internal Combustion
PPC	999	Other

Withdrawn/Retirée

PPL Populated Place Category

The number of people within a feature (e.g. administrative and built-up areas).

PPL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Persons	Short Integer	0±32,767	1 PERSON	

PPT Populated Place Type

The type of populated place.

PPT	0	Unknown
PPT	1	Native Settlement
PPT	2	Shanty town
PPT	3	Tent Dwellings
PPT	99	Inland Village
PPT	999	Other

PRC Periodic Restriction Category

Restriction due to climate or other limitations.

PRC	1	Perennially Open, Not Subject to Ice
PRC	2	Subject to Ice
PRC	3	Permanent Ice
PRC	4	Seasonal limit - Jan.
PRC	5	Seasonal limit - Feb.
PRC	6	Seasonal limit - Mar.
PRC	7	Seasonal limit - Apr.
PRC	8	Seasonal limit - May
PRC	9	Seasonal limit - Jun.
PRC	10	Seasonal limit - Jul.
PRC	11	Seasonal limit - Aug.
PRC	12	Seasonal limit - Sep.
PRC	13	Seasonal limit - Oct.
PRC	14	Seasonal limit - Nov.
PRC	15	Seasonal limit - Dec.
PRC	16	Closed
PRC	999	Other

PRO Product Category

Principal material involved or product resulting from activity at site.

PRO	0	Unknown
PRO	1	Aircraft
PRO	2	Aluminum
PRO	3	Ammunition
PRO	4	Ash
PRO	5	Asphalt
PRO	6	Basalt
PRO	7	Bedrock
PRO	8	Boulders

Withdrawn/Retirée

PRO	9	Brick
PRO	10	Calcareous
PRO	11	Cement
PRO	12	Chalk
PRO	13	Chemical
PRO	14	Cinders
PRO	15	Cirripedia
PRO	16	Clay
PRO	17	Coal
PRO	18	Cobble
PRO	19	Coke
PRO	20	Composition
PRO	21	Concrete
PRO	22	Conglomerate
PRO	23	Copper
PRO	24	Coral
PRO	25	Coral Head
PRO	26	Desalinated Water
PRO	27	Diamonds
PRO	28	Diatoms
PRO	29	Dolomite
PRO	30	Earthen
PRO	31	Electric
PRO	32	Eroded Lands
PRO	33	Explosives
PRO	34	Flynch
PRO	35	Food
PRO	36	Foraminifera
PRO	37	Fucus
PRO	38	Gas
PRO	39	Gasoline
PRO	40	Glass
PRO	41	Globigerina
PRO	42	Gold
PRO	43	Granite
PRO	44	VALUE INTENTIONALLY LEFT BLANK
PRO	45	Grass/Thatch
PRO	46	Gravel
PRO	47	Green Rocks
PRO	48	Ground
PRO	49	Ground (Shells)
PRO	50	Heat
PRO	51	Iron
PRO	52	Lava
PRO	53	VALUE INTENTIONALLY LEFT BLANK
PRO	54	Lead
PRO	55	Loess
PRO	56	Lumber
PRO	57	Macadam
PRO	58	Madrepores
PRO	59	Manganese
PRO	60	Marble
PRO	61	Marl
PRO	62	Masonry (Brick/Stone)
PRO	63	Mattes
PRO	64	Metal
PRO	65	Mud

Withdrawn/Retirée

PRO	66	Mussels
PRO	67	Oil
PRO	68	Oil Blister
PRO	69	Ooze
PRO	70	Oysters
PRO	71	Paper
PRO	72	Part Metal
PRO	73	Pebbles
PRO	74	Plastic
PRO	75	Polyzoa
PRO	76	Porphyry
PRO	77	Prestressed Concrete
PRO	78	Pteropods
PRO	79	Pumice
PRO	80	Quartz
PRO	81	Radiolaria
PRO	82	Radioactive Material
PRO	83	Reinforced Concrete
PRO	84	Rock/Rocky
PRO	85	Rubber
PRO	86	Rubble
PRO	87	Salt
PRO	88	Sand
PRO	89	Sandstone
PRO	90	Schist
PRO	91	VALUE INTENTIONALLY LEFT BLANK
PRO	92	Scoria
PRO	93	Sea Tangle
PRO	94	Seaweed
PRO	95	Sewage
PRO	96	Shells
PRO	97	VALUE INTENTIONALLY LEFT BLANK
PRO	98	Shingle
PRO	99	Silt
PRO	100	Silver
PRO	101	Slag
PRO	102	Sludge
PRO	103	Snow/Ice
PRO	104	Soil
PRO	105	Spicules
PRO	106	Sponge
PRO	107	Steel
PRO	108	Stone
PRO	109	Sugar
PRO	110	Travertin
PRO	111	Tufa
PRO	112	Uranium
PRO	113	Vegetation Products
PRO	114	Volcanic
PRO	115	Volcanic Ash
PRO	116	Water
PRO	117	Wood
PRO	118	Zinc
PRO	119	Bauxite
PRO	120	Bananas
PRO	121	Cotton
PRO	122	Bamboo

Withdrawn/Retirée

PRO	123	Coffee
PRO	124	Common fruit and/or nuts
PRO	125	Palms
PRO	126	Palmetto
PRO	127	Tailings
PRO	128	Refuse
PRO	129	Tobacco
PRO	130	None
PRO	131	Personnel
PRO	132	Not Applicable
PRO	133	Telecommunications
PRO	134	Fish
PRO	997	Not Applicable
PRO	998	Multiple
PRO	999	Other

PSC Physical Surface Characteristics

Principal characteristic(s) of the surface.

PSC	0	Unknown
PSC	1	Broken
PSC	2	Coarse
PSC	3	Decayed
PSC	4	Fine, minute particles
PSC	5	Gritty
PSC	6	Hard
PSC	7	Rotten
PSC	8	Soft
PSC	9	Sticky
PSC	10	Stiff
PSC	11	Streaky
PSC	12	Tenacious
PSC	13	Uneven
PSC	14	Bare/cleared
PSC	15	Karst
PSC	16	Membrane
PSC	17	Calcareous
PSC	18	Flinty
PSC	19	Glacial
PSC	20	Ground
PSC	21	Large
PSC	22	Rocky
PSC	23	Small
PSC	24	Speckled
PSC	25	Varied
PSC	26	Volcanic
PSC	27	Medium
PSC	28	Springs in Seabed
PSC	29	Mobile Bottom
PSC	99	Medium
PSC	999	Other

Withdrawn/Retirée

PST Physical State Category

Describes the physical state of the feature.

PST	0	Unknown
PST	1	Solid
PST	2	Liquid

QID Quality/Source Record Identifiers

The three character tag for the Source or Quality Record followed by the record number, (e.g. QAL4).

QID 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			4 Characters

QLE Releasability

Releasability statement with regard to the feature.

QLE 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			4 Characters

QUA Quality of Position

Stipulates the quality of the position.

QUA	0	Undefined
QUA	1	Surveyed
QUA	2	Unsurveyed
QUA	3	Inadequately surveyed
QUA	4	Approximated
QUA	5	Doubtful
QUA	6	Unreliable
QUA	7	Reported (not surveyed)
QUA	8	Reported (not confirmed)

QUL Percentage Reliability of a Qualitative Attribute

Percentage reliability of a Qualitative Attribute.

QUL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

Withdrawn/Retirée

QUT Standard Deviation of a Qualitative Attribute

Standard deviation of a Qualitative Attribute.

QUT 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer	0-4	1 Unit	

RAD Radius of Sharp Curve

Radius of curvature of sharp curves, expressed in meters.

RAD 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

RAN Range of Effectiveness

Radius of effectiveness of a navigational aid.

RAN 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Nautical Miles	Short Integer	0±32,767	1 NM	

RAS Radar Station Classification

Tabulates types of radar stations.

RAS	0	Undefined
RAS	1	Radar surveillance station
RAS	2	Coast radar station

RBC Reliability of Bridge

Reliability of bridge characteristics and military load classification based upon data source.

RBC	0	Unknown
RBC	1	Known
RBC	2	Estimated

RDT Road Type

Classifies the various types of roads.

RDT	0	Unknown
RDT	1	Street
RDT	2	Rapid transit
RDT	3	Laneway
RDT	4	Service Lane
RDT	998	Not applicable
RDT	999	Other

Withdrawn/Retirée

REF Radar Reflector Attribute

Indicates whether or not a radar reflector is attached to, or connected with, a feature.

REF	1	Radar Reflector Present
REF	2	Radar Reflector Absent

REL Religious Denomination

Name of religious order at site.

REL	0	Unknown
REL	1	Buddhist
REL	2	Moslem
REL	3	Roman Catholic
REL	4	Christian (undefined)
REL	5	Judaism
REL	6	Greek Orthodox
REL	7	Protestant
REL	8	Shinto
REL	999	Other

RET Reflection Type Category

The type of sonar reflection detected.

RET	1	Hyperbolic, from Bottom
RET	2	Hyperbolic, from Sub-Bottom

RFQ Radar Transponder Beacon Frequency

Specifies the specific frequency of a radar transponder beacon.

RFQ	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Kilohertz	Short Integer	0±32,767	1 KHZ	

RGC Railroad Gauge Category

The type of gauge used.

RGC	1	Broad
RGC	2	Narrow
RGC	3	Normal (Standard)
RGC	4	Any

RIT Road Interchange Type

The unique interchange design.

RIT	0	Unknown
RIT	1	Cloverleaf
RIT	2	Diamond
RIT	3	Fork

Withdrawn/Retirée

RIT	4	Rotary /Traffic Circle/Roundabout
RIT	5	Staggered Ramps
RIT	6	Standard Ramps
RIT	7	Symmetrical Ramps
RIT	8	Trumpet
RIT	9	Turban
RIT	10	Wye
RIT	999	Other

RKF Rock Strata Formation

The structure of a rock formation.

RKF	0	Unknown
RKF	1	Columnar
RKF	2	Needle
RKF	3	Pinnacle
RKF	4	VALUE INTENTIONALLY LEFT BLANK
RKF	5	VALUE INTENTIONALLY LEFT BLANK
RKF	999	Other

ROS Radio Station Classification

Tabulates types of radio stations.

ROS	0	Undefined
ROS	1	Circular (non-directional) marine or aeromarine radio beacon
ROS	2	Directional radio beacon
ROS	3	Rotating pattern radio beacon
ROS	4	Consol beacon
ROS	5	Radio direction finding station
ROS	6	Coast radio station providing QTG service
ROS	7	Aeronautical radio beacon

RPA Required Port Access

An indicator that a water feature is used for access to a required port, or that the feature is in a water body used for access to a required port.

RPA	1	Access Required
RPA	2	Access Not Required

RRA Railroad Power Source

Source of electrical power for railroad.

RRA	0	Unknown
RRA	1	Electrified Track
RRA	3	Overhead Electrified
RRA	4	Non-electrified
RRA	999	Other

Withdrawn/Retirée

RRC Railroad Categories

The type of railroad system used to support various transportation uses.

RRC	0	Unknown
RRC	2	Car-Line
RRC	3	Monorail
RRC	6	Subway
RRC	8	Logging
RRC	10	Miniature
RRC	11	Rapid Transit Route- Rail
RRC	13	Marine Railroad
RRC	14	Tramway
RRC	15	Inclined Railway
RRC	16	Main Line
RRC	17	Branch Line
RRC	21	Railroad in Road
RRC	998	Not Applicable
RRC	999	Other
RRC	999	Other

RSA Rail Siding/Spur Attribute

Type of connecting track.

RSA	1	Spur
RSA	2	Siding
RSA	3	Passing

RSC Rescue Station Classification

Tabulates types of rescue station.

RSC	0	Undefined
RSC	1	Rescue station with life boat
RSC	2	Rescue station with rocket
RSC	3	Rescue station with life boat and rocket
RSC	4	Refuge for shipwrecked mariners
RSC	5	Refuge for intertidal area walkers
RSC	6	Lifeboat lying at a mooring

RST Road/Runway Surface Type

The physical surface composition of a road.

RST	0	Unknown
RST	1	Hard /Paved
RST	2	Loose /Unpaved
RST	3	Loose /Light
RST	4	Corduroy
RST	5	Grass/Sod (Soft)
RST	6	Natural
RST	7	Permanent
RST	8	Temporary
RST	998	Not Applicable
RST	999	Other

Withdrawn/Retirée

RTA Railroad Track Arrangement

The arrangement of trackage on a single railroad bed including both directions.

RTA	0	Unknown
RTA	1	Single
RTA	2	Double
RTA	3	Multiple
RTA	4	Justaxposition

RTB Radar Transponder Beacon Classification

Tabulates types of radar transponder beacon.

RTB	0	Undefined
RTB	1	Ramark, radar beacon transmitting continuously
RTB	2	Racon, radar transponder beacon with Morse identification

RTC Road Type Category

NATO road type classification (see STANAG 3675).

RTC	0	Unknown
RTC	1	NATO Category X
RTC	2	NATO Category Y
RTC	3	NATO Category Z

RTN Route Number

Official route number (I-95, M-2, A-1, etc.) assigned to the feature.

RTN	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			24 Characters

RTT Route Intended Use

Intended use of the route.

RTT	0	Unknown
RTT	1	Recommended Track
RTT	2	Recommended track for other than deep draft vessels
RTT	3	Recommended track for deep draft vessels
RTT	4	Deep Water Route
RTT	5	Transit Route
RTT	6	Radar Guided Track
RTT	7	Measured Distance Line
RTT	8	Safety Fairway/Channel
RTT	9	Traffic Lane (TSS)
RTT	10	Roundabout Lane (TSS)
RTT	11	Two-way Route
RTT	12	Recommended Track (TSS)
RTT	13	Recommended direction of traffic flow
RTT	14	Primary Route

Withdrawn/Retirée

RTT	15	Secondary Route
RTT	16	Limited Access Route (e.g. Motorway/Autobahn/Interstate)
RTT	96	Recommended Traffic Lane Part
RTT	97	Centerline
RTT	98	Deep Water Route - Centerline
RTT	99	Deep Water Route - Part
RTT	999	Other

SAW Signal Station, Warning Classification

Tabulates types of signal station, warning.

SAW	0	Undefined
SAW	1	Danger
SAW	2	Maritime obstruction
SAW	3	Cable
SAW	4	Military practice
SAW	5	Distress
SAW	6	Weather
SAW	7	Storm
SAW	8	Ice
SAW	9	Time
SAW	10	Tide
SAW	11	Tidal stream
SAW	12	Tide gauge
SAW	13	Tide scale

SBC Shelter Belt Condition

Indicates whether a linear stand of trees functions as a shelter belt, protecting roadways, railroads, cropland, construction, etc., from the effects of adverse weather.

SBC	1	Functions as a shelter belt
SBC	2	Does not function as a shelter belt

SCC Spring/Well Characteristic Category

Type of available water.

SCC	0	Unknown
SCC	1	Alkaline
SCC	2	Not Applicable
SCC	3	VALUE INTENTIONALLY LEFT BLANK
SCC	4	Mineral
SCC	5	VALUE INTENTIONALLY LEFT BLANK
SCC	6	VALUE INTENTIONALLY LEFT BLANK
SCC	9	Freshwater /Potable
SCC	10	Salt
SCC	11	Fresh
SCC	999	Other

Withdrawn/Retirée

SD1 Stem Diameter Size Range (1)

Estimated range (1) of the average stem diameter within area of feature, determined in centimeters at a distance of 1.4 meters above the ground.

SD1	0	Unknown
SD1	1	> 0 and ≤ 2.00
SD1	2	> 2.00 and ≤ 4.00
SD1	3	> 4.00 and ≤ 6.00
SD1	4	> 6.00 and ≤ 8.00
SD1	5	> 8.00 and ≤ 10.00
SD1	6	> 10.00 and ≤ 12.00
SD1	7	> 12.00 and ≤ 15.00
SD1	8	> 15.00 and ≤ 20.00
SD1	9	> 20.00 and ≤ 25.00
SD1	10	> 25.00 and ≤ 50.00
SD1	11	> 50.00 and ≤ 100.00
SD1	12	> 100.00
SD1	13	NA

SD2 Stem Diameter Size Range (2)

Estimated range (2) of the average stem diameter within area of feature, determined in centimeters at a distance of 1.4 meter above the ground.

SD2	0	Unknown
SD2	1	> 0 and ≤ 10.00
SD2	2	> 10.00 and ≤ 25.00
SD2	3	> 25.00 and ≤ 50.00
SD2	4	> 50.00 and ≤ 100.00
SD2	5	> 100.00
SD2	6	NA

SDC Soil Depth Category

General depth of soil or surface material.

SDC	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

SDO Sand Dune Orientation

Characteristic alignment of the dune as caused by the prevailing winds.

SDO	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

Withdrawn/Retirée

SDS Stem Diameter Size

The average diameter of trees in a stand, measured at a height of 1.4 m above the ground.

SDS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 Meter	

SEA Sea Area Classification

A property of large bodies of water characterized by tidal conditions, swells, or high heavy wave action. The condition can apply to both fresh and salt water.

SEA	0	Undefined
SEA	1	Sea area in general
SEA	2	Gat
SEA	3	Bank
SEA	4	Deep
SEA	5	Bay
SEA	6	Bench
SEA	7	Basin
SEA	8	Watt

SEC Security Classification

Defines the highest level of security associated with a feature.

SEC	0	Unknown
SEC	1	Top Secret
SEC	2	Secret
SEC	3	Confidential
SEC	4	Restricted
SEC	5	Unclassified
SEC	999	Other

SEQ Sequence of a Signal

Specifies the sequence of times occupied by intervals of light and eclipse.

SEQ 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			80 Characters

SFC Sea Floor Feature Category

Type of object or area on the sea floor or below the water surface.

SFC	1	Unknown (obstruction)
SFC	2	Other
SFC	3	Fish Haven
SFC	4	Well
SFC	5	Submerged Production Platform

Withdrawn/Retirée

SGC Gradient/Slope

Percentage of slope. (i.e. The change in height divided by the horizontal distance over which the change takes place, times one hundred ((h2-h1)/d)*100.)

SGC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

SGO Slope Gradient Orientation

The angular distance measured from true north (0 degrees) clockwise to the direction of maximum uphill slope of a feature.

SGO 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degrees	Short Integer	0-359	1 DEG	

SHC Safe Horizontal Clearance

Minimum safe horizontal distance between adjacent bridge support structures on either side of a navigable channel passing under the bridge.

SHC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Floating Point		0.1 M	

SHO Shoreline Category

Tabulates the topography and material types likely to be found on a shoreline.

SHO 1 Hillocks
SHO 2 Flat
SHO 3 Sandy
SHO 4 Stony or shingly shore
SHO 5 Artificial

SHP Shape of Beacon

Describes the characteristic geometric form of the beacon.

SHP 0 Undefined
SHP 1 Stake / pole
SHP 2 Withy
SHP 3 Beacon tower
SHP 4 Lattice beacon

SIC Snow/Ice Category

Indicates the composition of the feature.

SIC 1 Snow
SIC 2 Ice

Withdrawn/Retirée

SIT Signal Station, Traffic Classification

Tabulats types of signal station, traffic.

SIT	0	Undefined
SIT	1	Port control
SIT	2	Port entry and departure
SIT	3	International port traffic
SIT	4	Berthing
SIT	5	Dock
SIT	6	Lock
SIT	7	Flood barrage
SIT	8	Bridge passage
SIT	9	Dredging

SL1 Slope Gradient Left (1)

Predominant slope range (1) of the left bank (facing downstream) in percent, measured from mean water level to the first accessible break in slope above the mean water level.

SL1	0	Unknown
SL1	1	≤ 30
SL1	2	> 30 and ≤ 45
SL1	3	> 45 and ≤ 60
SL1	4	> 60
SL1	5	NA

SL2 Slope Gradient Left (2)

Predominant slope range (2) of the left bank (facing downstream) in percent, measured from mean water level to the first accessible break in slope above the mean water level.

SL2	0	Unknown
SL2	1	≤ 60
SL2	2	> 60
SL2	3	NA

SLT Shoreline Type Category

The physical characteristic of the shoreline area.

SLT	0	Unknown
SLT	6	Mangrove/Nipa
SLT	8	March, Swamp
SLT	10	Rocky
SLT	11	Rubble
SLT	13	Sandy
SLT	14	Stony, Shingly
SLT	15	Other

Withdrawn/Retirée

SM1 Surficial Material Depth Category

Estimated general depth of soil or unconsolidated surface materials, expressend in 0.5 meter increments.

SM1	0	Unknown
SM1	1	< 0.5 (Meters)
SM1	2	≥ 0.5 (Meters)

SMC Surface Material Category

Surface material composition excluding internal structural material.

SMC	0	Unknown
SMC	1	Aircraft
SMC	2	Aluminum
SMC	3	Ammunition
SMC	4	Ash
SMC	5	Asphalt
SMC	6	Basalt
SMC	7	Bedrock
SMC	8	Boulders
SMC	9	Brick
SMC	10	Calcareous
SMC	11	Cement
SMC	12	Chalk
SMC	13	Chemical
SMC	14	Cinders
SMC	15	Cirripedia
SMC	16	Clay
SMC	17	Coal
SMC	18	Cobble
SMC	19	Coke
SMC	20	Composition
SMC	21	Concrete
SMC	22	Conglomerate
SMC	23	Copper
SMC	24	Coral
SMC	25	Coral Head
SMC	26	Desalinated Water
SMC	27	Diamonds
SMC	28	Diatoms
SMC	29	Dolomite
SMC	30	Earthen
SMC	31	Electric
SMC	32	Eroded Lands
SMC	33	Explosives
SMC	34	Flynch
SMC	35	Food
SMC	36	Foraminifera
SMC	37	Fucus
SMC	38	Gas
SMC	39	Gasoline
SMC	40	Glass
SMC	41	Globigerina
SMC	42	Gold

Withdrawn/Retirée

SMC	43	Granite
SMC	44	VALUE INTENTIONALLY LEFT BLANK
SMC	45	Grass/Thatch
SMC	46	Gravel
SMC	47	Green Rocks
SMC	48	Ground
SMC	49	Ground (Shells)
SMC	50	Heat
SMC	51	Iron
SMC	52	Lava
SMC	53	VALUE INTENTIONALLY LEFT BLANK
SMC	54	Lead
SMC	55	Loess
SMC	56	Lumber
SMC	57	Macadam
SMC	58	Madrepores
SMC	59	Manganese
SMC	60	Marble
SMC	61	Marl
SMC	62	Masonry (Brick/Stone)
SMC	63	Mattes
SMC	64	Metal
SMC	65	Mud
SMC	66	Mussels
SMC	67	Oil
SMC	68	Oil Blister
SMC	69	Ooze
SMC	70	Oysters
SMC	71	Paper
SMC	72	Part Metal
SMC	73	Pebbles
SMC	74	Plastic
SMC	75	Polyzoa
SMC	76	Porphyry
SMC	77	Prestressed Concrete
SMC	78	Pteropods
SMC	79	Pumice
SMC	80	Quartz
SMC	81	Radiolaria
SMC	82	Radioactive Material
SMC	83	Reinforced Concrete
SMC	84	Rock/Rocky
SMC	85	Rubber
SMC	86	Rubble
SMC	87	Salt
SMC	88	Sand
SMC	89	Sandstone
SMC	90	Schist
SMC	91	Spoils/Tailings
SMC	92	Scoria
SMC	93	Sea Tangle
SMC	94	Seaweed
SMC	95	Sewage
SMC	96	Shells
SMC	97	VALUE INTENTIONALLY LEFT BLANK
SMC	98	Shingle
SMC	99	Silt

Withdrawn/Retirée

SMC	100	Silver
SMC	101	Slag
SMC	102	Sludge
SMC	103	Snow/Ice
SMC	104	Soil
SMC	105	Spicules
SMC	106	Sponge
SMC	107	Steel
SMC	108	Stone
SMC	109	Sugar
SMC	110	Travertin
SMC	111	Tufa
SMC	112	Uranium
SMC	113	Vegetation Products
SMC	114	Volcanic
SMC	115	Volcanic Ash
SMC	116	Water
SMC	117	Wood
SMC	118	Zinc
SMC	119	Distorted surface
SMC	120	Sand and gravel
SMC	121	Rip-Rap
SMC	198	Kelp
SMC	199	Sandwaves
SMC	999	Other

SND Sounding Category

Condition of depth.

SND	0	Unknown
SND	1	Drying Heights
SND	2	No Bottom Found
SND	3	VALUE INTENTIONALLY LEFT BLANK
SND	4	VALUE INTENTIONALLY LEFT BLANK
SND	6	VALUE INTENTIONALLY LEFT BLANK
SND	7	VALUE INTENTIONALLY LEFT BLANK
SND	8	Out of position
SND	9	Slant
SND	10	Ordinary
SND	90	Adequately sounded
SND	91	No bottom found at depth shown
SND	92	Depth unknown
SND	93	Doubtful sounding
SND	94	Unreliable sounding
SND	95	Least depth known
SND	96	Least depth unknown, safe clearance at value shown
SND	97	Value reported (not surveyed)
SND	98	Value reported (not confirmed)
SND	99	Maintained depth
SND	999	Other

Withdrawn/Retirée

SOH Severity of Hazard

Severity of hazard.

SOH	0	Unknown
SOH	1	Dangerous
SOH	2	Non-Dangerous
SOH	3	Obstruction
SOH	99	Non-Dangerous to surface navigation but, avoid anchoring/trawling
SOH	999	Other

SOU Exposition of Sounding

Indicates whether the value of a sounding is shallower than, deeper than, or within the range of depth of the surrounding depth area.

SOU	0	Undefined
SOU	1	Within the range of depth of the surrounding depth area
SOU	2	Shallower than the range of depth of the surrounding depth area
SOU	3	Deeper than the range of depth of the surrounding depth area

SPE Spot Elevation Category

Qualifies the spot elevation.

SPE	0	Unknown
SPE	1	Top of trees
SPE	2	Out of position
SPE	3	Summit

SPL Span Length Longest

Length of longest span of a bridge.

SPL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meter	Short Integer	0±32,767	1 M	

SPR Slope Polygon Range

Range indicating the slope of ground within delineated area of feature, reported in percent.

SPR	0	≤3
SPR	1	>3 and ≤10
SPR	2	> 10 and ≤ 15
SPR	3	> 15 and ≤ 20
SPR	4	> 20 and ≤ 30
SPR	5	> 30 and ≤ 45
SPR	6	> 45 and ≤ 60
SPR	7	> 60 and ≤ 85
SPR	8	> 85

Withdrawn/Retirée

SR1 Slope Gradient Right (1)

Predominant slope range (1) of the right bank (facing downstream) in percent, measured from mean water level to the first break in slope above the mean water level.

SR1	0	Unknown
SR1	1	≤ 30
SR1	2	> 30 and ≤ 45
SR1	3	> 45 and ≤ 60
SR1	4	> 60
SR1	5	NA

SR2 Slope Gradient Right (2)

Predominant slope range (2) of the right bank (facing downstream) in percent, measured from mean water level to the first break in slope above the mean water level.

SR2	0	Unknown
SR2	1	≤ 60
SR2	2	> 60
SR2	3	NA

SRD Surface Roughness Description

Describes the condition of the surface materials that maybe used for mobility prediction, construction material, and landing sites.

SRD	0	Unknown
SRD	1	No surface roughness effect
SRD	2	Area of high landslide potential
SRD	3	Uncohesive surface material/flat
SRD	4	Rough
SRD	5	Angular
SRD	6	Rounded
SRD	11	Surface of numerous cobbles and boulders
SRD	12	Areas of stony terrain
SRD	13	Stony soil with surface rock
SRD	14	Stony soil with scattered boulders
SRD	15	Stony soil with numerous boulders
SRD	16	Numerous boulders
SRD	17	Numerous rock outcrops and/or stony soil
SRD	18	Area of scattered boulders
SRD	19	Talus slope
SRD	20	Boulder Fields
SRD	31	Highly fractured rock surface
SRD	32	Weathered lava flows
SRD	33	Unweathered lava flows
SRD	34	Stony soil with numerous rock outcrops
SRD	35	Irregular surface with deep fractures of foliation
SRD	36	Rugged terrain with numerous rock outcrops
SRD	37	Rugged bedrock surface
SRD	38	Sand dunes
SRD	39	Sand dunes / low
SRD	40	Sand dunes/ high
SRD	41	Active sand dunes
SRD	42	Stablized sand dunes

Withdrawn/Retirée

SRD	43	Highly distorted area, sharp rocky ridges
SRD	51	Stony soil cut by numerous gullies
SRD	52	Moderately dissected terrain
SRD	53	Moderately dissected terrain with scattered rock outcrops
SRD	54	Dissected floodplain
SRD	55	Highly dissected terrain
SRD	56	Area with deep erosional gullies
SRD	57	Steep, rugged, dissected terrain with narrow gullies
SRD	58	Karst/areas of numerous sinkholes and solution valleys
SRD	59	Karst/area of numerous sinkholes
SRD	60	Karst/hummocky terrain covered with large conical hills
SRD	61	Karst/hummocky terrain covered with low, broad-based mounds
SRD	62	Arroyo/wadi/wash
SRD	63	Playa/dry lake
SRD	64	Area of numerous meander scars and/or oxbow lakes
SRD	65	Solifluction lobes and frost scars
SRD	66	Hummocky ground, areas of frost heaving
SRD	67	Area of frost polygons
SRD	68	Area containing sabkhas
SRD	69	Area of numerous small lakes and ponds
SRD	70	Area of numerous crevasses
SRD	81	Area of numerous terraces
SRD	82	Quarries
SRD	83	Strip mines
SRD	84	Quarry/gravel pit
SRD	85	Quarry/sand pit
SRD	86	Mine tailings/waste piles
SRD	87	Salt evaporators
SRD	88	Area of numerous dikes
SRD	89	Area of numerous diked fields
SRD	90	Area of numerous fences
SRD	91	Area of numerous stone walls
SRD	92	Area of numerous man-made canals/drains/ditches
SRD	93	Area of numerous terraced fields
SRD	94	Parallel earthen mounds (row crops)
SRD	95	Area of numerous hedgerows

SRQ Surface Roughness Qualifier

A code which relates a surface material mapping unit to a Surface Roughness Description (SRD) value.

SRQ 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Qualifier	Short Integer	0±32,767	1 QUALIFIER	

SSC Structure Shape Category

Geometric form, appearance, or configuration of the feature.

SSC	0	Unknown
SSC	1	Barrel, Ton
SSC	2	Blimp
SSC	3	Boat Hull (Float)
SSC	4	Bullet

Withdrawn/Retiree

SSC	5	VALUE INTENTIONALLY LEFT BLANK
SSC	6	Conical /Peaked/NUN
SSC	7	Cylindrical (Upright)/CAN
SSC	9	VALUE INTENTIONALLY LEFT BLANK
SSC	10	Pillar, Spindle
SSC	11	VALUE INTENTIONALLY LEFT BLANK
SSC	12	Pyramid
SSC	13	VALUE INTENTIONALLY LEFT BLANK
SSC	14	VALUE INTENTIONALLY LEFT BLANK
SSC	15	Solid/filled
SSC	16	Spar
SSC	17	Spherical (Hemispherical)
SSC	18	Truss
SSC	19	With Radome
SSC	20	VALUE INTENTIONALLY LEFT BLANK
SSC	21	Artificial Mountain
SSC	22	Crescent
SSC	23	Ferris Wheel
SSC	24	Enclosed
SSC	25	Roller coaster
SSC	26	Lateral
SSC	27	Mounds
SSC	28	Ripple
SSC	29	Star
SSC	30	Transverse
SSC	31	VALUE INTENTIONALLY LEFT BLANK
SSC	33	VALUE INTENTIONALLY LEFT BLANK
SSC	34	VALUE INTENTIONALLY LEFT BLANK
SSC	35	VALUE INTENTIONALLY LEFT BLANK
SSC	36	Windmotor
SSC	38	VALUE INTENTIONALLY LEFT BLANK
SSC	40	VALUE INTENTIONALLY LEFT BLANK
SSC	46	Open
SSC	52	'A' Frame
SSC	53	'H' Frame
SSC	54	'I' Frame
SSC	56	'Y' Frame
SSC	57	VALUE INTENTIONALLY LEFT BLANK
SSC	58	VALUE INTENTIONALLY LEFT BLANK
SSC	59	Telescoping Gasholder (Gasometer)
SSC	60	Mast
SSC	61	Tripod
SSC	62	VALUE INTENTIONALLY LEFT BLANK
SSC	63	VALUE INTENTIONALLY LEFT BLANK
SSC	65	Cylindrical with flat top
SSC	66	Cylindrical with domed top
SSC	71	Cylindrical/Peaked
SSC	73	Superbuoy
SSC	74	'T' Frame
SSC	75	Tetrahedron
SSC	76	Funnel
SSC	77	Arch
SSC	78	Multi-Arch
SSC	79	Round
SSC	80	Rectangular
SSC	81	Dragons Teeth
SSC	82	I-Beam

Withdrawn/Retirée

SSC	83	Square
SSC	84	Irregular
SSC	85	Diamond Shaped Buoy
SSC	86	Oval
SSC	87	Dome
SSC	107	Tower
SSC	108	Scanner
SSC	109	Obelisk
SSC	999	Other

SSR Structure Shape of Roof

Roof shape.

SSR	0	Unknown
SSR	6	Conical /Peaked/NUN
SSR	38	Curved /Round (Quonset)
SSR	40	Dome
SSR	41	Flat
SSR	42	Gable (pitched)
SSR	43	VALUE INTENTIONALLY LEFT BLANK
SSR	44	VALUE INTENTIONALLY LEFT BLANK
SSR	45	VALUE INTENTIONALLY LEFT BLANK
SSR	46	VALUE INTENTIONALLY LEFT BLANK
SSR	47	Sawtooth
SSR	48	VALUE INTENTIONALLY LEFT BLANK
SSR	49	VALUE INTENTIONALLY LEFT BLANK
SSR	50	With Monitor
SSR	51	With Steeple
SSR	55	Flat with Monitor
SSR	58	VALUE INTENTIONALLY LEFT BLANK
SSR	64	Gable with Monitor
SSR	65	VALUE INTENTIONALLY LEFT BLANK
SSR	66	VALUE INTENTIONALLY LEFT BLANK
SSR	71	VALUE INTENTIONALLY LEFT BLANK
SSR	72	VALUE INTENTIONALLY LEFT BLANK
SSR	77	With Cupola
SSR	78	With Turret
SSR	79	With Tower
SSR	80	With Minaret
SSR	999	Other

SST Sound Signal Type

Type of audible signal.

SST	0	Unknown
SST	1	Bell
SST	2	Diaphone
SST	3	Explosive Fog Signal
SST	4	Gong
SST	5	Gun
SST	6	Horn
SST	7	Nautophone
SST	8	Radio Fog Signal
SST	9	Siren

Withdrawn/Retirée

SST	10	Submarine Fog Bell
SST	11	Submarine Oscillator
SST	12	Submarine Sound Signal (Connected to Shore)
SST	13	Submarine Sound Signal (Not Connected to Shore)
SST	14	Whistle
SST	15	Reed
SST	16	None
SST	98	Tyfon
SST	999	Other

STA Station Type Category (Maritime)

Equipment or activity at site.

STA	0	Unknown
STA	1	Coast Guard
STA	2	Fireboat
STA	3	Marine Police
STA	4	Ice Signal
STA	5	Lifeboat/Rescue
STA	6	Port Control
STA	7	VALUE INTENTIONALLY LEFT BLANK
STA	8	VALUE INTENTIONALLY LEFT BLANK
STA	9	VALUE INTENTIONALLY LEFT BLANK
STA	10	VALUE INTENTIONALLY LEFT BLANK
STA	11	Pilot
STA	12	VALUE INTENTIONALLY LEFT BLANK
STA	13	Signal
STA	14	Signal Mast
STA	15	Storm Signal
STA	16	Stream Signal
STA	17	Tide Signal
STA	18	Time Ball
STA	19	Time Signal
STA	20	Unmanned Oceanographic
STA	21	Weather signal
STA	22	Fog Signal
STA	23	VALUE INTENTIONALLY LEFT BLANK
STA	25	Semaphore
STA	26	STA
STA	27	Tidal Current Signal
STA	28	Traffic Signal
STA	29	Bridge Signal
STA	30	Lock Signal
STA	31	VALUE INTENTIONALLY LEFT BLANK
STA	32	International Port Signals
STA	33	Firing Practice Signal Station
STA	34	Signal Station, Traffic
STA	35	Warning
STA	999	Other

Withdrawn/Retirée

STG Soil Trafficability Group (Derived from STP)

Soils described by the Unified Soil Classification System categorized by their wet weather trafficability characteristics.

STG	0	Unknown
STG	1	A
STG	2	B
STG	3	C
STG	4	D
STG	5	E
STG	6	X

STP Soil Types

Soils described by the Unified Soil Classification System (USCS).

STP	0	Unknown
STP	1	GW Well graded gravels or gravel-sand mixtures
STP	2	GP Poorly graded gravels or gravel-sand mixtures
STP	3	GM Silty gravels, gravel-sand-silt mixtures
STP	4	GC Clayey gravels, gravel-sand-clay mixture
STP	5	SW Well graded sand or gravelly sands
STP	6	SP Poorly graded sands or gravelly sands
STP	7	SM Silty sands, sand-silt mixture.
STP	8	SC Clayey sands, sand-clay mixtures
STP	9	ML Inorganic silts and very fine sands
STP	10	CL Inorganic clays of low to medium plasticity
STP	11	OL Organic silts and organic silty clays
STP	12	CH Inorganic clays of high plasticity, fat clays
STP	13	MH Inorganic silts, micaceous or diatomaceous
STP	14	OH Organic clays of medium to high plasticity
STP	15	PT Peat and other highly organic soils
STP	17	ML-CL Soil type having both ML and CL characteristics
STP	18	Evaporites
STP	99	Not Evaluated
STP	501	CCM-1 (used for DA010)
STP	502	CCM-2 (used for DA010)
STP	503	CCM-3 (used for DA010)
STP	504	CCM-4 (used for DA010)
STP	505	CCM-5 (used for DA010)
STP	506	CCM-6 (used for DA010)
STP	999	Other

STR Summer Tree Cover Density Code

Coded value indicating percent of summer canopy closure within delineated area of feature.

STR	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Percent	Short Integer	0-100	1 %	

Withdrawn/Retirée

SUP Supervision of Light

Stipulates whether the light is equipped with a standby or emergency equipment.

SUP	0	Undefined
SUP	1	Watched light
SUP	2	Unwatched light

SUR Survey Category

Tabulates the various qualifiers of the survey carried out for a feature.

SUR	0	Unknown (see QUA)
SUR	1	Surveyed
SUR	2	Inadequately Surveyed

SVC Sounding Velocity

Indicates type of correction that has been added to, or subtracted from instrument reading to obtain correct depth.

SVC	0	Unknown
SVC	1	Echo Sounder Calibrated at 4800 Ft/Sec Uncorrected
SVC	2	Echo Sounder Calibrated at 1500 M/Sec Uncorrected
SVC	3	Mathews Tables (NP 139) Corrected
SVC	4	Sound Velocity Meter (SVM) Corrected
SVC	5	Corrected by other means of calibration
SVC	999	Other

SWC Soil Wetness Condition

General moisture content or condition of a soil.

SWC	0	Unknown
SWC	1	Dry
SWC	2	Moist
SWC	3	Wet
SWC	4	Frozen/Permafrost
SWC	999	Other

SWL Single Wheel Bearing Load

The estimated single wheel load (ESWL).

SWL	0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Kips	Short Integer	0±32,767	1 KIP	

SWT Well/Spring Type

Identifies the type of spring or water-hole.

SWT	0	Unknown
SWT	1	Geyser

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SWT	2	Hot Spring
SWT	3	Fumarole
SWT	4	Artesian
SWT	5	Water Hole
SWT	6	Walled-In Spring
SWT	999	Other

TCL Tree Canopy Levels

The number of canopies (vegetation levels) in a woodland.

TCL	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Levels	Short Integer	0±32,767	1 LEVEL	

TEC Technique of Sounding Measurement

Encodes the various techniques and methods of sounding measurement.

TEC	0	Undefined
TEC	1	Found by echo sounder
TEC	2	Found by side scan sonar
TEC	3	Found by multi-beam
TEC	4	Found by diver
TEC	5	Found by lead-line
TEC	6	Found by wire-drag

TEL Telescope Category

Classifies the types of telescopes.

TEL	0	Unknown
TEL	1	Optical
TEL	2	Parabolic Radio Antenna
TEL	3	Radio Ground Array
TEL	999	Other

TID Tidal / Non-Tidal Category

Identifies whether a feature is affected by tidal water.

TID	1	Non-Tidal
TID	2	Tidal / Tidal fluctuating

TIM Time Attribute

The time, expressed in hours of duration, for which an activity is permitted.

TIM	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Hours	Short Integer	0 - 24	1 H	

Withdrawn/Retirée

TMC Top Mark Characteristic

The characteristic shape secured at the top of a buoy or beacon to aid identification.

TMC	0	Unknown
TMC	1	East Mark (2 cones - base together)
TMC	2	Isolated Danger (2 balls)
TMC	3	North Mark (2 cones - pointing up)
TMC	4	Port Hand (can or cylinder)
TMC	5	Safe Water (1 ball)
TMC	6	Special (X)
TMC	7	Starboard Hand (1 cone - pointing up)
TMC	8	South Mark (2 cones - pointing down)
TMC	9	West Mark (2 cones - points together)
TMC	10	Nun
TMC	11	VALUE INTENTIONALLY LEFT BLANK
TMC	12	Ball
TMC	13	Can
TMC	14	St. Andrew's Cross
TMC	15	Ball over Cone
TMC	16	Cone over Ball
TMC	17	Broom point up
TMC	18	Perch
TMC	19	Diamond
TMC	20	Broom point down
TMC	21	Cone (Point Upwards)
TMC	22	Cone (Point Downwards)
TMC	23	Upright Cross
TMC	24	Optical Reflector
TMC	25	Can (Open)
TMC	26	Can (Filled)
TMC	27	Ball (Open)
TMC	28	Ball (Filled)
TMC	29	Can Over Ball (Open)
TMC	30	Cross Over Ball (Filled)
TMC	31	Diamond Over Ball (Filled)
TMC	32	Double Cone, Points Apart (Open)
TMC	33	None
TMC	999	Other

TOP Shape of Top Mark

Tabulates the various shapes of top mark.

TOP	0	Undefined
TOP	1	Cone, point up
TOP	2	Cone, point down
TOP	3	Sphere
TOP	4	2 spheres
TOP	5	Cylinder
TOP	6	Board
TOP	7	X-shaped
TOP	8	Cross shaped
TOP	9	Cube, point up
TOP	10	2 cones, point-to-point
TOP	11	2 cones, base-to-base

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TOP	12	Diamond
TOP	13	2 cones (points upward)
TOP	14	2 cones (points downward)
TOP	15	Besom (point up)
TOP	16	Besom (point down)

TRA Traversability

Indicates whether the feature is traversable by foot.

TRA	0	Unknown
TRA	1	Traversability
TRA	2	Non-Traversable
TRA	4	Polygon
TRA	5	Pond
TRA	999	Other

TRE Tree Type Category

Type of tree coverage.

TRE	0	Unknown
TRE	1	Deciduous
TRE	2	Evergreen
TRE	3	Mixed

TRF Traffic Flow

Encodes the general destination of traffic.

TRF	0	Undefined
TRF	1	Inbound
TRF	2	Outbound
TRF	3	One-way
TRF	4	Two-way

TRK Recommended Track Classification

Tabulates types of recommended track.

TRK	0	Undefined
TRK	1	Based on a system of fixed marks
TRK	2	Not based on a system of fixed marks

TS1 Tree Spacing Range (1)

Estimated range (1) of the average distance between trees in a stand, determined in decimeters from center to center of adjacent trees.

TS1	0	Unknown
TS1	1	> 0 and ≤ 5.0
TS1	2	> 5.0 and ≤ 10.0
TS1	3	> 10.0 and ≤ 15.0
TS1	4	> 15.0 and ≤ 20.0
TS1	5	> 20.0 and ≤ 25.0

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TS1	6	> 25.0 and ≤ 30.0
TS1	7	> 30.0 and ≤ 35.0
TS1	8	> 35.0 and ≤ 40.0
TS1	9	> 40.0 and ≤ 50.0
TS1	10	> 50.0 and ≤ 60.0
TS1	11	> 60.0 and ≤ 80.0
TS1	12	> 80.0 and ≤ 100.0
TS1	13	> 100.0 and ≤ 150.0
TS1	14	> 150.0
TS1	15	NA

TS2 Tree Spacing Range (2)

Estimated range (2) of the average distance between trees in a stand, determined in decimeters from center to center of adjacent trees.

TS2	0	Unknown
TS2	1	> 0 and ≤ 30.0
TS2	2	> 30.0 and ≤ 60.0
TS2	3	> 60.0 and ≤ 100.0
TS2	4	> 100.0
TS2	5	NA

TSC Tree Spacing Category

Average distance between adjacent tree centerlines within area of feature.

TSC	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

TSP Traffic Scheme Part

Component of the traffic routing system.

TSP	1	Arrow
TSP	2	Outer Boundary
TSP	3	Separation Zone Area
TSP	4	Separation Zone Line
TSP	5	Separation Zone Point
TSP	6	Inbound Area
TSP	7	Outbound Area

TSS Traffic Separation Scheme Classification

Tabulates types of traffic separation schemes.

TSS	0	Undefined
TSS	1	IMO - adopted
TSS	2	Not IMO - adopted

Withdrawn/Retirée

TST Transmission Line Suspension

Types of suspension of power transmission lines between pylons.

TST	0	Unknown
TST	1	Normal Suspension
TST	2	Catenary (Over Mountains)
TST	3	Catenary (Over Water)

TTC Tower Type Category

Appearance or configuration of the feature.

TTC	0	Unknown
TTC	1	Bridge
TTC	2	Observation/Lookout
TTC	3	Other
TTC	4	Undefined
TTC	5	Light tower
TTC	6	Water tower
TTC	7	Radio tower
TTC	8	Cooling tower
TTC	9	Radar tower
TTC	10	Lookout tower
TTC	11	Television tower
TTC	12	Fire
TTC	13	Mooring Tower, articulated loading platform , single anchor leg
TTC	14	Powerline
TTC	15	Loran
TTC	16	Control
TTC	17	Micro Wave

TUC Transportation Use Category

Identifies the primary user, function, or authority of the transportation system.

TUC	0	Unknown
TUC	1	Both Road and Railroad
TUC	2	Highway
TUC	3	Railroad
TUC	4	Road
TUC	6	Street
TUC	7	Through Routes
TUC	8	Air Traffic Control
TUC	12	Marine
TUC	13	Air
TUC	14	Bus
TUC	17	Pedestrian
TUC	18	Pipeline
TUC	19	Animal
TUC	20	Aircraft
TUC	21	Ship
TUC	22	Automotive
TUC	23	Boat
TUC	24	Bulk Motor Boat/Barge
TUC	25	VALUE INTENTIONALLY LEFT BLANK

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TUC	26	Passenger
TUC	27	Chair lift
TUC	28	Ski tow
TUC	29	Sleigh tow
TUC	30	Cart tow
TUC	31	Motor Cycle
TUC	32	Bicycle
TUC	33	Minerals
TUC	34	Waterway
TUC	35	No Transport Use
TUC	36	Slip Road/Access Road
TUC	37	Portage
TUC	38	Canal
TUC	39	Caravan Route
TUC	40	Subway
TUC	999	Other

TXT Text Attribute

Narrative or other description.

TXT	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	Lexical			256 Characters

UBC Underbridge Clearance Category

Clearance below bridge, measured from the lowest surface level to the base of the lower of either a cross beam or the lowest bridge deck.

UBC	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

UMC Underlying Material

Characteristics of underlying material composition of feature.

UMC	0	Unknown
UMC	2	Coarse
UMC	3	Decayed
UMC	4	Fine, Minute Particles
UMC	5	Gritty
UMC	6	Hard
UMC	7	Rotten
UMC	8	Soft
UMC	9	Sticky
UMC	10	Stiff
UMC	11	Streaky
UMC	12	Tenacious
UMC	13	Uneven
UMC	17	Calcareous
UMC	18	Flinty

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UMC	19	Glacial
UMC	20	Ground
UMC	21	Large
UMC	22	Rocky
UMC	23	Small
UMC	24	Speckled
UMC	25	Varied
UMC	26	Volcanic
UMC	27	Medium

UNI Units

Units associated strictly with the measured distance lines (FC100) for nautical data. [Reference DIGEST Part 3 for Units associated with DIGEST header data.]

UNI	1	Meters
UNI	11	Nautical Miles
UNI	22	Feet
UNI	23	Kilometers
UNI	24	Yards

USE Usage

Use (identifies the primary user, function, or controlling authority).

USE	0	Unknown
USE	1	VALUE INTENTIONALLY LEFT BLANK
USE	2	VALUE INTENTIONALLY LEFT BLANK
USE	3	VALUE INTENTIONALLY LEFT BLANK
USE	4	National
USE	5	State
USE	6	Private
USE	7	Tribal
USE	8	Military
USE	9	VALUE INTENTIONALLY LEFT BLANK
USE	10	Other
USE	11	Motel/Hotel
USE	12	Apartment
USE	13	Open
USE	14	VALUE INTENTIONALLY LEFT BLANK
USE	15	VALUE INTENTIONALLY LEFT BLANK
USE	16	City
USE	17	Advertising Billboard
USE	18	Scoreboard
USE	19	Highway Sign
USE	20	Closed
USE	21	Restricted
USE	22	Joint Military/Civilian
USE	23	International
USE	24	Unidentified Aircraft Landing Area
USE	25	Federal
USE	26	Primary/1st Order
USE	30	Secondary/2nd Order
USE	31	Tertiary/3rd Order
USE	32	Insular
USE	33	Provincial

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USE	37	Interstate
USE	41	Industrial
USE	42	Commercial
USE	43	Institutional
USE	44	Residential
USE	45	Agricultural
USE	48	Decoy
USE	49	Civilian/Public
USE	50	Limited
USE	51	Telegraph
USE	52	Telephone
USE	53	Power
USE	57	Marine
USE	60	Avalanche
USE	61	Refugee
USE	62	Prisoner
USE	68	Animal sanctuary
USE	69	Levee/Dike
USE	70	Reserve/Reservation
USE	73	Terminus/Terminal
USE	74	Low Altitude enroute
USE	75	High Altitude Enroute
USE	76	Low and High Altitude Enroute
USE	77	Short Take-off Landing Approach
USE	78	Visual Approach
USE	79	Non-Precision Instrument Approach
USE	80	Precision Instrument Approach
USE	81	Entry
USE	82	Exit
USE	83	Transaction
USE	84	Feeder
USE	85	Initial Approach Fix
USE	86	Final Approach Fix
USE	87	Visual Descent Point
USE	88	Missed Approach Point
USE	89	Radar
USE	90	Mileage Break Down
USE	91	NAVAID Changeover
USE	92	Altimeter Change
USE	93	Compulsory Reporting Points
USE	94	Non-Compulsory Reporting Points
USE	95	Alert Apron/Hardstand
USE	96	Operational Apron/Hardstand
USE	97	Hanger/Apron
USE	98	Base Flight Apron
USE	99	Engine Test Pad/Apron
USE	100	Transient Apron
USE	101	Depot Apron
USE	102	Stub Apron
USE	103	Dispersal Hardstand
USE	104	Pad Hardstand
USE	105	Refueling Hardstand
USE	106	Parking Hardstand
USE	107	Engine Run-up Hardstand
USE	108	Firing-In Hardstand
USE	109	Compass Rose Hardstand
USE	110	Maintenance Hardstand

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USE	111	Quaternary/4th Order
USE	112	Quinary/5th Order
USE	113	Regional
USE	114	Communal
USE	117	Outfall
USE	118	Intake
USE	119	Berthing of vessels
USE	120	Recreational
USE	121	Aircraft Facility/airport reference point
USE	122	Firebreak
USE	123	Tourist
USE	124	Irrigation
USE	125	Retaining
USE	127	as a causeway
USE	128	Mixed Urban or built-up Land
USE	129	Military District
USE	130	Transportation
USE	132	Container
USE	133	Single Point Mooring
USE	134	Utilities and Communication
USE	136	as a Fill
USE	139	Fill
USE	900	Butts
USE	901	School
USE	986	Military District
USE	991	Not Applicable
USE	992	Drag Strip
USE	993	Filtration Pond
USE	994	Dugout
USE	995	Drinking Water
USE	996	Triangulation
USE	997	Cable Sign/Pipeline Indicator
USE	998	Sea-Plane landing area
USE	999	Other

USP Urban Street Pattern

The predominant geometric configuration of streets found within the delineated area of the feature.

USP	0	Unknown
USP	2	Rectangular/Grid-Regular
USP	3	Rectangular/Grid-Irregular
USP	4	Curvilinear (cluster)
USP	6	Concentric / Radial-Regular
USP	7	Concentric / Radial-Irregular
USP	9	Mixed Curvilinear (cluster) and Rectangular (grid)
USP	10	Mixed Concentric / Radial and Rectangular/ (grid)
USP	11	Mixed Curvilinear (cluster) and Concentric / Radial
USP	12	Other
USP	13	Linear Strip

UTS UTM Square Identification

Locates feature to within a specific 100,000 m square, by a 5-digit alphanumeric designation: 1st two numbers are the UTM grid zone, 3rd letter is a specific 6-degree x 8-degree block

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within the grid zone (the unique Grid Zone Designation), and the last two letters are the 100,000 m square.

UTS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			5 Characters

UT1 UTM Grid Northing

Full 7 digits of the UTM grid coordinate Northing value. (UTS, along with the last five digits of both UT1 and UT2 can designate a feature's coordinates on the earth's surface.)

UT1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			8 Characters

UT2 UTM Grid Easting

Full 6 digits of the UTM grid coordinate Easting value. (UTS along with the last five digits of both UT1 and UT2 can designate a feature's coordinates on the earth's surface.)

UT2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			8 Characters

UZ1 UTM Grid Zone (1)

Two-character grid zone identifier.

UZ1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			2 Characters

UZ2 UTM Grid Zone (2)

Two-character grid zone identifier.

UZ2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Text String	ASCII Text			2 Characters

VAL Value

Generic numeric (integer) value.

VAL 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Numeric	Short Integer	±32,767	Unity	

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VAV Variation Anomaly Value

The difference between the magnetic variation of the disturbance area and the magnetic variation of the surrounding area.

VAV 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Degree	Short Integer	0-359	1 DEG	

VCA Void Collection Attribute

Reason data is not collected.

VCA	0	Unknown
VCA	1	Data Not Requested By User
VCA	2	Area Too Rough to Collect
VCA	3	No Available Imagery
VCA	4	Different Height Threshold Within Data Block
VCA	5	Low Data Collection Criteria
VCA	6	No Available Map Source
VCA	7	No Suitable Imagery
VCA	8	Data Not Required
VCA	999	Other

VCC Vertical Clearance, Closed

Encodes the vertical clearance of an object in closed condition, e.g. a closed lifting bridge, measured from the horizontal plane towards the object overhead.

VCC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

VCO Vertical Clearance, Opened

Encodes the vertical clearance of an object in opened condition, e.g. an open lifting bridge, measured from the plane towards the object overhead.

VCO 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

VCS Vertical Clearance, Safe

Encodes the safe vertical clearance of an object measured from the plane towards the object overhead.

VCS 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

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VCT Void Collection Type

Identifies type of missing information.

VCT	0	Unknown
VCT	1	Relief
VCT	2	Other

VDC Vertical Datum Category

The reference line (0 elevation) from which heights and depths are measured.

VDC	0	Unknown
VDC	1	VALUE INTENTIONALLY LEFT BLANK
VDC	2	High Water
VDC	3	Higher High Water
VDC	4	Indian Spring Low Water
VDC	5	Low Water
VDC	6	Lower Low Water
VDC	7	Mean High Water
VDC	8	Mean High Water Neaps
VDC	9	Mean High Water Springs
VDC	10	Mean Higher High Water
VDC	11	Mean Low Water
VDC	12	Mean Low Water Neaps
VDC	13	Mean Low Water Springs
VDC	14	Mean Lower Low Water
VDC	15	Mean Sea Level
VDC	16	Mean Tide Level
VDC	17	Neap Tide
VDC	18	Spring Tide
VDC	19	Mean Lower Low Water Springs
VDC	20	Lowest Astronomical Tide
VDC	21	Chart Datum (Unspecified)
VDC	22	Highest Astronomical Tide
VDC	24	Mean Higher Water
VDC	26	Highest Normal High Water
VDC	28	Highest High Water
VDC	30	Indian Spring High Water
VDC	90	Lowest low water
VDC	91	Lowest low water springs
VDC	92	Approximate mean low water springs
VDC	93	Low water springs
VDC	94	Approximate lowest astronomical tide
VDC	95	Nearly lowest low water
VDC	96	Approximate mean low water
VDC	97	Approximate mean lower low water
VDC	98	Approximate mean sea level
VDC	99	High water springs
VDC	999	Other

Withdrawn/Retiree

VEC Vehicle Capacity (Number of Vehicles)

Number of vehicles that a feature can accommodate.

VEC 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Vehicles	Short Integer	0±32,767	1 VEHICLE	

VEG Vegetation Characteristic

Type of plant or plantings.

VEG	0	Unknown
VEG	1	Dry Crops
VEG	2	VALUE INTENTIONALLY LEFT BLANK
VEG	3	VALUE INTENTIONALLY LEFT BLANK
VEG	4	Rice Paddies
VEG	5	Agriculture with scattered forests or rows of tree
VEG	6	Cranberry
VEG	7	Peat
VEG	8	Pasture, meadow, steppe
VEG	9	Grassland with scattered trees
VEG	10	Tropical Grass
VEG	11	Casuarina
VEG	12	Coniferous
VEG	16	Nipa Palm
VEG	17	Palm
VEG	18	Filao
VEG	19	Mangrove
VEG	20	Grove
VEG	22	Wheat
VEG	23	Corn
VEG	24	Deciduous
VEG	25	Evergreen
VEG	26	Cork-Oak
VEG	27	Fir
VEG	28	Beech
VEG	29	Eucalyptus
VEG	30	Oak
VEG	31	Pine
VEG	32	Walnut
VEG	33	Maple
VEG	34	Poplar
VEG	35	Olive
VEG	36	Chestnut
VEG	37	Larch
VEG	38	Cypress
VEG	39	Peach
VEG	40	Apple
VEG	41	Carob
VEG	42	Almond
VEG	43	Citrus
VEG	44	Elm
VEG	45	Ilex
VEG	46	Birch

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VEG	47	Ash
VEG	48	Hazel
VEG	49	VALUE INTENTIONALLY LEFT BLANK
VEG	49	Mixed Deciduous
VEG	50	Mixed Trees
VEG	51	Herb/Shrub
VEG	52	Forest Clearing
VEG	53	Brushland open to medium density
VEG	54	Brushland medium to dense density
VEG	55	With trees
VEG	56	Without trees
VEG	999	Other

VEM Quality of Vertical Measurement

Qualifiers of the various values of vertical measurement.

VEM	0	Undefined
VEM	1	Measured
VEM	2	Estimated

VH1 Predominant Vegetation Height Range (1)

Range of predominant height (in meters) of vegetation within delineated area of feature (First Range).

VH1	1	≤ 2
VH1	2	> 2 and ≤ 5
VH1	3	> 5 and ≤ 10
VH1	4	> 10 and ≤ 15
VH1	5	> 15 and ≤ 20
VH1	6	> 20 and ≤ 30
VH1	7	> 30 and ≤ 40
VH1	8	> 40
VH1	9	> 20 and ≤ 25
VH1	10	> 25 and ≤ 30
VH1	11	> 30 and ≤ 35
VH1	12	> 35 and ≤ 40
VH1	13	NA

VH2 Predominant Vegetation Height Range (2)

Range of predominant height (in meters) of vegetation within delineated area of feature (Second Range).

VH2	1	≤ 5
VH2	2	> 5 and ≤ 20
VH2	3	> 20
VH2	4	NA

VIS Visibility of Light

Encodes the specific visibility of light.

VIS	0	Undefined

Withdrawn/Retirée

VIS	1	High intensity
VIS	2	Low intensity
VIS	3	Faint
VIS	4	Intensified
VIS	5	Unintensified
VIS	6	Visibility deliberately restricted
VIS	7	Obscured
VIS	8	Partially obscured

VRC Vegetation Roughness Category

An indexed value indicating the roughness of vegetation.

VRC	1	0.00	100% reduction
VRC	2	0.05	
VRC	3	0.10	
VRC	4	0.15	
VRC	5	0.20	
VRC	6	0.25	
VRC	7	0.30	
VRC	8	0.35	
VRC	9	0.40	
VRC	10	0.45	
VRC	11	0.50	50% reduction.
VRC	12	0.55	
VRC	13	0.60	
VRC	14	0.65	
VRC	15	0.70	
VRC	16	0.75	
VRC	17	0.80	
VRC	18	0.85	
VRC	19	0.90	
VRC	20	0.95	
VRC	21	1.00	0% reduction.
VRC	22	Not evaluated area where development has precluded evaluation of soil.	
VRC	23	NA	

VRR Vertical Reference Category

Relative location referenced to sounding datum, unless otherwise indicated.

VRR	0	Unknown
VRR	1	Above Surface/Does not cover (At High Water)
VRR	2	Awash at Sounding Datum
VRR	4	Below Surface/Submerged
VRR	8	Covers and Uncovers
VRR	9	Not Applicable

WD1 Minimum Traveled Way Width

Minimum width of the traveled way, excluding hard pavements and shoulders (in decimeters).

WD1	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeters	Short Integer	0±32,767	1 DM	

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WD2 Total Usable Width

Total usable width including pavements and hard shoulders (in decimeters).

WD2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeters	Short Integer	0±32,767	1 DM	

WD3 Military Gap Width

The minimum horizontal bridging distance between banks (in decimeters).

WD3 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeters	Short Integer	0±32,767	1 DM	

WD4 Wet Gap Width

The wet gap width at low tide (in meters).

WD4 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

WD5 Width Top

The width at the top of a feature (in meters).

WD5 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

WD6 Width Bottom

The width at the bottom of a feature (in meters).

WD6 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

WDA Water Depth Average

The average water depth (in meters).

WDA 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

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WFT Well Feature Type

Type of well.

WFT	0	Unknown
WFT	1	Waterhole
WFT	2	Walled-in Spring
WFT	3	Artesian Well
WFT	4	Fountain
WFT	5	Dug or Drilled Well

WID Width

A measurement of the shorter of two linear axes. For a square feature, measure either axis. For a round feature, width shall be equal to LEN. For a bridge, the width is the measurement perpendicular to the axis between the abutments.

WID	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	0±32,767	1 M	

WLE Water Level Effect

Encodes the possible effects of the surrounding water.

WLE	0	Unknown
WLE	1	Partly submerged at high water
WLE	2	Always dry
WLE	3	Always under water/submerged
WLE	4	Covers and uncovers
WLE	5	Awash
WLE	6	Drying

WPC Work in Progress Category

Type of work in progress.

WPC	1	Land Reclamation
WPC	2	Construction of Structures

WPT Waypoint Description Code

The name/type of a named waypoint.

WPT	0	Unknown
WPT	1	Airport waypoint
WPT	2	Essential waypoint
WPT	3	Off-airway waypoint
WPT	4	Runway waypoint
WPT	5	Non-essential waypoint
WPT	6	Transition essential waypoint
WPT	7	VOR, VORDME, VORTAC
WPT	8	End of continuous airway procedure
WPT	9	Uncharted airway intersection

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WPT	10	ATC compulsory waypoint
WPT	11	Gateway fix
WPT	12	First leg of missed approach
WPT	13	Final approach fix
WPT	14	Holding fix
WPT	15	Final approach course fix
WPT	16	Missed approach point
WPT	999	Other

WRK Wreck Classification

Tabulates types of wrecks.

WRK	0	Undefined
WRK	1	Non-dangerous wreck
WRK	2	Dangerous wreck
WRK	3	Remains of wreck / foul area
WRK	4	Wreck showing mast / masts
WRK	5	Wreck showing any portion of hull or superstructure

WSC Waste/Scrap Type Category

Identifies type of waste/scrap within defined feature limits.

WSC	1	Automobile

WTC Weather Type Category

Weather conditions under which a feature is usable.

WTC	0	Unknown
WTC	1	All Weather
WTC	2	Fair /Dry Weather
WTC	3	Winter Only
WTC	4	All Weather (Limited Traffic Due to Weather)
WTC	998	Not Applicable
WTC	999	Other

WTI Wall Type Identifier

Type of wall structure category.

WTI	0	Unknown
WTI	1	Standing
WTI	2	Retaining
WTI	3	Other

WTR Winter Tree Cover Density Code

Coded value indicating percent of winter canopy closure within delineated area of feature.

WTR	1	≤ 25
WTR	2	> 25 and ≤ 50
WTR	3	> 50 and ≤ 75

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WTR	4	> 75
WTR	5	NA

WV1 Water Velocity Average 1

Range of water velocity, estimated in meters/second within delineation of feature exclusive of high water due to runoff or low water due to drought.

WV1	0	Unknown
WV1	1	≤ 1.5
WV1	2	> 1.5
WV1	3	NA

WVA Water Velocity Average

Average water velocity, estimated in meters/second within delineation of feature exclusive of high water due to runoff or low water due to drought.

WVA	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters/Sec.	Short Integer	0±32,767	1 M/S	

XPD Primary Display Mode

The normal display status of the feature.

XPD	1	Normal Display (On)
XPD	2	Display Partially Suppressed
XPD	3	Display Fully Suppressed

XSA Spatial Alignment

The existence status of the feature's spatial alignment.

XSA	0	Unknown
XSA	1	Alignment Definite
XSA	2	Reported Alignment
XSA	3	Approximate Alignment
XSA	4	Feature Connector

YLN Length of Greater Precision

A measurement of the longer of two linear axes capable of being expressed in decimal meter units.

YLN	0	Actual Value

Units	Format	Range	Increment	Maximum Characters
Decimeters	Floating Point	0.0+32,767.9	1 DM	

Withdrawn/Retirée

YSU Service Branch

Identifies a specific military organization.

YSU	0	Unknown
YSU	1	Airforce
YSU	2	Army
YSU	3	Coast Guard
YSU	4	Marines
YSU	5	Navy
YSU	6	Other
YSU	7	Joint

ZV1 Lowest Z-value

Elevation above a given datum to the lowest portion of the feature.

ZV1 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	-400 to 30,000	1 M	

ZV2 Highest Z-value

Elevation above a given datum to the highest portion of the feature.

ZV2 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	-400 to 30,000	1 M	

ZV3 Airfield/Aerodrome Elevation

The highest point of an airport's usable runways measured in meters from mean sea level.

ZV3 0 Actual Value

Units	Format	Range	Increment	Maximum Characters
Meters	Short Integer	-400 to 30,000	1 M	

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Withdrawn/Retirée

Annex C — Features and Associated Attributes

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Annex C — Features and Associated Attributes

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	ARH	Area Coverage Attribute Hectares
	COC	Conspicuous Category
	EXS	Existence Category
	MIN	Mining Category
	NAM	Name
	PRO	Product Category
	TXT	Text Attribute
AA011	Quarry/Mine Shear Wall	
Attributes:	DEP	Depth Below Surface Level
	DIR	Directivity
	WID	Width
AA040	Rig /Superstructure	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	PRO	Product Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
AA050	Well	
Attributes:	EXS	Existence Category
	HYC	Hydrological Category
	NAM	Name
	PRO	Product Category
	SCC	Spring/Well Characteristic Category
	SWT	Well/Spring Type
	TXT	Text Attribute
	WFT	Well Feature Type
AB000	Disposal Site /Waste Pile	
Attributes:	ARA	Area Coverage Attribute
	ATN	Aids to Navigation

Withdrawn/Retirée

	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	PRO	Product Category
	ZV2	Highest Z-value

AB010	Wrecking Yard/Scrap Yard	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AC000	Processing Plant/Treatment Plant	
Attributes:	AOO	Angle of Orientation
	COC	Conspicuous Category
	NAM	Name
	PRO	Product Category
	WID	Width

AC010	Blast Furnace	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AC020	Catalytic Cracker	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AC030	Settling Basin /Sludge Pond	
Attributes:	WID	Width

AD010	Power Plant	
Attributes:	AOO	Angle of Orientation
	ARA	Area Coverage Attribute
	ARH	Area Coverage Attribute Hectares

Withdrawn/Retirée

	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	PPC	Power Plant Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AD020	Solar Panels	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AD030	Substation /Transformer Yard	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	WID	Width
	ZV2	Highest Z-value

AD040	Nuclear Reactor	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AF010	Chimney /Smokestack	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DMS	Density Measure (Structure Count)
	EXS	Existence Category

Withdrawn/Retirée

	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AF020	Conveyor	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AF030	Cooling Tower	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AF040	Crane	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TUC	Transportation Use Category
	USE	Usage
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AF050	Dredge /Powershovel /Dragline	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

Withdrawn/Retirée

AF070	Flare Pipe	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
AF080	Hopper	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
AH010	Bastion/Rampart/Fortification	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
AH050	Fortification	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	USE	Usage
	WID	Width
	ZV2	Highest Z-value
AI020	Mobile Home /Mobile Home Park	
Attributes:	NAM	Name
	TXT	Text Attribute

Withdrawn/Retirée

AJ010	Circular Irrigation System	
Attributes:	TXT	Text Attribute
AJ030	Feed Lot /Stockyard /Holding Pen	
Attributes:	none required at this time	
AJ050	Windmill	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	PRO	Product Category
	SSC	Structure Shape Category
	USE	Usage
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
AK020	Amusement Park Attraction	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	SSC	Structure Shape Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
AK030	Amusement Park	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	WID	Width
	ZV2	Highest Z-value
AK040	Athletic Field	
Attributes:	AOO	Angle of Orientation
	COC	Conspicuous Category

Withdrawn/Retirée

	NAM	Name
AK080	Drive In Theater Screen	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
AK090	Fairgrounds	
Attributes:	NAM	Name
AK100	Golf Course	
Attributes:	NAM	Name
AK110	Grandstand	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
AK120	Park	
Attributes:	ARA	Area Coverage Attribute
	NAM	Name
	USE	Usage
AK130	Race Track	
Attributes:	COC	Conspicuous Category
	NAM	Name
	TXT	Text Attribute
AK150	Ski Jump	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width

Withdrawn/Retirée

	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AK160	Stadium /Amphitheater	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AK170	Swimming Pool	
Attributes:	TXT	Text Attribute

AK180	Zoo/Safari Park	
Attributes:	COC	Conspicuous Category
	NAM	Name
	TXT	Text Attribute

AL012	Archeological Site	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AL015	Building	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BFC	Building Function Category
	COC	Conspicuous Category
	COL	Character of Light
	EXS	Existence Category
	HGT	Height Above Surface Level
	HWT	House of Worship Type
	LEN	Length/Diameter of Point Feature
	NAM	Name
	REL	Religious Denomination
	SST	Sound Signal Type

Withdrawn/Retirée

	STA	Station Type Category (Maritime)
	TUC	Transportation Use Category
	TXT	Text Attribute
	USE	Usage
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AL018 Building Superstructure Addition

Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BFC	Building Function Category
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	HWT	House of Worship Type
	LEN	Length/Diameter of Point Feature
	SSR	Structure Shape of Roof
	WID	Width
	ZV2	Highest Z-value

AL019 Shed

Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AL020 Built-Up Area

Attributes:	ACC	Accuracy Category
	ARA	Area Coverage Attribute
	ARH	Area Coverage Attribute Hectares
	ATN	Aids to Navigation
	BFC	Building Function Category
	COC	Conspicuous Category
	DMR	Density Measure (% of Roof Cover)
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	PHT	Predominant Height
	PPL	Populated Place Category
	PPT	Populated Place Type
	USE	Usage
	ZV2	Highest Z-value

AL025 Cairn

Attributes:	ACC	Accuracy Category

Withdrawn/Retirée

	COC	Conspicuous Category
	CPA	Control Point Attribute
	NAM	Name
	ZV2	Highest Z-value

AL030	Cemetery	
Attributes:	NAM	Name
	TXT	Text Attribute

AL050	Display Sign	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	USE	Usage
	WID	Width
	ZV2	Highest Z-value

AL060	Dragon Teeth	
Attributes:	LOC	Location Category
	USE	Usage

AL070	Fence	
Attributes:	COC	Conspicuous Category
	LEN	Length/Diameter of Point Feature

AL073	Flagstaff / Flagpole	
Attributes:	ACC	Accuracy Category

AL080	Gantry	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AL100	Hut	
Attributes:	COC	Conspicuous Category
	TXT	Text Attribute

AL105	Settlement	
Attributes:	AOO	Angle of Orientation
	ARA	Area Coverage Attribute

Withdrawn/Retirée

	ATN	Aids to Navigation
	COC	Conspicuous Category
	DMR	Density Measure (% of Roof Cover)
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAS	Native Settlement Type
	PPT	Populated Place Type
	WID	Width
	ZV2	Highest Z-value

AL110	Light Standard/Light Support	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	PHT	Predominant Height
	WID	Width
	ZV2	Highest Z-value

AL120	Missile Site	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	FCO	Feature Configuration
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AL130	Monument	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	SSC	Structure Shape Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AL135	Native Settlement	
Attributes:	NAS	Native Settlement Type

Withdrawn/Retirée

AL140	Particle Accelerator	
Attributes:	COC	Conspicuous Category
AL155	Overhead Obstruction Location	
Attributes:	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	OOC	Overhead Obstruction Category
	SHC	Safe Horizontal Clearance
	TUC	Transportation Use Category
	WID	Width
AL200	Ruins	
Attributes:	AOO	Angle of Orientation
	ARA	Area Coverage Attribute
	ARH	Area Coverage Attribute Hectares
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HDH	Hydrographic Drying Height
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	TXT	Text Attribute
	VRR	Vertical Reference Category
	WID	Width
	ZV2	Highest Z-value
AL210	Snow Shed/Rock Shed	
Attributes:	LEN	Length/Diameter of Point Feature
	USE	Usage
	WID	Width
AL220	Steeple	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
AL240	Tower (Non- Communication)	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation

Withdrawn/Retirée

	ATN	Aids to Navigation
	BFC	Building Function Category
	COC	Conspicuous Category
	COL	Character of Light
	EXS	Existence Category
	GUG	Guyed or Unguyed Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TTC	Tower Type Category
	TTC	Tundra Traversability Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AL260	Wall	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	USE	Usage
	WID	Width
	ZV2	Highest Z-value

AM010	Depot (Storage)	
Attributes:	TXT	Text Attribute

AM020	Grain Bin/Silo	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	PHT	Predominant Height
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AM030	Grain Elevator	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category

Withdrawn/Retirée

	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	PHT	Predominant Height
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AM040	Mineral Pile	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	PRO	Product Category
	WID	Width
	ZV2	Highest Z-value

AM060	Storage Bunker /Storage Mound	
Attributes:	COC	Conspicuous Category
	TXT	Text Attribute

AM070	Tank	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	COL	Character of Light
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	PHT	Predominant Height
	PRO	Product Category
	SSC	Structure Shape Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AM080	Water Tower	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

Withdrawn/Retirée

AN010	Railroad	
Attributes:	ACC	Accuracy Category
	CTL	Cumulative Track Length
	EXS	Existence Category
	FCO	Feature Configuration
	GAW	Gauge Width
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	LOG	Length of Gradient
	LTN	Track/Lane Number
	NAM	Name
	RGC	Railroad Gauge Category
	RRA	Railroad Power Source
	RRC	Railroad Categories
	RSA	Rail Siding/Spur Attribute
	SGC	Gradient/Slope
	UBC	Underbridge Clearance Category
	USE	Usage
	VRR	Vertical Reference Category
	WID	Width

AN050	Railroad Siding /Railroad Spur	
Attributes:	CTL	Cumulative Track Length
	EXS	Existence Category
	FCO	Feature Configuration
	LEN	Length/Diameter of Point Feature
	LTN	Track/Lane Number
	RGC	Railroad Gauge Category
	RRA	Railroad Power Source
	RRC	Railroad Categories
	RSA	Rail Siding/Spur Attribute
	USE	Usage
	WID	Width

AN060	Railroad Yard/Marshaling Yard	
Attributes:	AOO	Angle of Orientation
	CTL	Cumulative Track Length
	EXS	Existence Category
	FCO	Feature Configuration
	LEN	Length/Diameter of Point Feature
	LTN	Track/Lane Number
	NAM	Name
	RRA	Railroad Power Source
	RRC	Railroad Categories
	RSA	Rail Siding/Spur Attribute
	RST	Road/Runway Surface Type
	USE	Usage
	WID	Width

AP010	Cart Track	
Attributes:	ACC	Accuracy Category

Withdrawn/Retirée

	EXS	Existence Category
	FCO	Feature Configuration
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	RST	Road/Runway Surface Type
	TUC	Transportation Use Category
	WD1	Minimum Traveled Way Width
	WD2	Total Usable Width
	WID	Width
	WTC	Weather Type Category

AP020	Interchange	
Attributes:	AOO	Angle of Orientation
	EXS	Existence Category
	LAB	Feature Label
	LC1	Load Class Type 1
	LC2	Load Class Type 2
	LC3	Load Class Type 3
	LC4	Load Class Type 4
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	RIT	Road Interchange Type
	RST	Road/Runway Surface Type
	RTC	Road Type Category
	SGC	Gradient/Slope
	USE	Usage
	WD1	Minimum Traveled Way Width
	WTC	Weather Type Category

AP030	Road	
Attributes:	ACC	Accuracy Category
	EXS	Existence Category
	FCO	Feature Configuration
	LAB	Feature Label
	LC1	Load Class Type 1
	LC2	Load Class Type 2
	LC3	Load Class Type 3
	LC4	Load Class Type 4
	LOC	Location Category
	LOG	Length of Gradient
	LTN	Track/Lane Number
	MED	Median Category
	NA3	Classification. Name
	NAM	Name
	RST	Road/Runway Surface Type
	RTC	Road Type Category
	RTN	Route Number
	RTT	Route Intended Use
	SGC	Gradient/Slope
	TUC	Transportation Use Category
	USE	Usage
	WD1	Minimum Traveled Way Width
	WD2	Total Usable Width

Withdrawn/Retirée

	WID	Width
	WTC	Weather Type Category
	ZV2	Highest Z-value

AP040	Gate	
Attributes:	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	TUC	Transportation Use Category
	WID	Width

AP050	Trail	
Attributes:	TUC	Transportation Use Category
	WTC	Weather Type Category

AQ010	Aerial Cableway Lines/Ski Lift Lines	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	USE	Usage
	WID	Width
	ZV2	Highest Z-value

AQ020	Aerial Cableway Pylon /Ski Pylon	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AQ040	Bridge /Overpass /Viaduct	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BCC	Bypass Condition Category
	BDC	Bridge Design Category
	BOT	Bridge Opening Type
	BRN	Bridge Reference Number
	BSC	Bridge/Bridge Superstructure Category
	BSN	Bridge Serial Number
	COC	Conspicuous Category
	DAT	Date
	EXS	Existence Category
	HGT	Height Above Surface Level

Withdrawn/Retirée

	IDN	Identification Number
	LC1	Load Class Type 1
	LC2	Load Class Type 2
	LC3	Load Class Type 3
	LC4	Load Class Type 4
	LEN	Length/Diameter of Point Feature
	MBI	Military Bridge Information
	MCC	Material Composition Category
	MVC	Maximum Vertical clearance
	NAM	Name
	NOS	Number of spans
	OHB	Overall Height of Bridge
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	RBC	Reliability of Bridge
	SHC	Safe Horizontal Clearance
	TUC	Transportation Use Category
	UBC	Underbridge Clearance Category
	UT1	UTM Grid Northing
	UT2	UTM Grid Easting
	UZ1	UTM Grid Zone (1)
	UZ2	UTM Grid Zone (2)
	VAL	Value
	WD1	Minimum Traveled Way Width
	WID	Width
	YLN	Length of Greater Percision
	ZV2	Highest Z-value

AQ045	Bridge Span	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	BCC	Bypass Condition Category
	BRN	Bridge Reference Number
	BSM	Bridge Span Mobility
	BSP	Bridge Span Category
	EXS	Existence Category
	LC1	Load Class Type 1
	LC2	Load Class Type 2
	LC3	Load Class Type 3
	LC4	Load Class Type 4
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	NOS	Number of spans
	OHC	Overhead Clearance Category
	TUC	Transportation Use Category
	UBC	Underbridge Clearance Category
	WD1	Minimum Traveled Way Width
	YLN	Length of Greater Percision

AQ050	Bridge Superstructure	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category

Withdrawn/Retirée

	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AQ058	Constriction/Expansion	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	CCA	Constriction/Expansion Category
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	TUC	Transportation Use Category
	WD1	Minimum Traveled Way Width
	WD2	Total Usable Width
	WID	Width

AQ060	Control Tower	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TUC	Transportation Use Category
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AQ062	Crossing	
Attributes:	AOO	Angle of Orientation
	CRC	Crossing Category
	LAB	Feature Label
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	TUC	Transportation Use Category
	TXT	Text Attribute
	WID	Width

AQ070	Ferry Crossing	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	CAP	Capacity
	EXS	Existence Category
	FCL	Ferry Crossing Length
	FCO	Feature Configuration
	FER	Ferry Type
	LEN	Length/Diameter of Point Feature
	NAM	Name
	OHC	Overhead Clearance Category
	RST	Road/Runway Surface Type

Withdrawn/Retirée

	TUC	Transportation Use Category
	TXT	Text Attribute
	USE	Usage
	UNI	Units Category
	WD1	Minimum Traveled Way Width
	WID	Width

AQ080	Ferry Site	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	TUC	Transportation Use Category
	WID	Width

AQ090	Entrance/Exit	
Attributes:	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	WID	Width

AQ110	Mooring Mast	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	GUG	Guyed or Unguyed Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AQ111	Prepared Raft or Float Bridge Site	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	WD5	Width Top
	WID	Width

AQ113	Pipeline /Pipe	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DEP	Depth Below Surface Level
	EXS	Existence Category

Withdrawn/Retirée

	HGT	Height Above Surface Level
	HSB	Height Above Sea Bottom
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	PLT	Pipeline Type
	PRO	Product Category
	TXT	Text Attribute
	USE	Usage
	WID	Width
	ZV2	Highest Z-value

AQ116	Pumping Station	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	COC	Conspicuous Category
	NAM	Name
	PRO	Product Category
	TXT	Text Attribute

AQ118	Sharp Curve	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	RAD	Radius of Sharp Curve
	SOH	Severity of Hazard
	TUC	Transportation Use Category
	WD1	Minimum Traveled Way Width
	WID	Width

AQ125	Station (Miscellaneous)	
Attributes:	AOO	Angle of Orientation
	COC	Conspicuous Category
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TUC	Transportation Use Category
	WID	Width

AQ130	Tunnel	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	EXS	Existence Category
	FCO	Feature Configuration
	HDP	Hydrographic Depth
	LEN	Length/Diameter of Point Feature
	LTN	Track/Lane Number
	NAM	Name
	OHC	Overhead Clearance Category

Withdrawn/Retirée

	RST	Road/Runway Surface Type
	SHC	Safe Horizontal Clearance
	TRA	Traversability Attribute
	TUC	Transportation Use Category
	WD1	Minimum Traveled Way Width
	WD2	Total Usable Width
	WID	Width

AQ135	Vehicle Stopping Area/Rest Area	
Attributes:	AFA	Available Facilities
	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	NAM	Name
	SMC	Surface Material Category
	USE	Usage
	WID	Width

AQ140	Vehicle Storage /Parking Area	
Attributes:	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	SMC	Surface Material Category
	TUC	Transportation Use Category
	USE	Usage
	WID	Width

AT005	Cable	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LOC	Location Category
	USE	Usage
	WID	Width
	ZV2	Highest Z-value

AT010	Disk /Dish	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

AT020	Early Warning Radar Site	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation

Withdrawn/Retirée

	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AT030	Power Transmission Line	
Attributes:	ACC	Accuracy Category
	ATN	Aids to Navigation
	CAP	Capacity
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	TST	Transmission Line Suspension
	TXT	Text Attribute
	UNI	Units Category
	WID	Width
	ZV2	Highest Z-value

AT040	Power Transmission Pylon /Line	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

AT045	Radar Transmitter	
Attributes:	ACC	Accuracy Category
	SSC	Structure Shape Category

AT050	Communication Building	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BFC	Building Function Category
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	NST	Navigation System Types

Withdrawn/Retirée

	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

AT060	Telephone Line/Telegraph Line	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	WID	Width
	ZV2	Highest Z-value

AT070	Telephone-Telegraph Pylon/Pole	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	ZV2	Highest Z-value

AT080	Communication Tower	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BRF	Broadcast Frequency
	COC	Conspicuous Category
	COL	Character of Light
	EXS	Existence Category
	GUG	Guyed or Unguyed Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	NST	Navigation System Types
	SSC	Structure Shape Category
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

BA010	Coastline/Shoreline	
Attributes:	ACC	Accuracy Category
	EXS	Existence Category
	SLT	Shoreline Type Category
	VDC	Vertical Datum Category

BA020	Foreshore	
Attributes:	MCC	Material Composition Category
	MCS	Materials Composition Secondary
	WID	Width

Withdrawn/Retirée

BA030	Island	
Attributes:	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	NAM	Name
	WID	Width
BA040	Water (Except Inland)	
Attributes:	ARA	Area Coverage Attribute
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	NAM	Name
	WID	Width
BB005	Harbor	
Attributes:	NAM	Name
	PRC	Periodic Restriction Category
	TXT	Text Attribute
	USE	Usage
BB010	Anchorage	
Attributes:	COD	Certainty of Delineation
	MAC	Maritime Area Category
	NAM	Name
	TIM	Time Attribute
BB020	Berth	
Attributes:	BER	Berth Identifier
BB040	Breakwater/Groyne	
Attributes:	AOO	Angle of Orientation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	VRR	Vertical Reference Category
	WID	Width
	ZV2	Highest Z-value
BB050	Calling-In Point	
Attributes:	DF1	Direction of Traffic - 1
	DF2	Direction of Traffic - 2
	DF3	Direction of Traffic - 3
	DF4	Direction of Traffic - 4
	NAM	Name

Withdrawn/Retirée

BB090	Drydock	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	WID	Width
	ZV2	Highest Z-value
BB140	Jetty	
Attributes:	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	VRR	Vertical Reference Category
	WID	Width
BB150	Landing Place	
Attributes:	COD	Certainty of Delineation
	EXS	Existence Category
BB170	Offshore Loading Facility	
Attributes:	AOO	Angle of Orientation
	CHA	Light Characteristic Category
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	USE	Usage
	WID	Width
	ZV2	Highest Z-value
BB190	Pier/Wharf/Quay	
Attributes:	AOO	Angle of Orientation
	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	NAM	Name
	SMC	Surface Material Category
	USE	Usage
	WID	Width
BB220	Ramp (Maritime)	
Attributes:	VRR	Vertical Reference Category

Withdrawn/Retirée

BB230	Seawall	
Attributes:	none required at this time	
BB240	Slipway/Patent Slip	
Attributes:	NAM	Name
	VRR	Vertical Reference Category
BC010	Beacon	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	BR2	Broadcast Frequency 2
	BRF	Broadcast Frequency
	CCC	Color Code Category
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	NS2	Navigation Systems Type (2)
	NST	Navigation System Types
	OR2	Navigation System Secondary
	ORC	Operating Range Category
	REF	Radar Reflector Attribute
	SST	Sound Signal Type
	TMC	Top Mark Characteristic
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
BC020	Buoy	
Attributes:	BR2	Broadcast Frequency 2
	BRF	Broadcast Frequency
	BTC	Beacon/Buoy Type Category
	CCC	Color Code Category
	COL	Character of Light
	EOL	Elevation of Light
	LVN	Light Range, Nominal
	MLR	Multiple Light Ranges
	NAM	Name
	NS2	Navigation System Secondary
	NST	Navigation System Types
	PER	Period of Light
	REF	Radar Reflector Attribute
	SSC	Structure Shape Category
	SST	Sound Signal Type
	TMC	Top Mark Characteristic
	TXT	Text Attribute

Withdrawn/Retirée

BC030	Leading Light(s)	
Attributes:	CCC	Color Code Category
	CHA	Light Characteristic Category
	LCN	Light Characteristic Number
	LFA	Light Function Aeronautical
	MCA	Morse Code

BC035	Lights in Line	
Attributes:	CCC	Color Code Category
	CHA	Light Characteristic Category
	LCN	Light Characteristic Number
	LFA	Light Function Aeronautical
	MCA	Morse Code

BC040	Light	
Attributes:	ACC	Accuracy Category
	BR2	Broadcast Frequency 2
	BRF	Broadcast Frequency
	CCC	Color Code Category
	COL	Character of Light
	EOL	Elevation of Light
	HLT	Hydrographic Light Type
	IAC	IALA Aid Category
	LFA	Light Function Aeronautical
	LVN	Light Range, Nominal
	MLR	Multiple Light Ranges
	NAM	Name
	NS2	Navigation System Secondary
	NST	Navigation System Types
	PER	Period of Light
	REF	Radar Reflector Attribute
	SST	Sound Signal Type
	TMC	Top Mark Characteristic
	TXT	Text Attribute

BC050	Lighthouse	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LFA	Light Function Aeronautical
	WID	Width
	ZV2	Highest Z-value

BC060	Light Sector	
Attributes:	COL	Character of Light
	LSA	Light Sector Angle

Withdrawn/Retirée

BC070	Light Vessel /Lightship	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value
BC100	Leading Line	
Attributes:	BRG	Bearing of Object
	DRP	Description of Reference Point
	LAF	Line Associated Features
BD000	Underwater Danger /Underwater Hazard	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	SFC	Sea Floor Feature Category
	SOH	Severity of Hazard
	TXT	Text Attribute
	VAL	Value
BD010	Breakers	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	VAL	Value
BD020	Crib	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DAT	Date
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	VAL	Value
	VRR	Vertical Reference Category
	WID	Width
	ZV2	Highest Z-value

Withdrawn/Retirée

BD030	Discolored Water	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	VAL	Value
BD050	Foul Ground	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	VAL	Value
BD070	Obstruction (Nautical)	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value
BD080	Overfalls/Tide Rips	
Attributes:	NAM	Name
BD100	Pile/Piling/Post	
Attributes:	ACC	Accuracy Category
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DAT	Date
	EXS	Existence Category
	HGT	Height Above Surface Level
	VAL	Value
	VRR	Vertical Reference Category
	ZV2	Highest Z-value
BD110	Platform	
Attributes:	AFA	Available Facilities
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	CHA	Light Characteristic Category
	COC	Conspicuous Category
	DMF	Density Measure Feature Count
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name

Withdrawn/Retirée

	NST	Navigation System Types
	PHT	Predominant Height
	SMC	Surface Material Category
	SST	Sound Signal Type
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

BD120	Reef	
Attributes:	ACC	Accuracy Category
	ARA	Area Coverage Attribute
	COD	Certainty of Delineation
	DAT	Date
	EXS	Existence Category
	HDH	Hydrographic Drying Height
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	LOC	Location Category
	MCC	Material Composition Category
	NAM	Name
	SOH	Severity of Hazard
	TXT	Text Attribute
	VAL	Value
	VRR	Vertical Reference Category

BD130	Rock	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ARA	Area Coverage Attribute
	ARH	Area Coverage Attribute Hectares
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DAT	Date
	EXS	Existence Category
	HDH	Hydrographic Drying Height
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	MCC	Material Composition Category
	NAM	Name
	SOH	Severity of Hazard
	VAL	Value
	VRR	Vertical Reference Category
	WID	Width
	ZV2	Highest Z-value

BD140	Snags/Stumps	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information

Withdrawn/Retirée

	HDP	Hydrographic Depth
	VAL	Value
	VRR	Vertical Reference Category

BD180	Wreck	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	COD	Certainty of Delineation
	DAT	Date
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	PRO	Product Category
	SOH	Severity of Hazard
	VAL	Value
	VRR	Vertical Reference Category
	WID	Width
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

BE010	Depth Curve	
Attributes:	ACC	Accuracy Category
	CRV	Depth Curve or Contour Value
	CVH	Depth Curve or Contour Value High
	CVL	Depth Curve or Contour Value Low

BE015	Depth Contour	
Attributes:	ACC	Accuracy Category
	CRV	Depth Curve or Contour Value
	HDP	Hydrographic Depth
	UNI	Units Category
	VAL	Value
	VDC	Vertical Datum Category

BE020	Sounding	
Attributes:	ACC	Accuracy Category
	DAT	Date
	EXS	Existence Category
	HDH	Hydrographic Drying Height
	HDP	Hydrographic Depth
	SND	Sounding Category
	SVC	Sounding Velocity
	VAL	Value

Withdrawn/Retirée

BF010	Bottom Characteristics	
Attributes:	CSM	Secondary Material Characteristics
	MCC	Material Composition Category
	MCS	Materials Composition Secondary
	MCU	Material Composition Underlying
	PSC	Physical Surface Characteristics
	UMC	Underlying Materials
BG010	Current Flow	
Attributes:	CRN	Current Rate Minimum
	CRX	Current Rate Maximum
	CUR	Current Type Category
	DOF	Direction of Flow
	EXS	Existence Category
	HS1	Current Information (1)
	HS2	Current Information (2)
	NAM	Name
BG030	Tide Data Point	
Attributes:	NAM	Name
BG040	Current Diagram	
Attributes:	C80	Rate of Current
	C81	Rate of Current(1)
	C82	Rate of Current(2)
	C83	Rate of Current(3)
	C84	Rate of Current(4)
	C85	Rate of Current(5)
	C86	Rate of Current(6)
	C87	Rate of Current(7)
	C88	Rate of Current(8)
	C89	Rate of Current(9)
	C90	Rate of Current(10)
	C91	Rate of Current(11)
	D80	Direction of Current
	D81	Direction of Current (1)
	D82	Direction of Current (2)
	D83	Direction of Current (3)
	D84	Direction of Current (4)
	D85	Direction of Current (5)
	D86	Direction of Current (6)
	D87	Direction of Current (7)
	D88	Direction of Current (8)
	D89	Direction of Current (9)
	D90	Direction of Current (10)
	D91	Direction of Current (11)
BH010	Aqueduct	
Attributes:	AOO	Angle of Orientation
	ATC	Aqueduct Type Category

Withdrawn/Retirée

	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	MCC	Material Composition Category
	OHC	Overhead Clearance Category
	OWO	Over Water Obstruction
	WID	Width
	ZV2	Highest Z-value
BH015	Bog	
Attributes:	VEG	Vegetation Characteristics
BH020	Canal	
Attributes:	BGL	Bank Gradient Left
	BGR	Bank Gradient Right
	BHL	Bank Height Left
	BHR	Bank Height Right
	BVL	Bank Vegetation Left
	BVR	Bank Vegetation Right
	CDA	Covered Drain Attribute
	CDL	Covered Drain Length
	EXS	Existence Category
	HDP	Hydrographic Depth
	HYC	Hydrological Category
	LAB	Feature Label
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	NAM	Name
	PRC	Periodic Restriction Category
	RPA	Required Port Access
	WD3	Military Gap Width
	WDA	Water Depth Average
	WID	Width
	WVA	Water Velocity Average
BH030	Ditch	
Attributes:	HYC	Hydrological Category
	LEN	Length/Diameter of Point Feature
	WID	Width
BH040	Filtration Beds/Aeration Beds	
Attributes:	COC	Conspicuous Category
	EXS	Existence Category
	WID	Width
BH050	Fish Hatchery/Fish Farm/Marine Farm	
Attributes:	COC	Conspicuous Category
	WID	Width

Withdrawn/Retirée

BH060	Flume	
Attributes:	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	WID	Width
	ZV2	Highest Z-value
BH070	Ford	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	EXS	Existence Category
	FCO	Feature Configuration
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	OHC	Overhead Clearance Category
	RST	Road/Runway Surface Type
	TUC	Transportation Use Category
	WD1	Minimum Traveled Way Width
	WD5	Width Top
	WID	Width
BH080	Lake /Pond	
Attributes:	ARA	Area Coverage Attribute
	DEP	Depth Below Surface Level
	HYC	Hydrological Category
	NAM	Name
	RPA	Required Port Access
	SCC	Spring/Well Characteristic Category
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
BH090	Land Subject to Inundation	
Attributes:	ARA	Area Coverage Attribute
	EXS	Existence Category
	FTC	Farming Type Category
	HOC	Hydrographic Origin Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
BH095	Marsh /Swamp	
Attributes:	ARA	Area Coverage Attribute
	BUD	Brush/Undergrowth Density Code
	DMT	Density Measure (% of Tree/Canopy Cover)
	EXS	Existence Category
	PHT	Predominant Height
	SDS	Stem Diameter Size

Withdrawn/Retirée

	TID	Tidal / Non-Tidal Category
	TSC	Tree Spacing Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
	VRR	Vertical Reference Category
BH100	Moat	
Attributes:	LOC	Location Category
	USE	Usage
BH110	Penstock	
Attributes:	LEN	Length/Diameter of Point Feature
	LOC	Location Category
BH120	Rapids	
Attributes:	AOO	Angle of Orientation
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TXT	Text Attribute
	WID	Width
BH130	Reservoir	
Attributes:	ARA	Area Coverage Attribute
	DEP	Depth Below Surface Level
	EXS	Existence Category
	HYC	Hydrological Category
	NAM	Name
BH135	Rice Field	
Attributes:	ARA	Area Coverage Attribute
	FTC	Farming Type Category
	VEG	Vegetation Characteristics
BH140	River /Stream	
Attributes:	ACC	Accuracy Category
	BGL	Bank Gradient Left
	BGR	Bank Gradient Right
	BHL	Bank Height Left
	BHR	Bank Height Right
	BVL	Bank Vegetation Left
	BVR	Bank Vegetation Right
	CDA	Covered Drain Attribute
	CDL	Covered Drain Length
	DEP	Depth Below Surface Level
	EXS	Existence Category
	HFC	Hydrological Form Category
	HYC	Hydrological Category
	LAB	Feature Label
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category

Withdrawn/Retirée

	NAM	Name
	PRC	Periodic Restriction Category
	RPA	Required Port Access
	SLT	Shoreline Type Category
	TID	Tidal / Non-Tidal Category
	WD3	Military Gap Width
	WDA	Water Depth Average
	WID	Width
	WVA	Water Velocity Average
BH145	River Stream Vanishing Point	
Attributes:	HFC	Hydrological Form Category
BH150	Salt Pan	
Attributes:	ARA	Area Coverage Attribute
BH155	Salt Evaporator	
Attributes:	ARA	Area Coverage Attribute
	EXS	Existence Category
BH160	Sebkha	
Attributes:	ARA	Area Coverage Attribute
	NAM	Name
BH170	Spring /Water-Hole	
Attributes:	HYC	Hydrological Category
	NAM	Name
	SCC	Spring/Well Characteristic Category
BH180	Waterfall	
Attributes:	AOO	Angle of Orientation
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	TXT	Text Attribute
	WID	Width
BH190	Lagoon/Reef Pool	
Attributes:	ARA	Area Coverage Attribute
BH210	Inland Shoreline	
Attributes:	ACC	Accuracy Category
	AHC	Associated Hydrographic Category
	SLT	Shoreline Type Category
BI005	Boat Lift	
Attributes:	AOO	Angle of Orientation

Withdrawn/Retirée

	ATN	Aids to Navigation
	CAP	Capacity
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	HGU	Height 2/Depth 2
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	UNI	Units Category
	WID	Width
	ZV2	Highest Z-value

BI010	Cistern	
Attributes:	EXS	Existence Category

BI020	Dam/Weir	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ARR	Angle of Radar Reflector
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DIR	Directivity
	EXS	Existence Category
	HGT	Height Above Surface Level
	HGU	Height 2/Depth 2
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	MCC	Material Composition Category
	NAM	Name
	TUC	Transportation Use Category
	TXT	Text Attribute
	USE	Usage
	WD5	Width Top
	WID	Width
	ZV2	Highest Z-value

BI030	Lock	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	NAM	Name
	WD5	Width Top
	WID	Width
	ZV2	Highest Z-value

BI040	Sluice gate	
Attributes:	AOO	Angle of Orientation

Withdrawn/Retirée

	EXS	Existence Category
	LEN	Length/Diameter of Point Feature
	WID	Width

BI050	Water Intake Tower	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	TXT	Text Attribute
	WID	Width
	ZV2	Highest Z-value

BI070	Gauging Station	
Attributes:	CCC	Color Code Category
	NAM	Name
	SSC	Structure Shape Category
	TMC	Top Mark Characteristic

BJ020	Moraine	
Attributes:	WID	Width

BJ030	Glacier	
Attributes:	NAM	Name
	WID	Width
	ZV2	Highest Z-value

BJ040	Ice Cliff	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	WID	Width
	ZV2	Highest Z-value

BJ060	Ice Peak/ Nunatak	
Attributes:	COC	Conspicuous Category
	HGT	Height Above Surface Level
	MCC	Material Composition Category
	ZV2	Highest Z-value

BJ065	Ice Shelf
Attributes:	none required at this time

Withdrawn/Retirée

BJ070	Pack Ice	
Attributes:	ARA	Area Coverage Attribute
	PRC	Periodic Restriction Category
BJ080	Polar ice	
Attributes:	ARA	Area Coverage Attribute
	PRC	Periodic Restriction Category
BJ100	Snow Field/Ice Field	
Attributes:	ARA	Area Coverage Attribute
	SIC	Snow/Ice Category
	SMC	Surface Material Category
BJ110	Tundra	
Attributes:	ARA	Area Coverage Attribute
CA010	Contour Line (Land)	
Attributes:	HQC	Hypsography Portrayal Category
	MCC	Material Composition Category
	USE	Usage
	ZV1	Lowest Z-value
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
CA020	Ridge Line	
Attributes:	ZV1	Lowest Z-value
	ZV2	Highest Z-value
CA025	Valley Bottom Line	
Attributes:	ZV1	Lowest Z-value
	ZV2	Highest Z-value
CA030	Spot Elevation	
Attributes:	ACC	Accuracy Category
	ELA	Elevation Accuracy
	MCC	Material Composition Category
	ZV1	Lowest Z-value
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
DA005	Asphalt Lake	
Attributes:		
DA010	Ground Surface Element	
Attributes:	ARA	Area Coverage Attribute

Withdrawn/Retirée

	MCC	Material Composition Category
	RAT	Relational Attribute Table
	SDC	Soil Depth Category
	SMC	Surface Material Category
	SRD	Surface Roughness Description
	SRQ	Surface Roughness Qualifier
	STP	Soil Type
	SWC	Soil Wetness Condition
	VRC	Vegetation Roughness Category

DA020	Barren Ground	
Attributes:	FTC	Farming Type Category
	VEG	Vegetation Characteristics

DB010	Bluff /Cliff /Escarpment	
Attributes:	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	USE	Usage
	ZV2	Highest Z-value

DB500	Bottomline of cliff	
Attributes:	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	USE	Usage
	ZV2	Highest Z-value

DB030	Cave	
Attributes:	AOO	Angle of Orientation
	COC	Conspicuous Category
	NAM	Name

DB060	Crevice/Crevasse	
Attributes:	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	WID	Width

DB070	Cut	
Attributes:	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	USE	Usage

DB090	Embankment/Fill	
Attributes:	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	PFH	Predominant Feature Height
	TUC	Transportation Use Category

Withdrawn/Retirée

	USE	Usage
	VRR	Vertical Reference Category
	ZV2	Highest Z-value
DB100	Esker	
Attributes:	LEN	Length/Diameter of Point Feature
DB110	Fault	
Attributes:	LEN	Length/Diameter of Point Feature
DB115	Geothermal Feature	
Attributes:	SWT	Well/Spring Type
DB150	Mountain Pass	
Attributes:	AOO	Angle of Orientation
	NAM	Name
	PRC	Periodic Restriction Category
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation
DB160	Rock Strata/Rock Formation	
Attributes:	COC	Conspicuous Category
	RAT	Relational Attribute Table
	RKF	Rock Strata Formation
	SRD	Surface Roughness Description
	SRQ	Surface Roughness Qualifier
DB170	Sand Dune /Sand Hills	
Attributes:	ARA	Area Coverage Attribute
	FEO	Feature Element Orientation
	HGT	Height Above Surface Level
	SSC	Structure Shape Category
	ZV2	Highest Z-value
DB180	Volcano	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	DAT	Date
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	NAM	Name
	VAL	Value
	WID	Width
	ZV2	Highest Z-value

Withdrawn/Retirée

DB190	Volcanic Dike	
Attributes:	LOC	Location Category
	USE	Usage
DB200	Gully/Gorge	
Attributes:	BGL	Bank Gradient Left
	BGR	Bank Gradient Right
	BHL	Bank Height Left
	BHR	Bank Height Right
	BVL	Bank Vegetation Left
	BVR	Bank Vegetation Right
	EXS	Existence Category
	HYC	Hydrological Category
	MCC	Material Composition Category
	WD3	Military Gap Width
	WDA	Water Depth Average
	WVA	Water Velocity Average
DB210	Potential Landslide Area	
Attributes:	TXT	Text Attribute
EA010	Cropland	
Attributes:	FTC	Farming Type Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
EA020	Hedgerow	
Attributes:	LOC	Location Category
	USE	Usage
EA040	Orchard /Plantation	
Attributes:	ARA	Area Coverage Attribute
	BUD	Brush/Undergrowth Density Code
	COC	Conspicuous Category
	DMT	Density Measure (% of Tree/Canopy Cover)
	EXS	Existence Category
	FEO	Feature Element Orientation
	HGT	Height Above Surface Level
	NAM	Name
	PHT	Predominant Height
	PRO	Product Category
	SDS	Stem Diameter Size
	TSC	Tree Spacing Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
	ZV2	Highest Z-value

Withdrawn/Retirée

EA050	Vineyards	
Attributes:	ARA	Area Coverage Attribute
	FTC	Farming Type Category
	HGT	Height Above Surface Level
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
EB010	Grassland	
Attributes:	ARA	Area Coverage Attribute
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
EB020	Scrub /Brush	
Attributes:	FTC	Farming Type Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
EC010	Bamboo/Cane	
Attributes:	FTC	Farming Type Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
EC015	Forest	
Attributes:	ARA	Area Coverage Attribute
	COC	Conspicuous Category
	COD	Certainty of Delineation
	DMT	Density Measure (% of Tree/Canopy Cover)
	EXS	Existence Category
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	NAM	Name
	SBC	Shelter Belt Condition
	VEG	Vegetation Characteristics
	WID	Width
EC020	Oasis	
Attributes:	NAM	Name
	VEG	Vegetation Characteristics
EC030	Trees	
Attributes:	BUD	Brush/Undergrowth Density Code
	DMT	Density Measure (% of Tree/Canopy Cover)
	EXS	Existence Category
	FEO	Feature Element Orientation
	HGT	Height Above Surface Level
	NAM	Name
	PHT	Predominant Height
	SBC	Shelter Belt Condition

Withdrawn/Retirée

	SDS	Stem Diameter Size
	TRE	Tree Category
	TSC	Tree Spacing Category
	VEG	Vegetation Characteristics
	VRC	Vegetation Roughness Category
	ZV2	Highest Z-value

EC040	Cleared Way/Firebreak	
Attributes:	LEN	Length/Diameter of Point Feature
	WID	Width

FA000	Administrative Boundary	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NAM	Name
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	TXT	Text Attribute
	USE	Usage

FA001	Administrative Area	
Attributes:	ACC	Accuracy Category
	NAM	Name
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	TXT	Text Attribute
	USE	Usage

FA015	Firing Range/Gunnery Range	
Attributes:	EXS	Existence Category
	FRT	Firing Range Type
	NAM	Name

FA020	Armistice Line	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	TXT	Text Attribute
	USE	Usage

FA030	Cease-Fire Line	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NM3	Name 3 (name of political entity on one side of boundary)
	TXT	Text Attribute
	USE	Usage

Withdrawn/Retirée

FA040	Claim Line	
Attributes:	NM3	Name 3 (name of political entity on one side of boundary)
FA050	Mandate Line/Convention Line	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NM3	Name 3 (name of political entity on one side of boundary)
	TXT	Text Attribute
	USE	Usage
FA060	Defacto Boundary	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	TXT	Text Attribute
	USE	Usage
FA070	Demilitarized Zone	
Attributes:	ACC	Accuracy Category
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	USE	Usage
FA090	Geophysical Prospecting Grid	
Attributes:	LEN	Length/Diameter of Point Feature
FA110	International Date Line	
Attributes:	ACC	Accuracy Category
	BST	Boundary Status Type
	NM3	Name 3 (name of political entity on one side of boundary)
	TXT	Text Attribute
	USE	Usage
FA165	Training Area	
Attributes:	EXS	Existence Category
	NAM	Name
	USE	Usage
FA170	Zone of Occupation	
Attributes:	ACC	Accuracy Category
	NM3	Name 3 (name of political entity on one side of boundary)
	NM4	Name 4 (name of political entity on the other side of boundary)
	USE	Usage

Withdrawn/Retirée

FC021	Maritime Limit Boundary	
Attributes:	BRG	Bearing of Object
	COD	Certainty of Delineation
	DRP	Description of Reference Point
	EXS	Existence Category
	LAF	Line Associated Features
	MAC	Maritime Area Category
	MBL	Maritime Boundary Limit
	NAM	Name
	OPS	Operational Status
	PBV	Pilot Boarding Vehicle
	PRO	Product Category
	TXT	Text Attribute
FC031	Maritime Area	
Attributes:	ATN	Aids to Navigation
	COD	Certainty of Delineation
	DAN	Description of Aids to Navigation
	DAT	Date
	EXS	Existence Category
	HDP	Hydrographic Depth
	IAS	IMO Approval Status
	MAC	Maritime Area Category
	MAS	Maintenance Status
	NAM	Name
	TSP	Traffic Scheme Part
	VAL	Value
	WID	Width
	WPC	Work in Progress Category
FC036	Restricted Area	
Attributes:	MAC	Maritime Area Category
	PRO	Product Category
	TXT	Text Attribute
	USE	Usage
FC041	Traffic Separation Scheme (TSS)	
Attributes:	DOF	Direction of Flow
	IAS	IMO Approval Status
	TSP	Traffic Scheme Part
FC100	Measured Distance Line	
Attributes:	BRR	Bearing and Reciprocal Category
	BCR	Bottom Return Rock Calssification
	LOR	Length of Range
	UNI	Units Category
FC130	Radar Reference Line	
Attributes:	BRR	Bearing and Reciprocal Category

Withdrawn/Retirée

	BCR	Bottom Return Rock Calssification
FC165	Route (Maritime)	
Attributes:	ATN	Aids to Navigation
	BRR	Bearing and Reciprocal Category
	BCR	Bottom Return Rock Calssification
	BRS	Bearing From Seaward
	BSR	Bottom Return Seabed Inst.
	DAN	Description of Aids to Navigation
	DOF	Direction of Flow
	DRP	Description of Reference Point
	EXS	Existence Category
	HDI	Hydrographic Depth/Height Information
	HDP	Hydrographic Depth
	NAM	Name
	RTT	Route Intended Use
FC170	Safety Fairway	
Attributes:	WID	Width
FC177	Swept Area	
Attributes:	DAT	Date
	HDP	Hydrographic Depth
	VAL	Value
GA005	Airspace	
Attributes:	AUA	ATS Use Attribute
	NAM	Name
GA020	Airspace Boundary Sector	
Attributes:	ACC	Accuracy Category
	OLQ	Obstruction Light Quality
GA035	NAVAIDS (Aeronautical)	
Attributes:	ACC	Accuracy Category
	BRF	Broadcast Frequency
	EXS	Existence Category
	LOC	Location Category
	MCA	Morse Code
	NAM	Name
	NST	Navigation System Types
	ORC	Operating Range Category
GB005	Airport/Airfield	
Attributes:	ACC	Accuracy Category
	APT	Airfield Type
	COD	Certainty of Delineation
	EXS	Existence Category
	HGT	Height Above Surface Level

Withdrawn/Retirée

	IKO	ICAO Designator
	LEN	Length/Diameter of Point Feature
	NAM	Name
	USE	Usage
	WID	Width
	ZV3	Airfield/Aerodrome Elevation
GB010	Airport Lighting	
Attributes:	ACC	Accuracy Category
	COL	Character of Light
	LFA	Light Function Aeronautical
GB015	Apron/Hardstand	
Attributes:	EXS	Existence Category
GB030	Helicopter Landing Pad	
Attributes:	EXS	Existence Category
	IKO	ICAO Designator
	NAM	Name
	ZV3	Airfield/Aerodrome Elevation
GB035	Heliport	
Attributes:	EXS	Existence Category
	IKO	ICAO Designator
	NAM	Name
	SMC	Surface Material Category
	USE	Usage
	ZV3	Airfield/Aerodrome Elevation
GB045	Overrun /Stopway	
Attributes:	LEN	Length/Diameter of Point Feature
GB055	Runway	
Attributes:	ACC	Accuracy Category
	AOO	Angle of Orientation
	CTL	Cumulative Track Length
	EXS	Existence Category
	FCO	Feature Configuration
	LEN	Length/Diameter of Point Feature
	NAM	Name
	OHC	Overhead Clearance Category
	RRA	Railroad Power Source
	RRC	Railroad Categories
	RST	Road/Runway Surface Type
	SMC	Surface Material Category
	TUC	Transportation Use Category
	USE	Usage
	WD1	Minimum Traveled Way Width
	WID	Width
	ZV3	Airfield/Aerodrome Elevation

Withdrawn/Retirée

GB065	Seaplane Base	
Attributes:	EXS	Existence Category
	IKO	ICAO Designator
	NAM	Name
	ZV3	Airfield/Aerodrome Elevation
GB070	Seaplane Landing /Seaplane Take-Off Area	
Attributes:	EXS	Existence Category
	IKO	ICAO Designator
	NAM	Name
	OPS	Operational Status
	ZV3	Airfield/Aerodrome Elevation
GB075	Taxiway	
Attributes:	EXS	Existence Category
	USE	Usage
GB220	Air Obstruction	
Attributes:	AOO	Angle of Orientation
	ATN	Aids to Navigation
	COC	Conspicuous Category
	EXS	Existence Category
	HGT	Height Above Surface Level
	IKO	ICAO Designator
	LEN	Length/Diameter of Point Feature
	NAM	Name
	WID	Width
	ZV2	Highest Z-value
SA030	Exposed Bedrock	
Attributes:	SDC	Soil Depth Category
	SRQ	Surface Roughness Qualifier
	STP	Soil Type
	SWC	Soil Wetness Condition
SA040	Permanent Snowfield	
Attributes:	SDC	Soil Depth Category
	SRQ	Surface Roughness Qualifier
	STP	Soil Type
	SWC	Soil Wetness Condition
SA050	Slope Polygon	
Attributes:	GSC	Ground Slope Category
SA060	Covered Drainage	
Attributes:	ACC	Accuracy Category
	EXS	Existence Category

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	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	MCC	Material Composition Category
	WD5	Width Top
	WID	Width

ZB035	Control Point/Control Station	
Attributes:	CPA	Control Point Attribute
	NAM	Name
	ZV2	Highest Z-value
	ZV3	Airfield/Aerodrome Elevation

ZC040	Magnetic Disturbance Area	
Attributes:	ARA	Area Coverage Attribute
	TXT	Text Attribute
	VAV	Variation Anomaly Value

ZD003	Artifact Location
Attributes:	none required at this time

ZD012	Geographic Information Point	
Attributes:	ACC	Accuracy Category
	CTL	Cumulative Track Length
	EXS	Existence Category
	FCO	Feature Configuration
	HGT	Height Above Surface Level
	LEN	Length/Diameter of Point Feature
	LOC	Location Category
	MCC	Material Composition Category
	NAM	Name
	OHC	Overhead Clearance Category
	RRA	Railroad Power Source
	RRC	Railroad Categories
	RST	Road/Runway Surface Type
	TUC	Transportation Use Category
	TXT	Text Attribute
	USE	Usage
	WD1	Minimum Traveled Way Width
	WD5	Width Top
	WID	Width

ZD020	Void Collection Area	
Attributes:	VCA	Void Collection Attribute
	VCT	Void Collection Type

ZD040	Named Location	
Attributes:	NAM	Name

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ZD045	Text Description
Attributes:	none required at this time

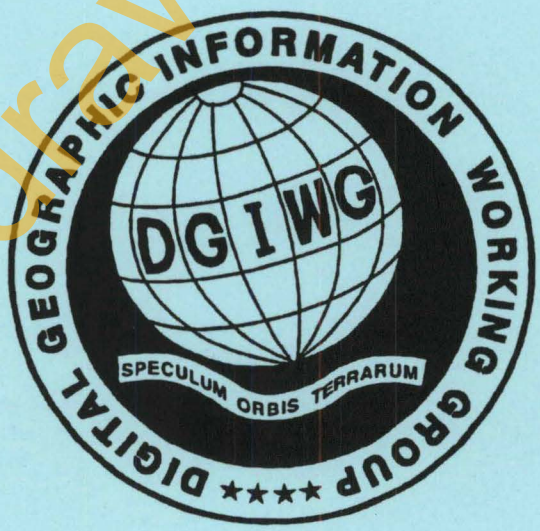
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The
DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD
(DIGEST)

Support Document:

Detailed Logical Flow Diagrams

Withdrawn/Retirée



Produced and issued under the direction of the Directorate of Geographic Operations,
Department of National Defence, Canada on behalf of the
Digital Geographic Information working Group.

Edition 1.2 January 1994

Logical Flow Diagrams

This report contains detailed logical flow diagrams of DIGEST 1.2 to assist in the implementation of the standard. The logical flow is taken directly from the ISO 8211 Encapsulation. It varies in minor detail from the ISO 8824 Encapsulation with respect to the General Information Record and the Quality File. At the lowest level, ISO 8824 encodes text and numbers in a manner particular for telecommunications environments. This is not reflected in the logical flow diagrams.

The diagrams presented in this report give a more detailed description of the logical flow diagrams in Part 2, Annex F of DIGEST 1.2. They make use of the same notation described in the standard.

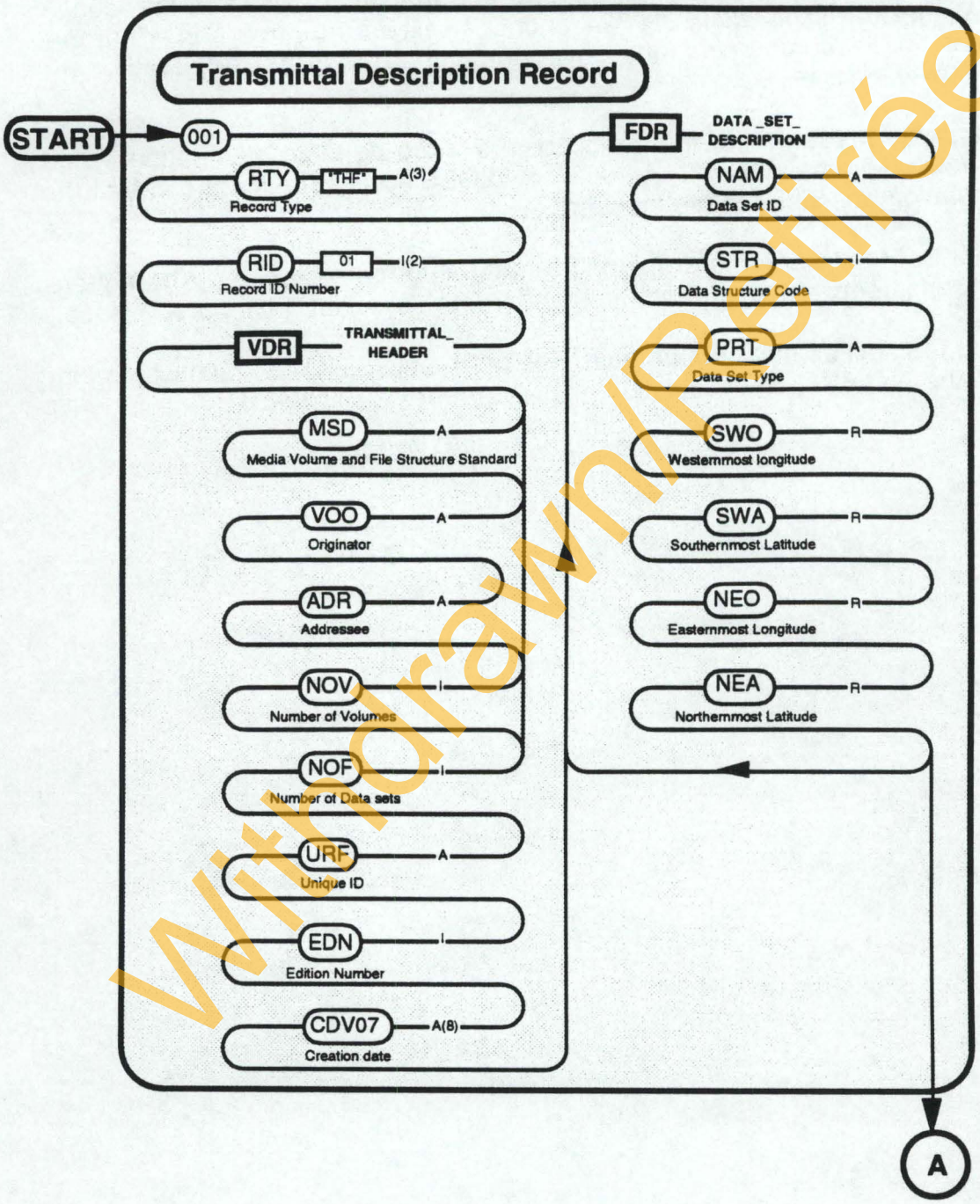
These logical flow diagrams are support material to the standard. Where there is a difference between them and the standard, the standard takes precedence.

Note that the section numbers of each "File" in the diagrams are identical to that found in the ISO 8211 Encapsulation, found in Annex A of DIGEST 1.2.

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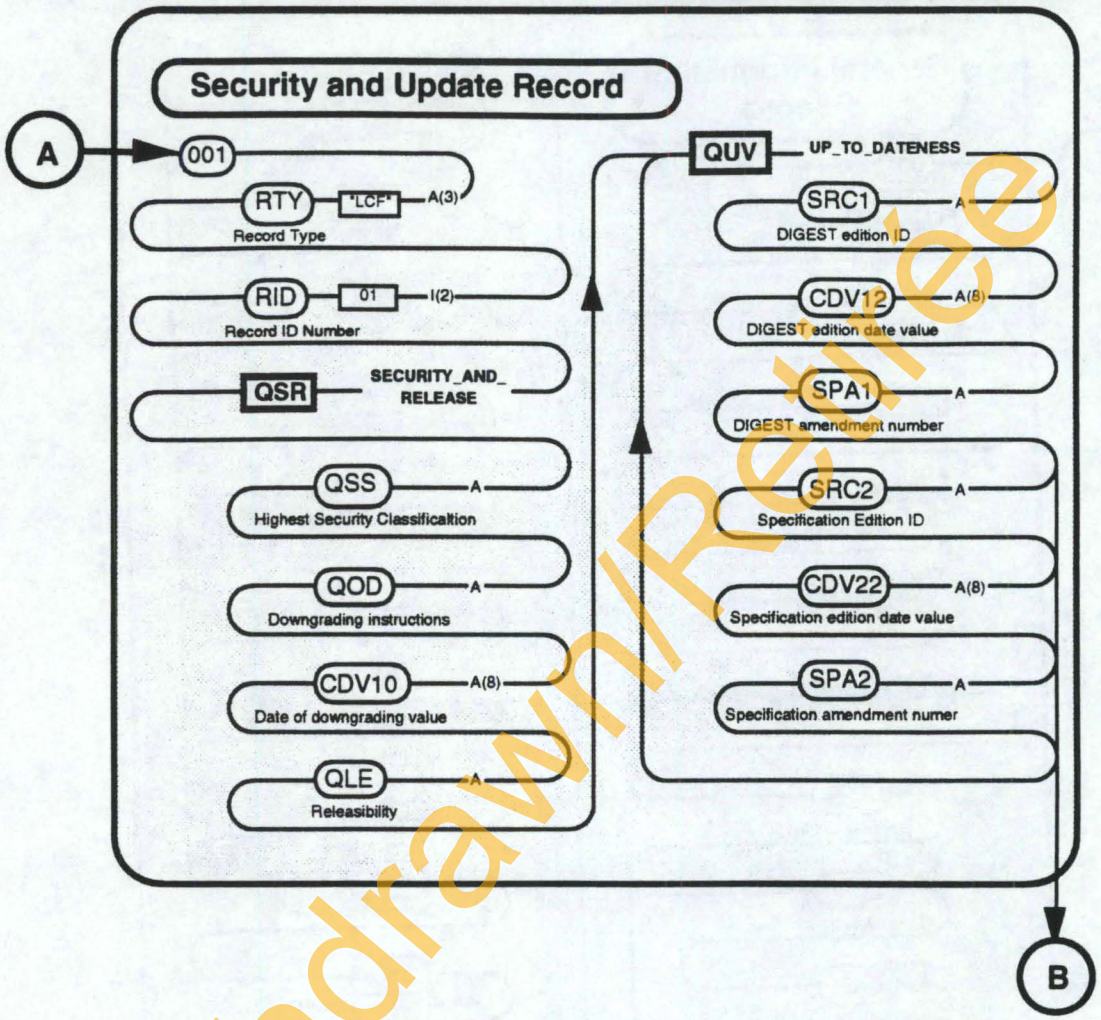
DETAILED LOGICAL FLOW

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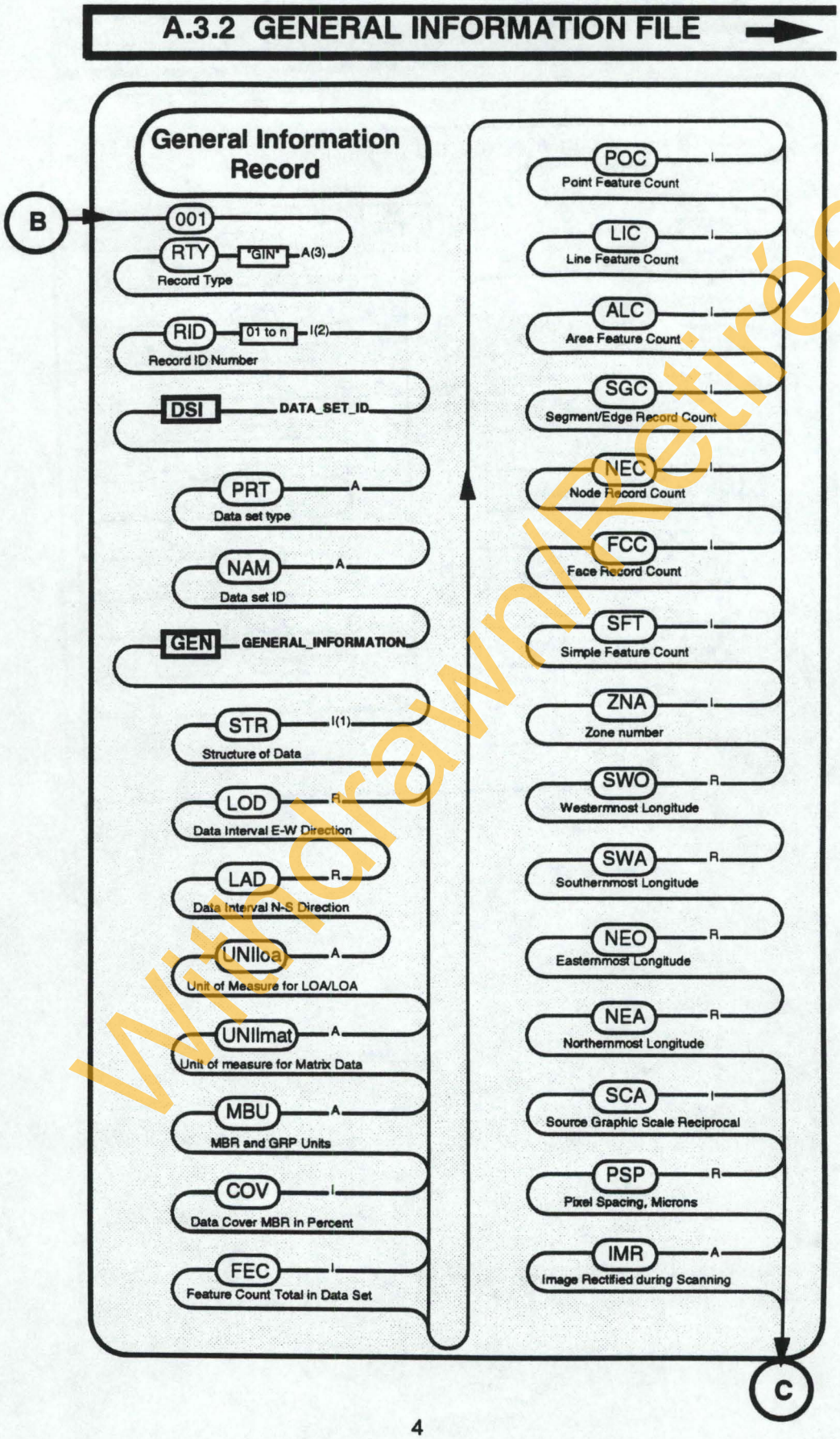


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A.3.1 TRANSMITTAL HEADER FILE

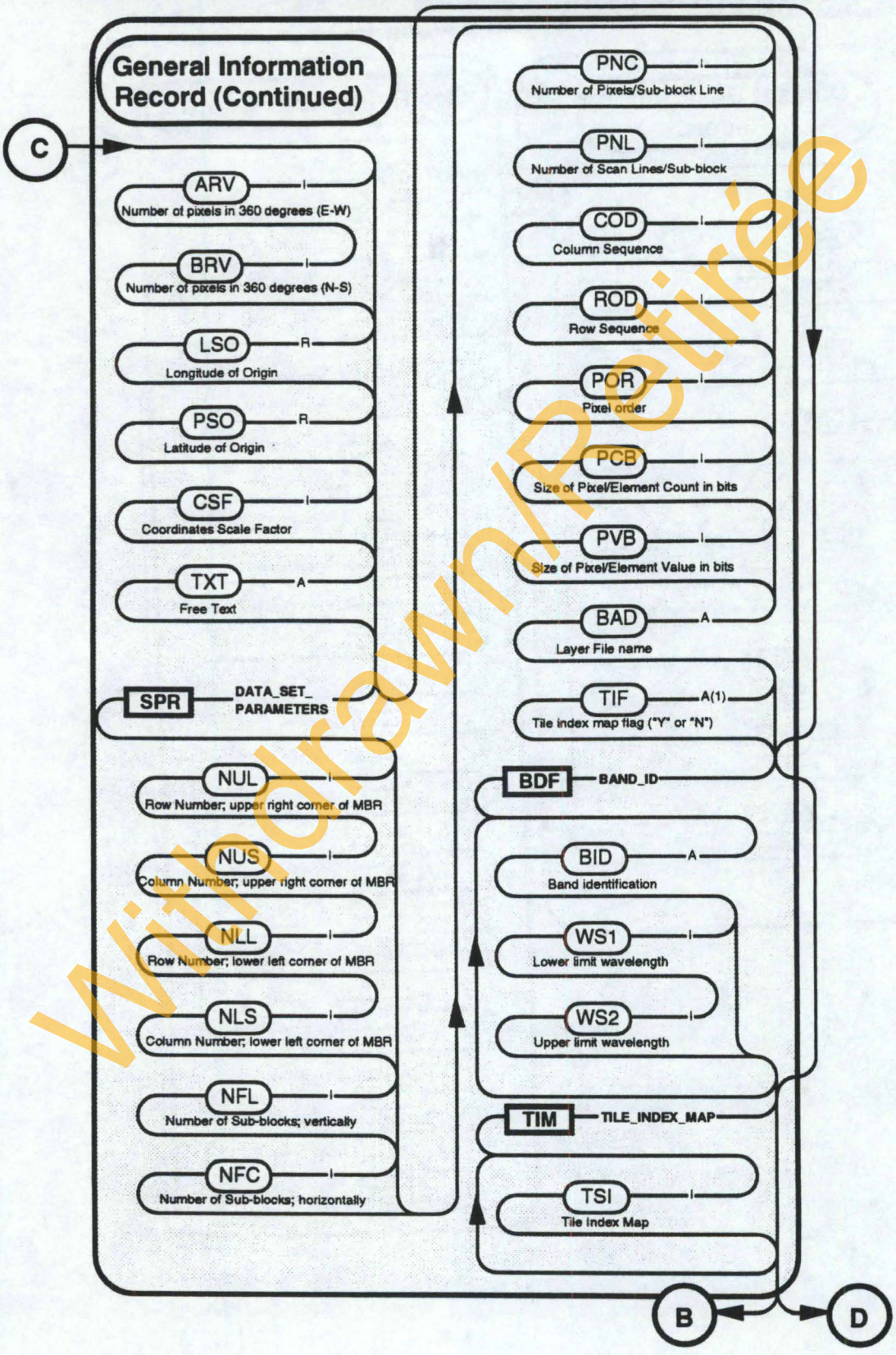


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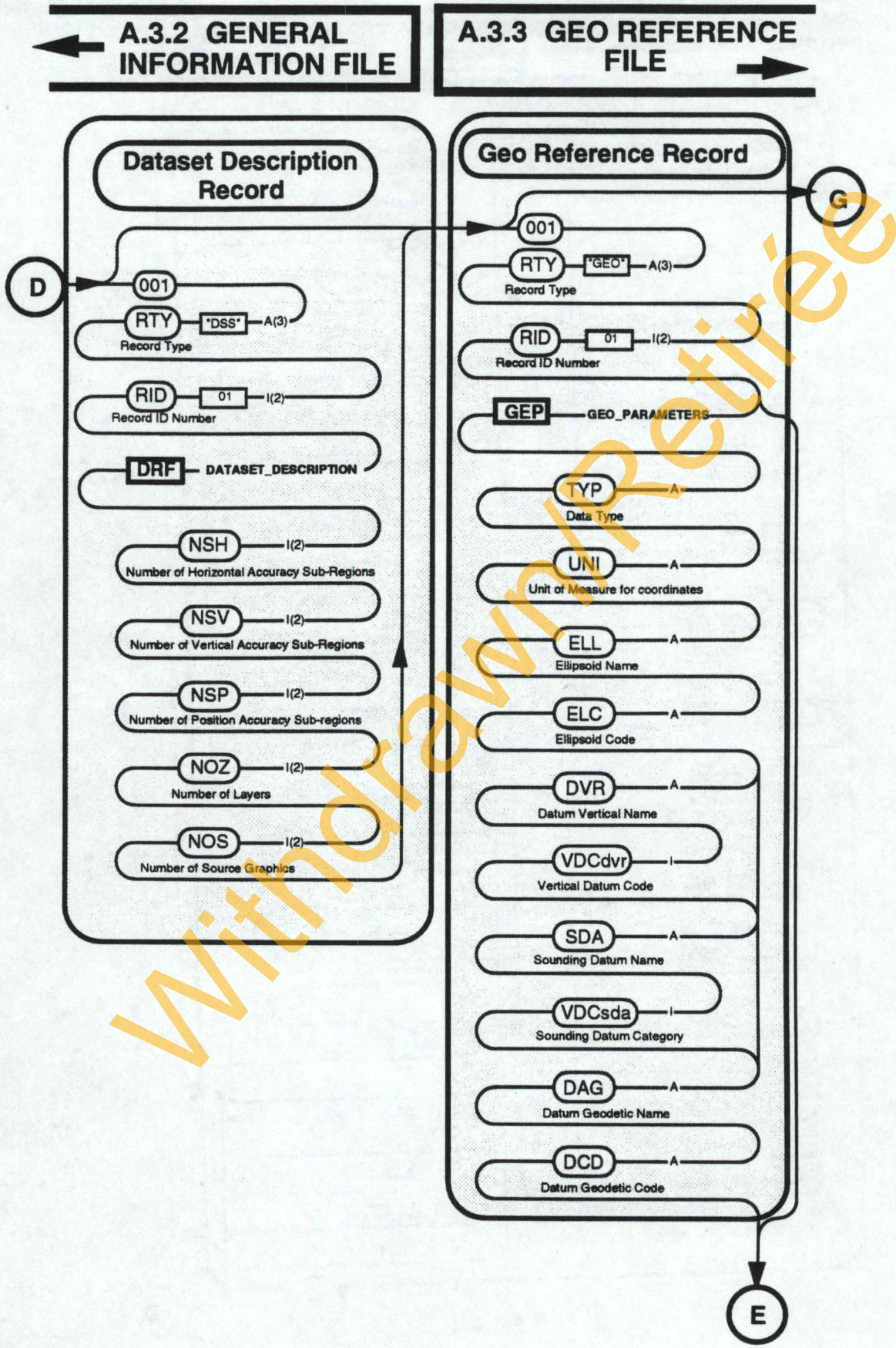


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A.3.2 GENERAL INFORMATION FILE

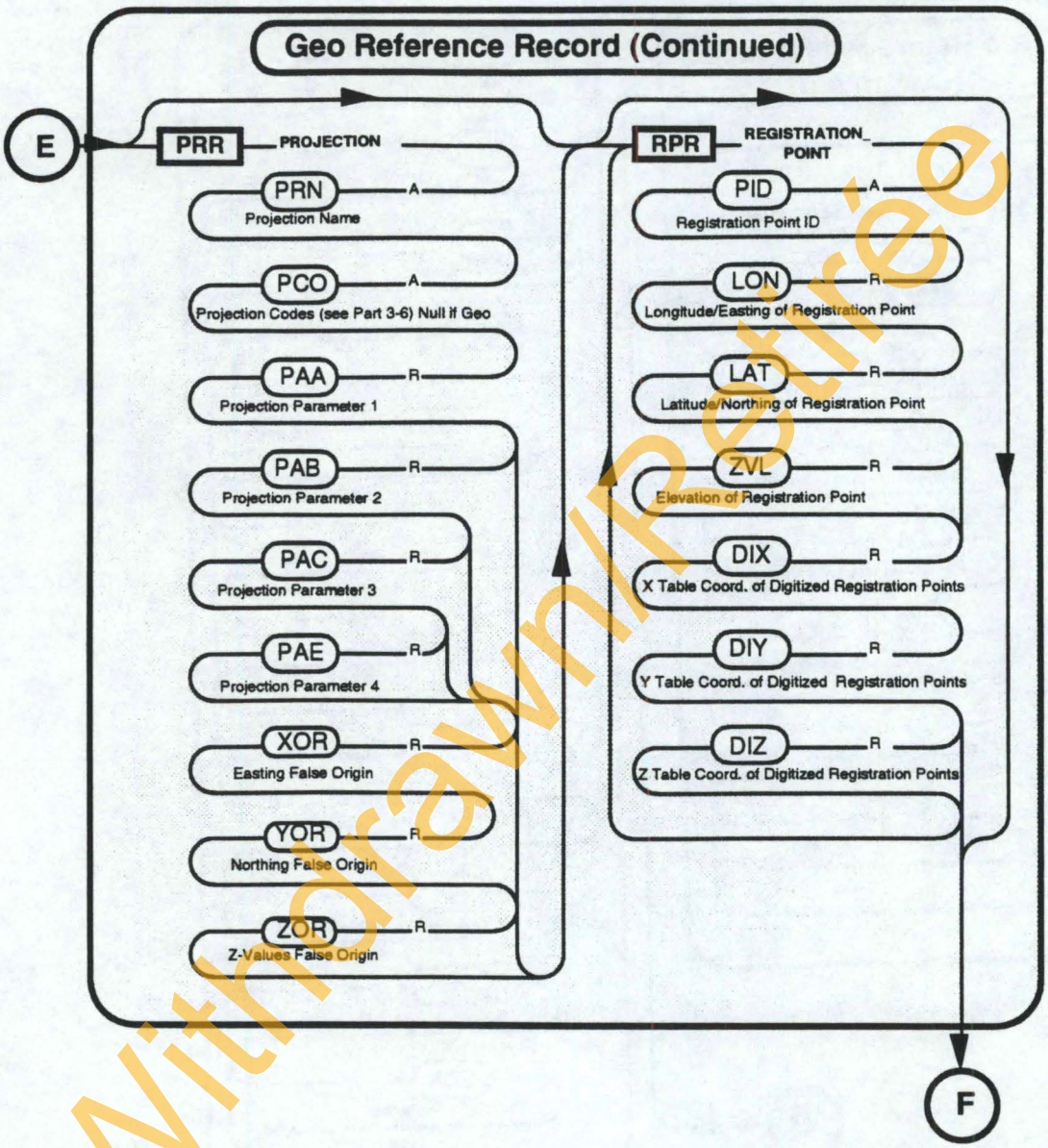


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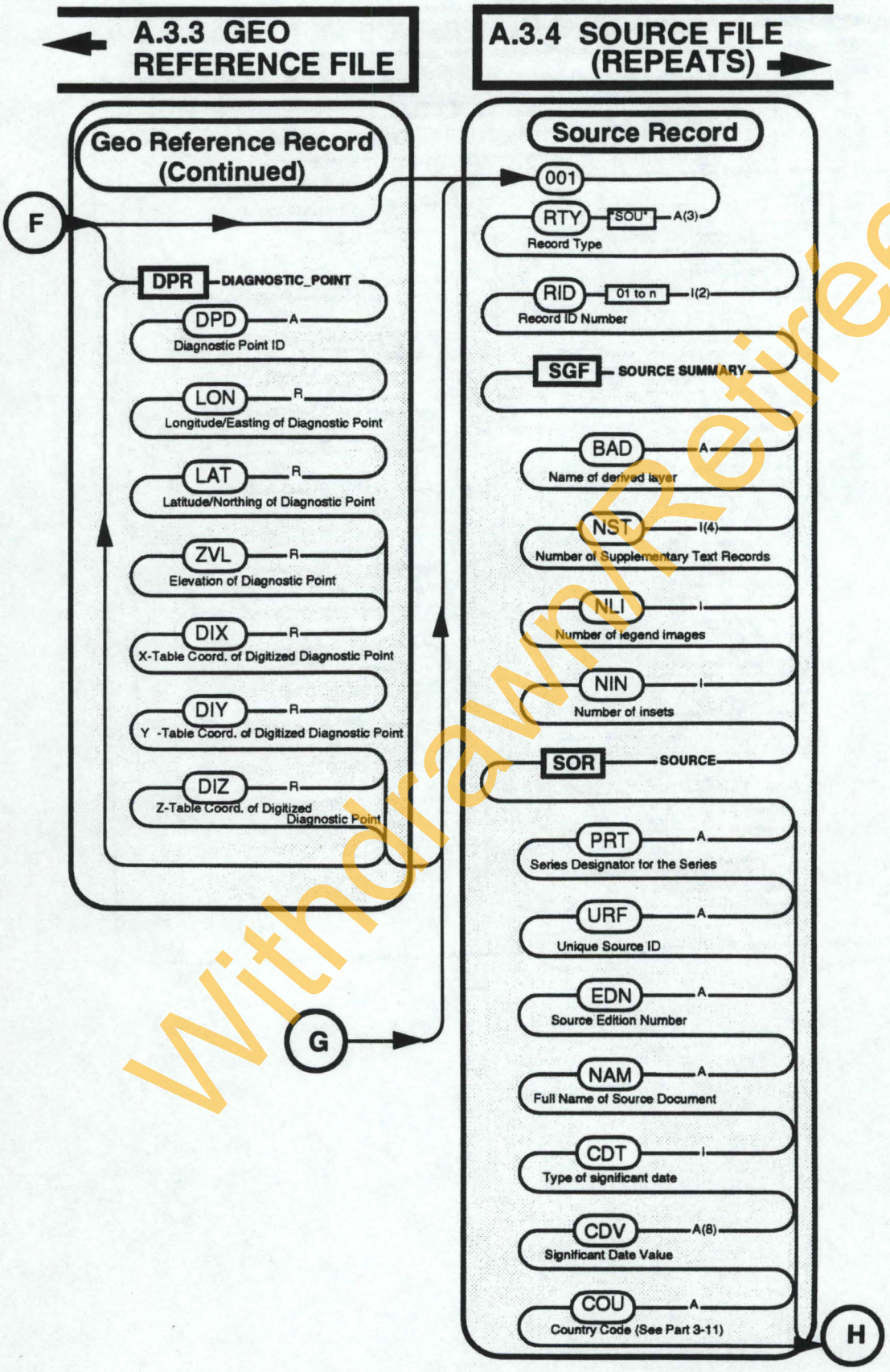


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A.3.3 GEO REFERENCE FILE

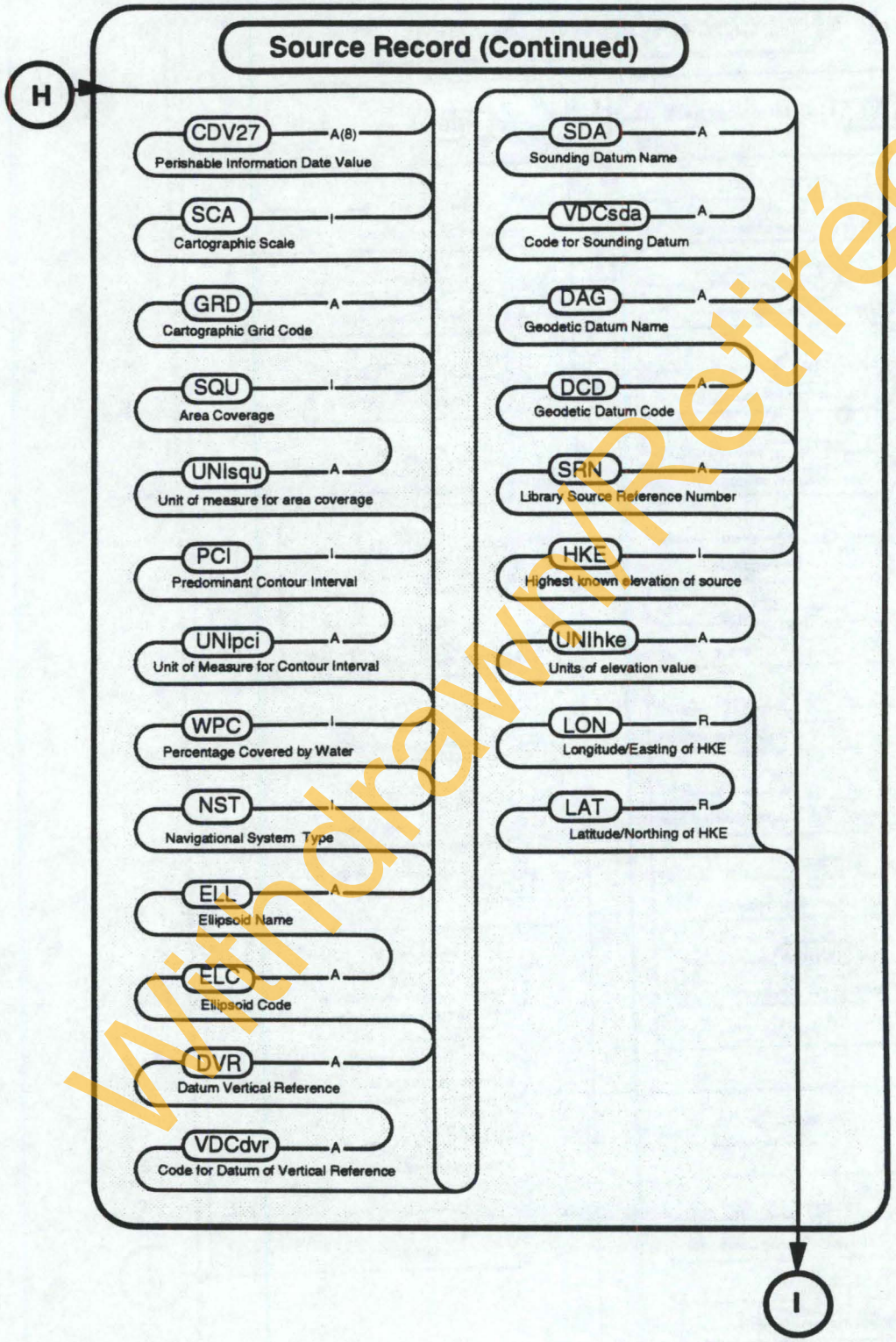


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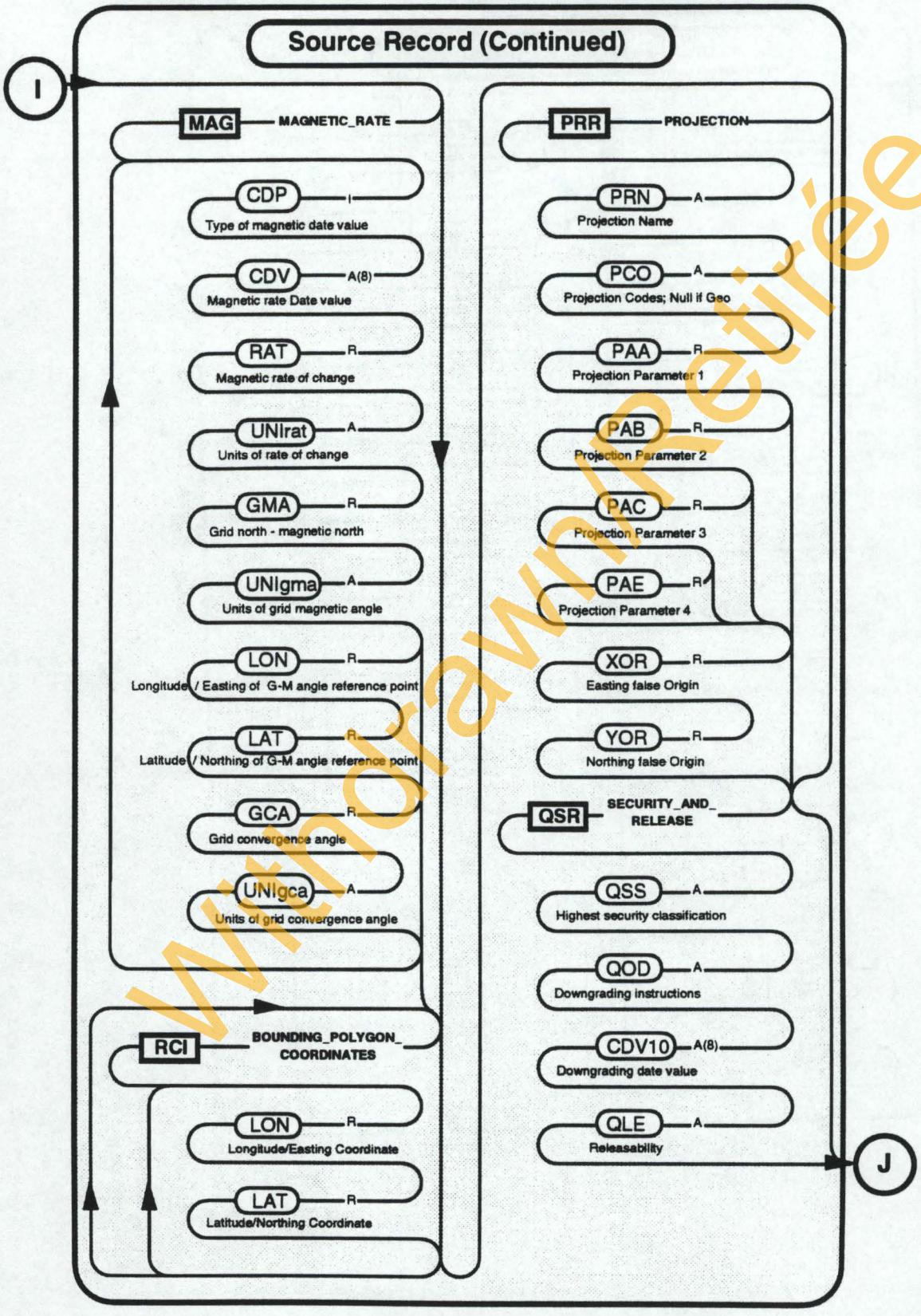
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A.3.4 SOURCE FILE (REPEATS)



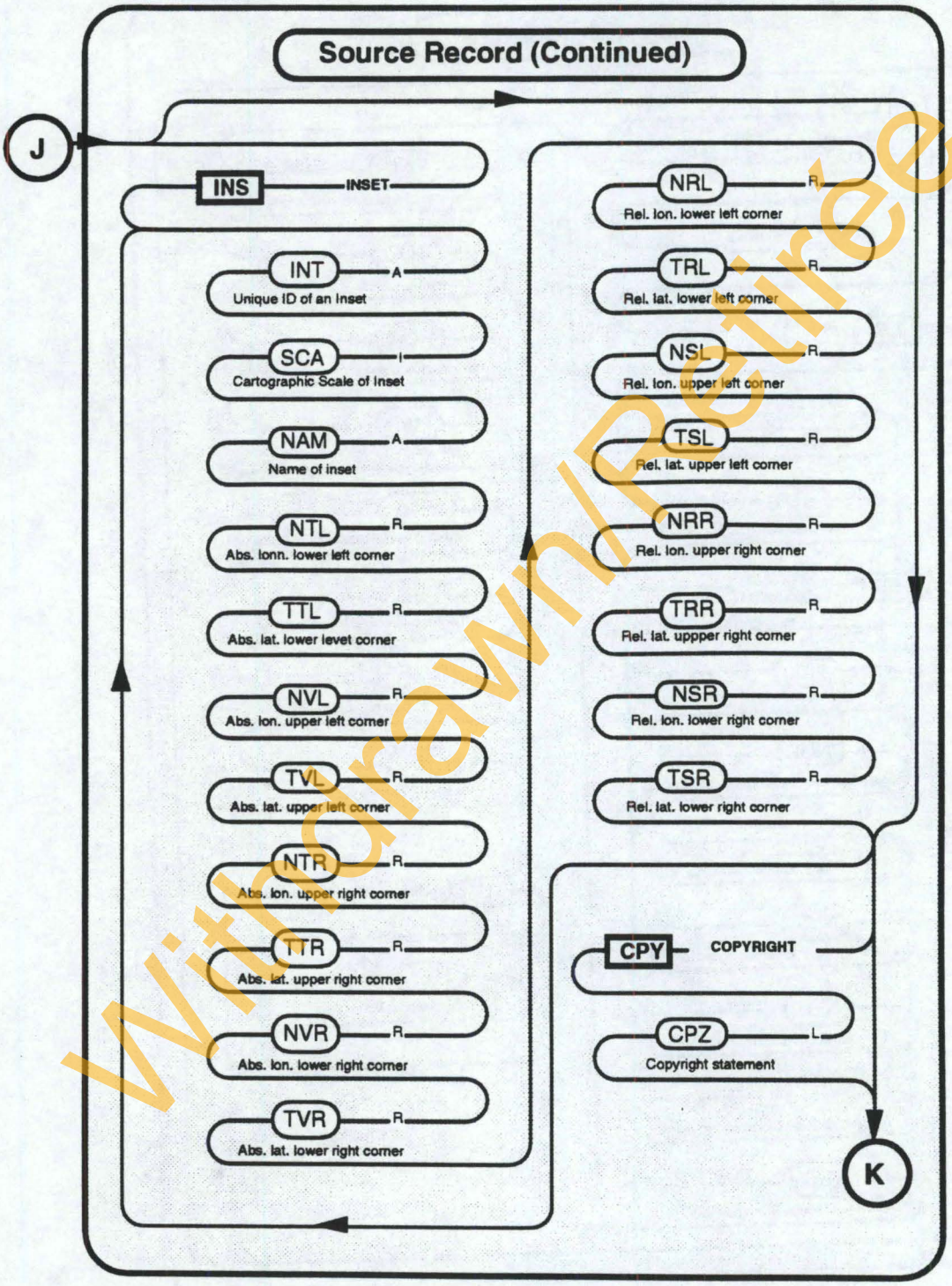
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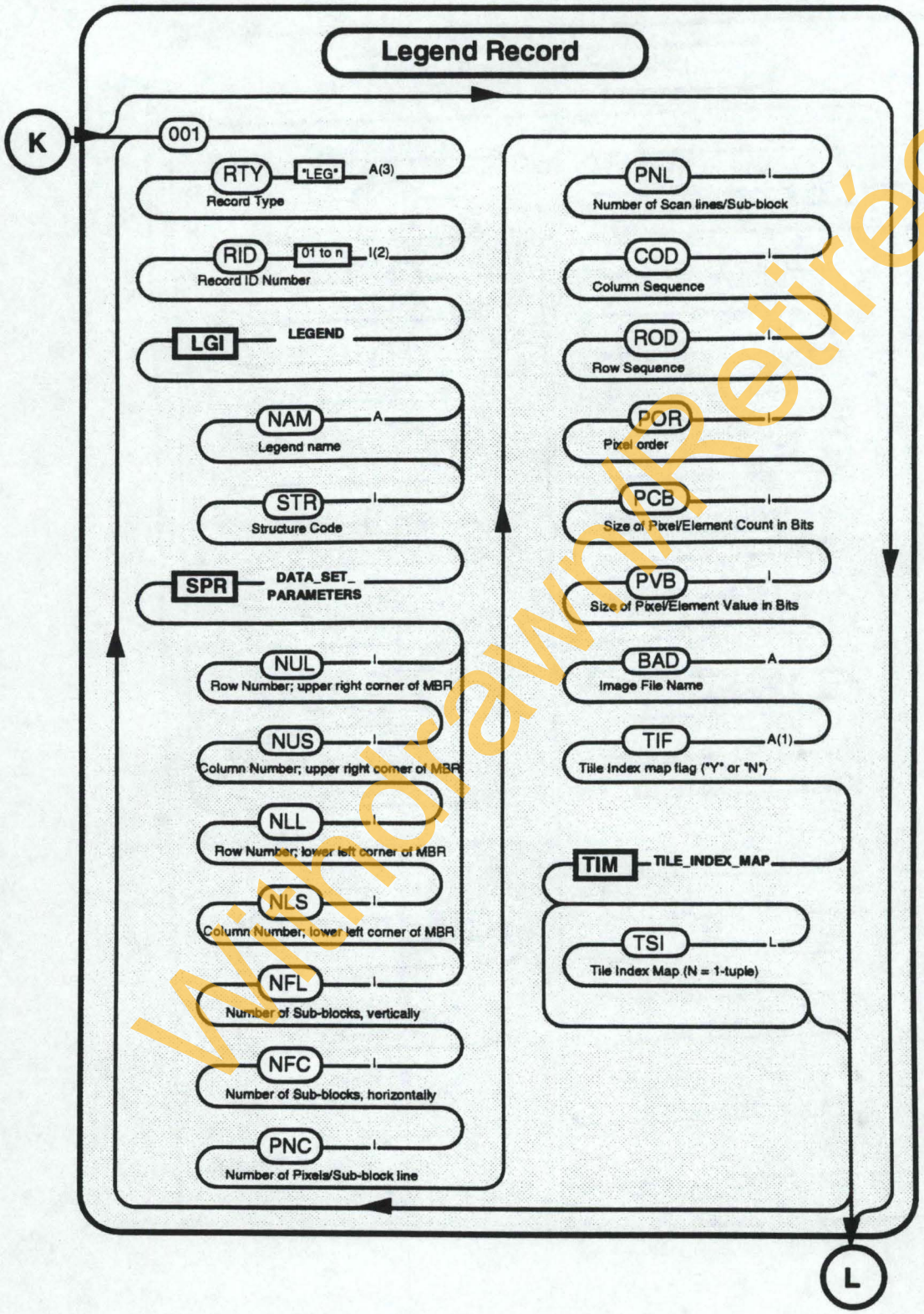
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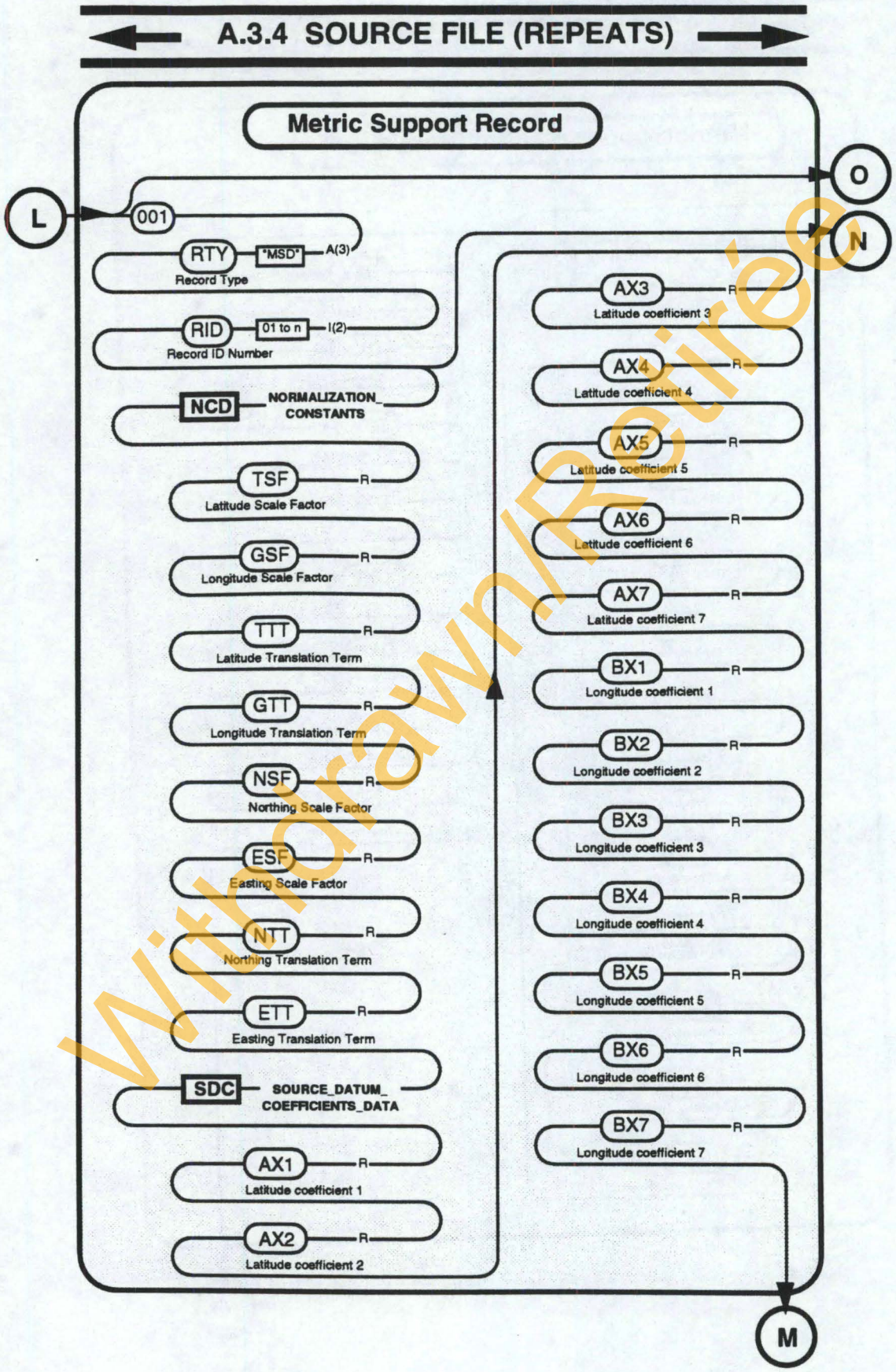


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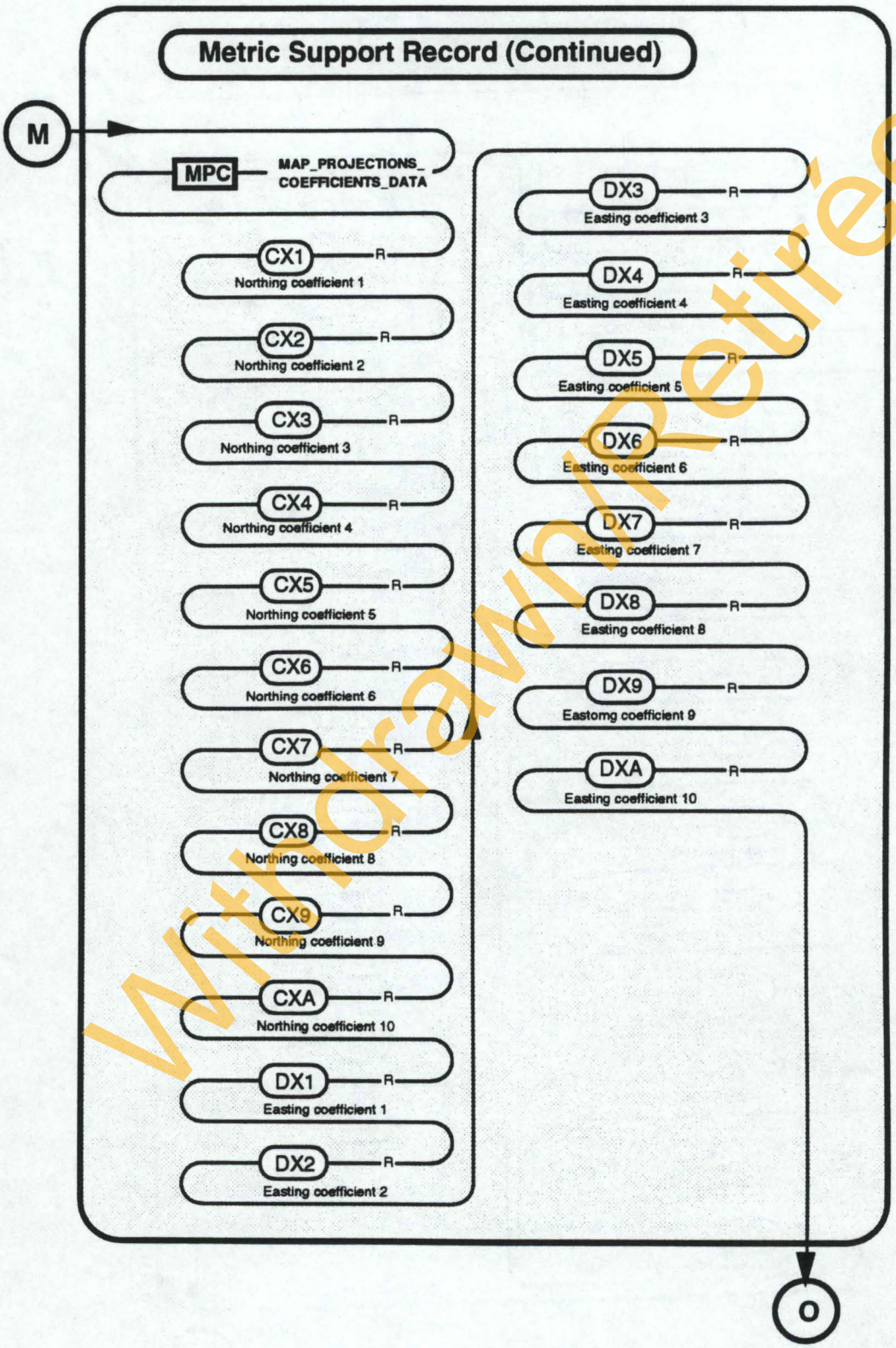


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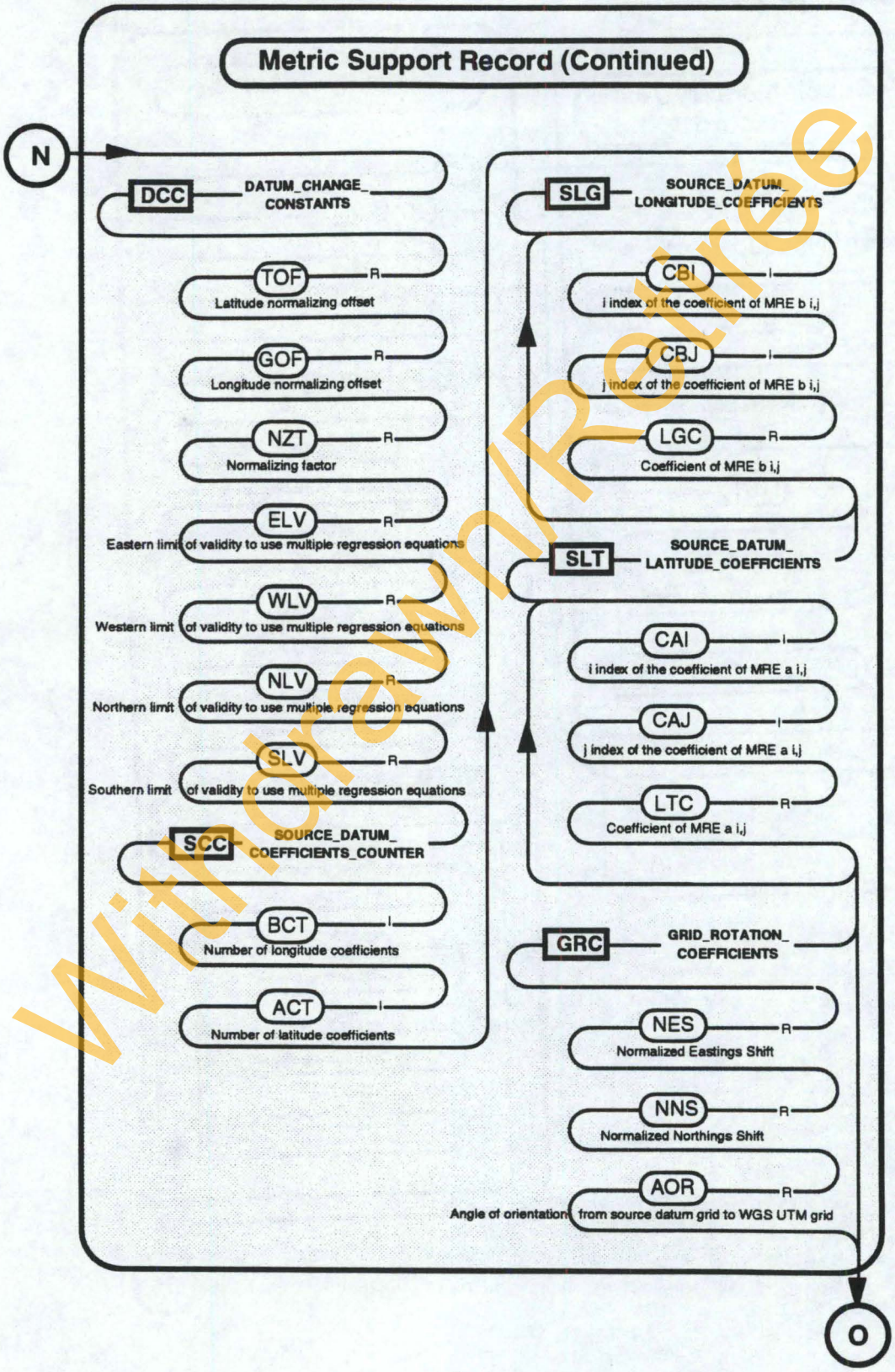
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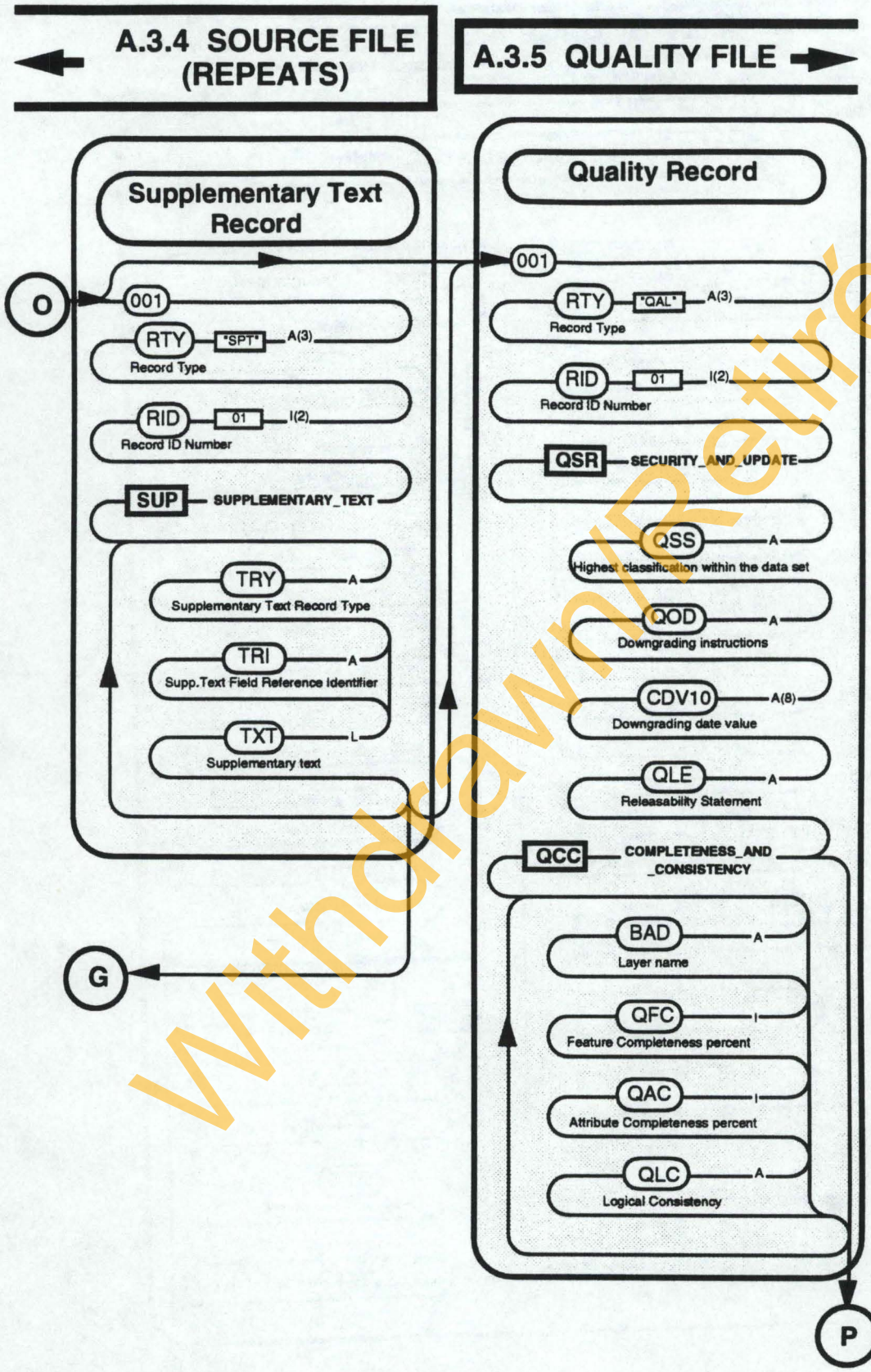


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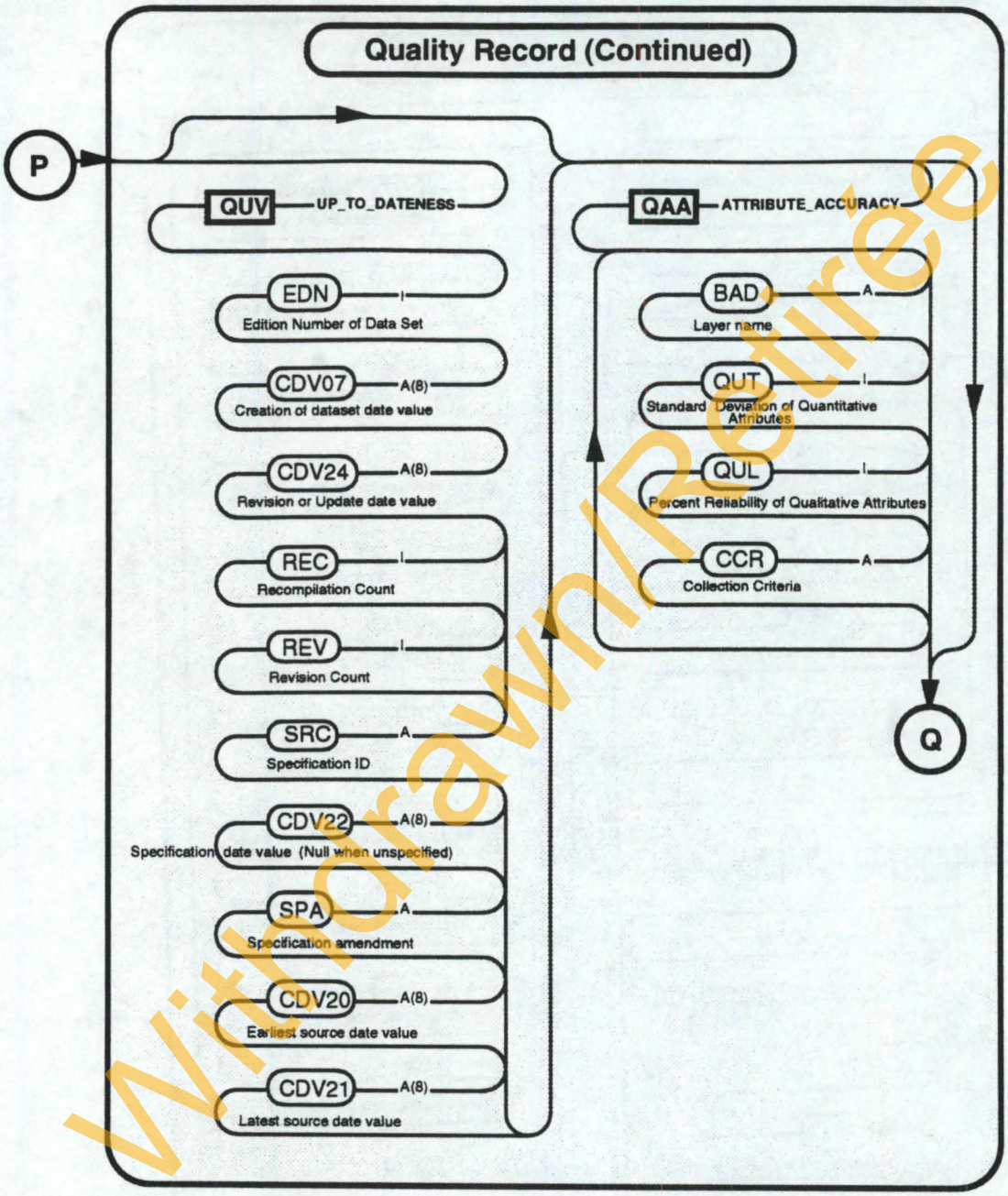


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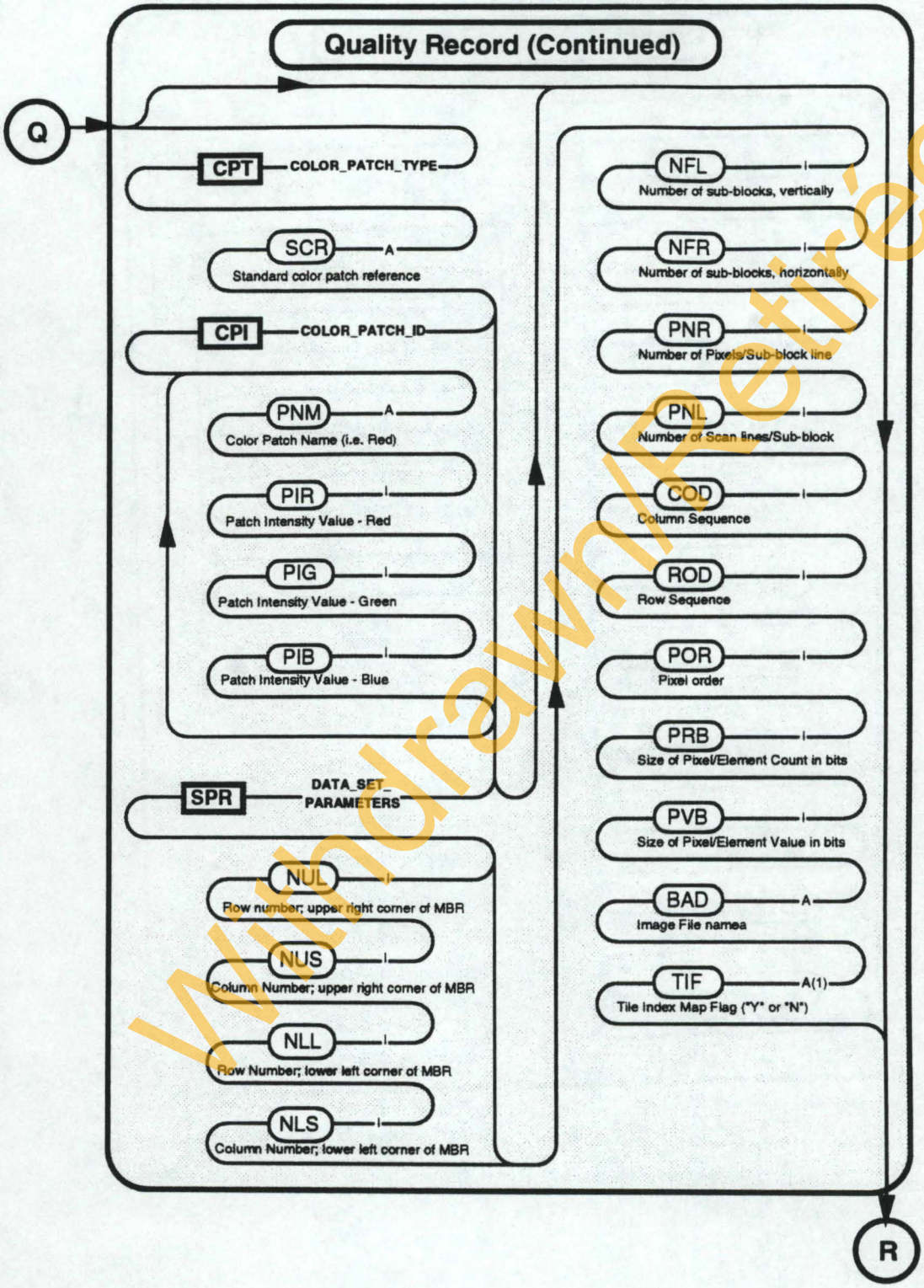
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A.3.5 QUALITY FILE



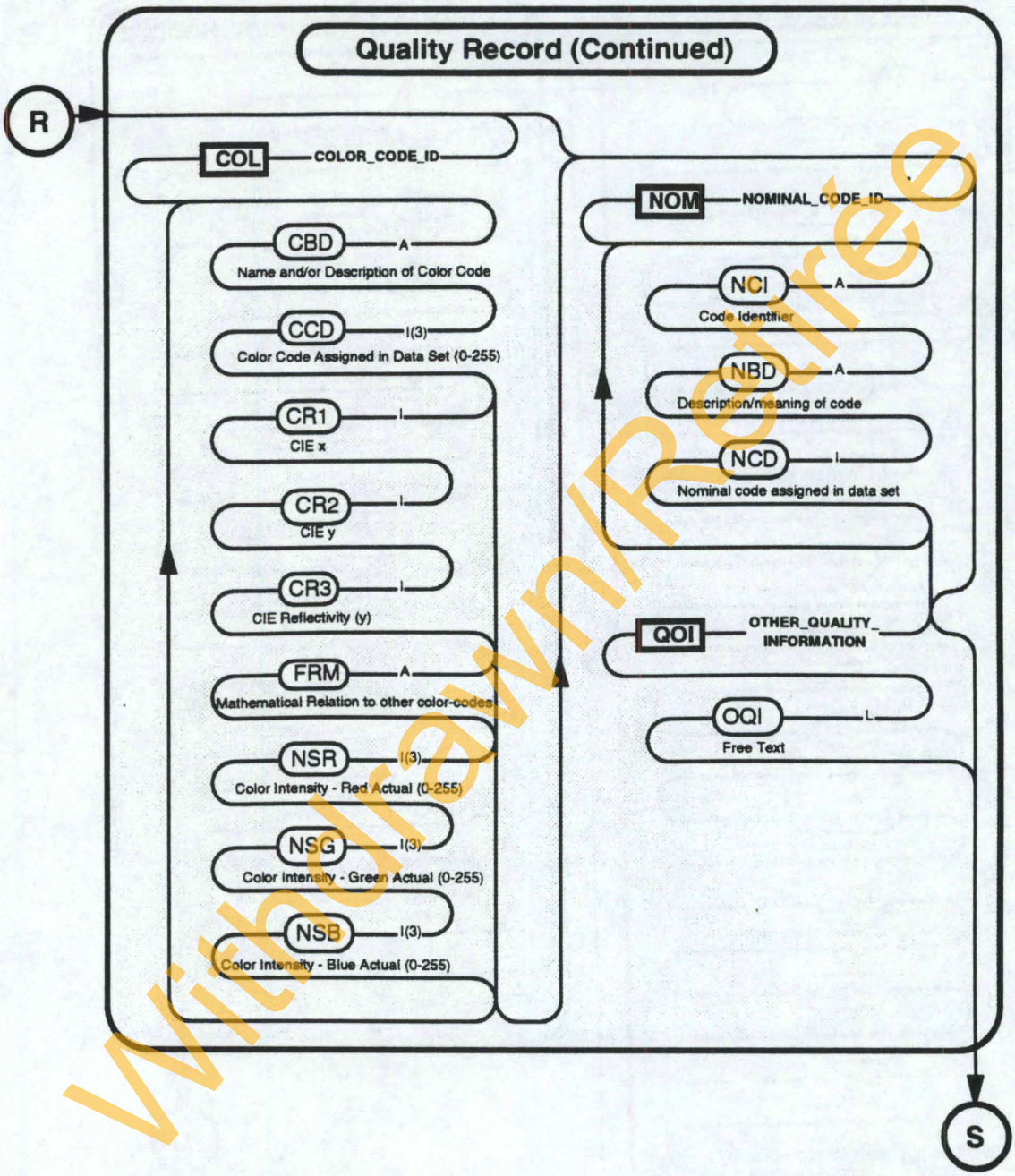
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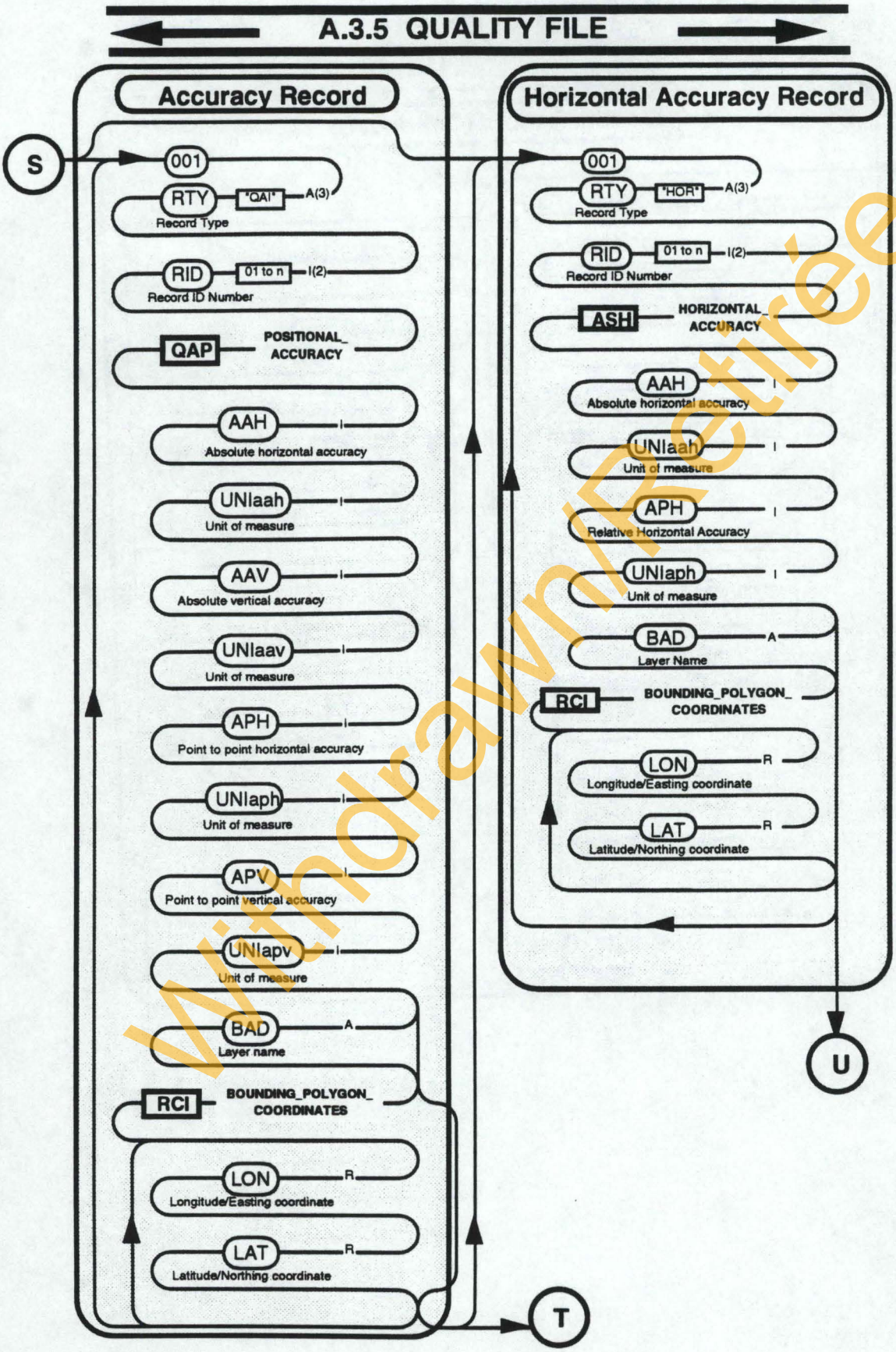


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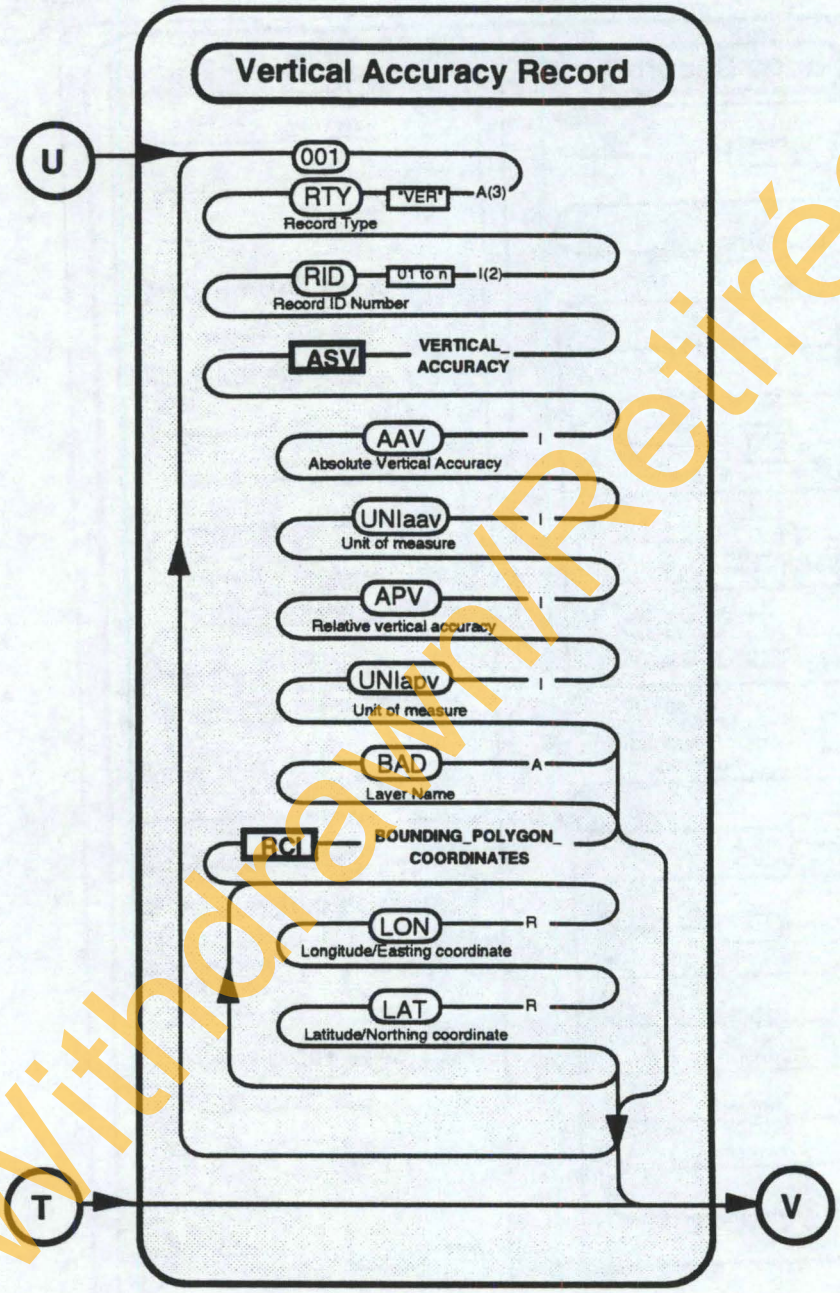


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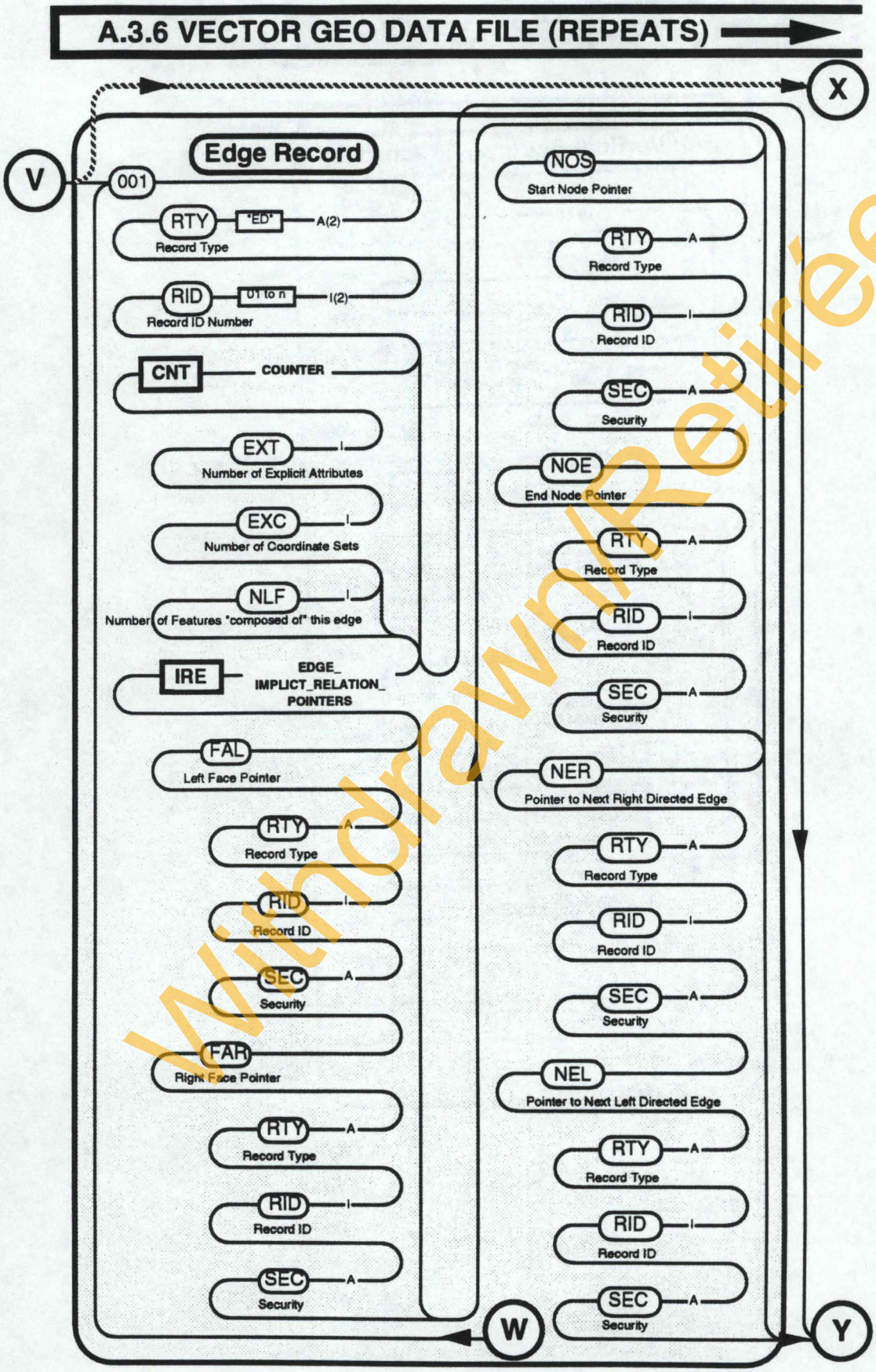


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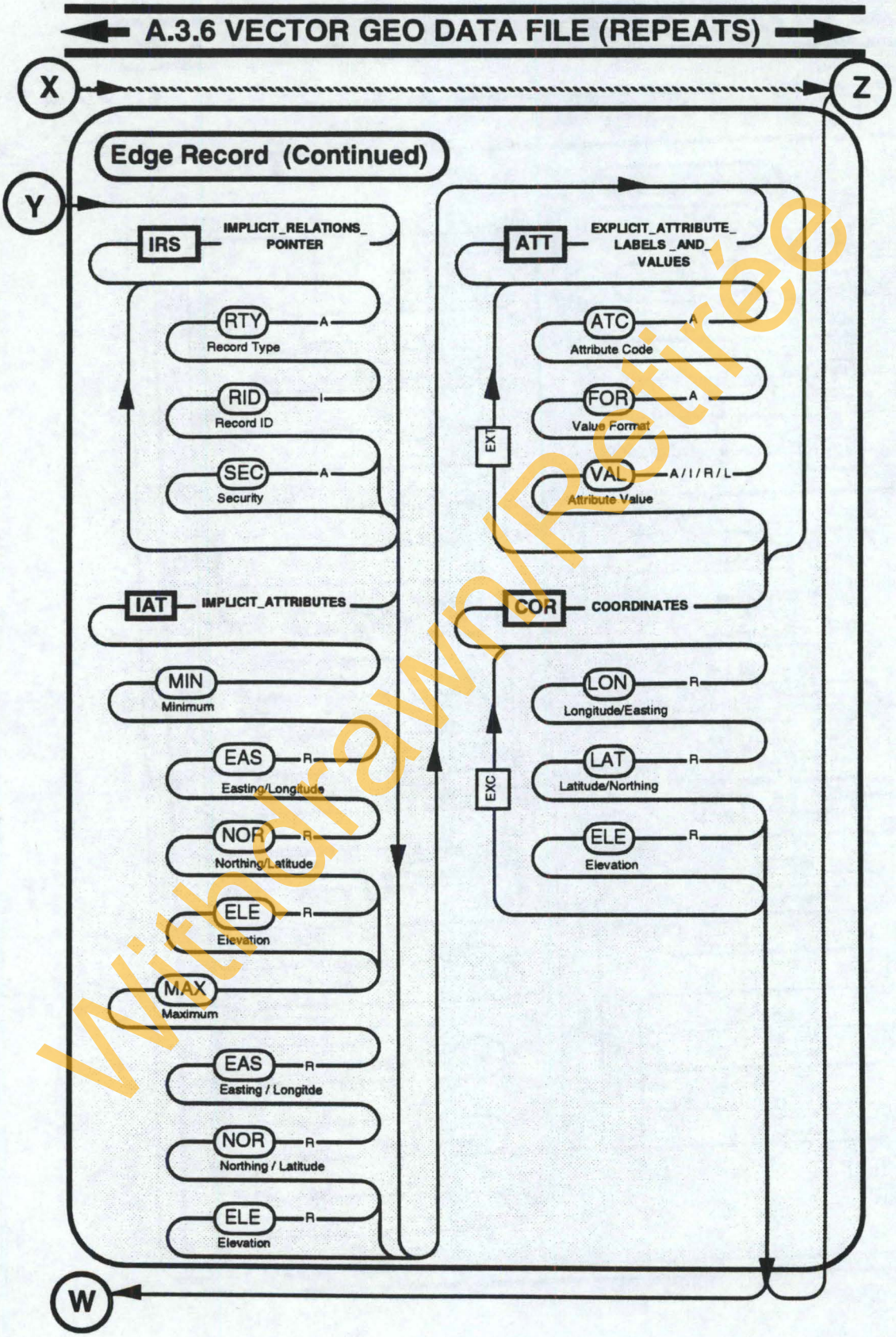
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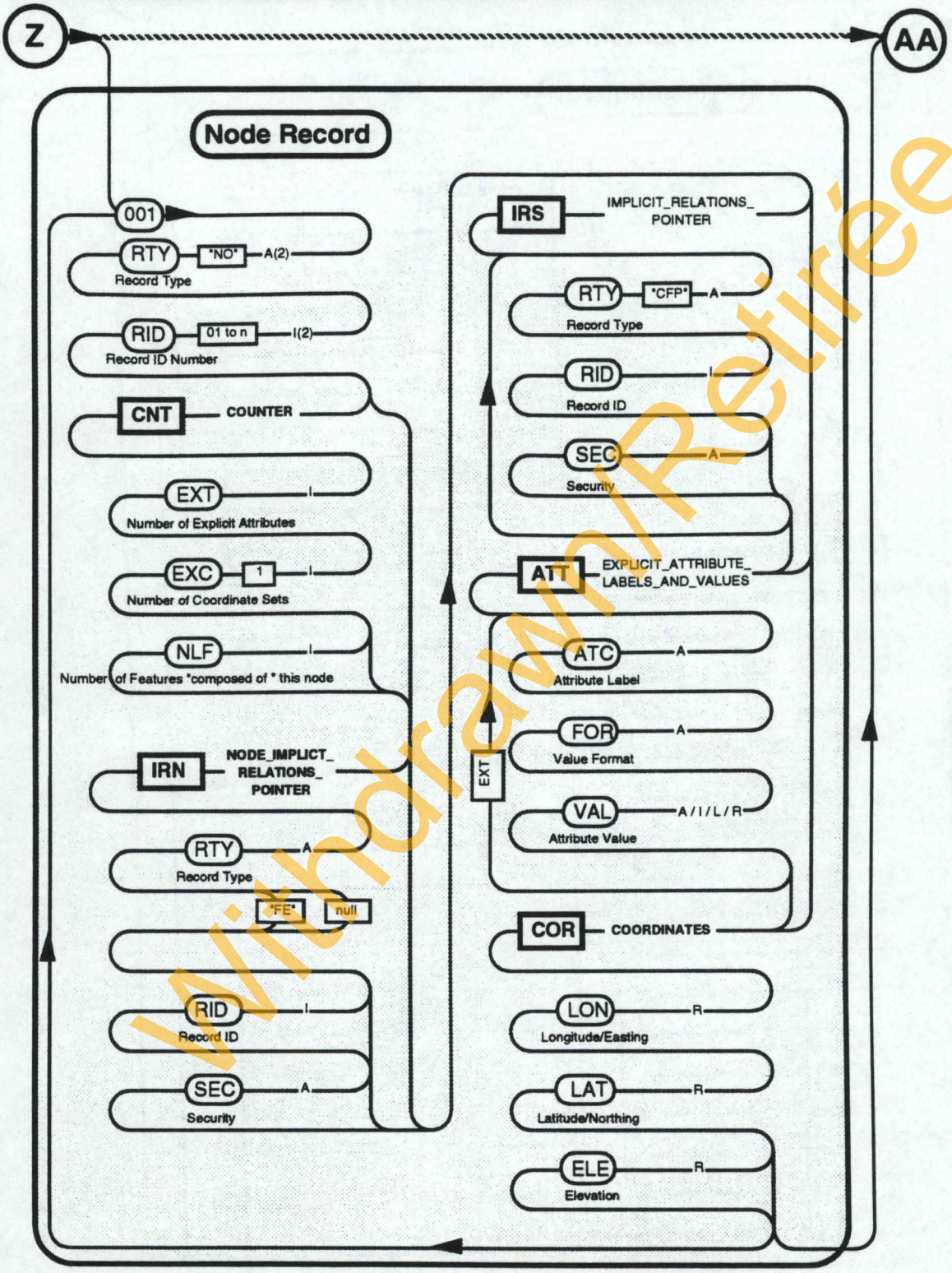


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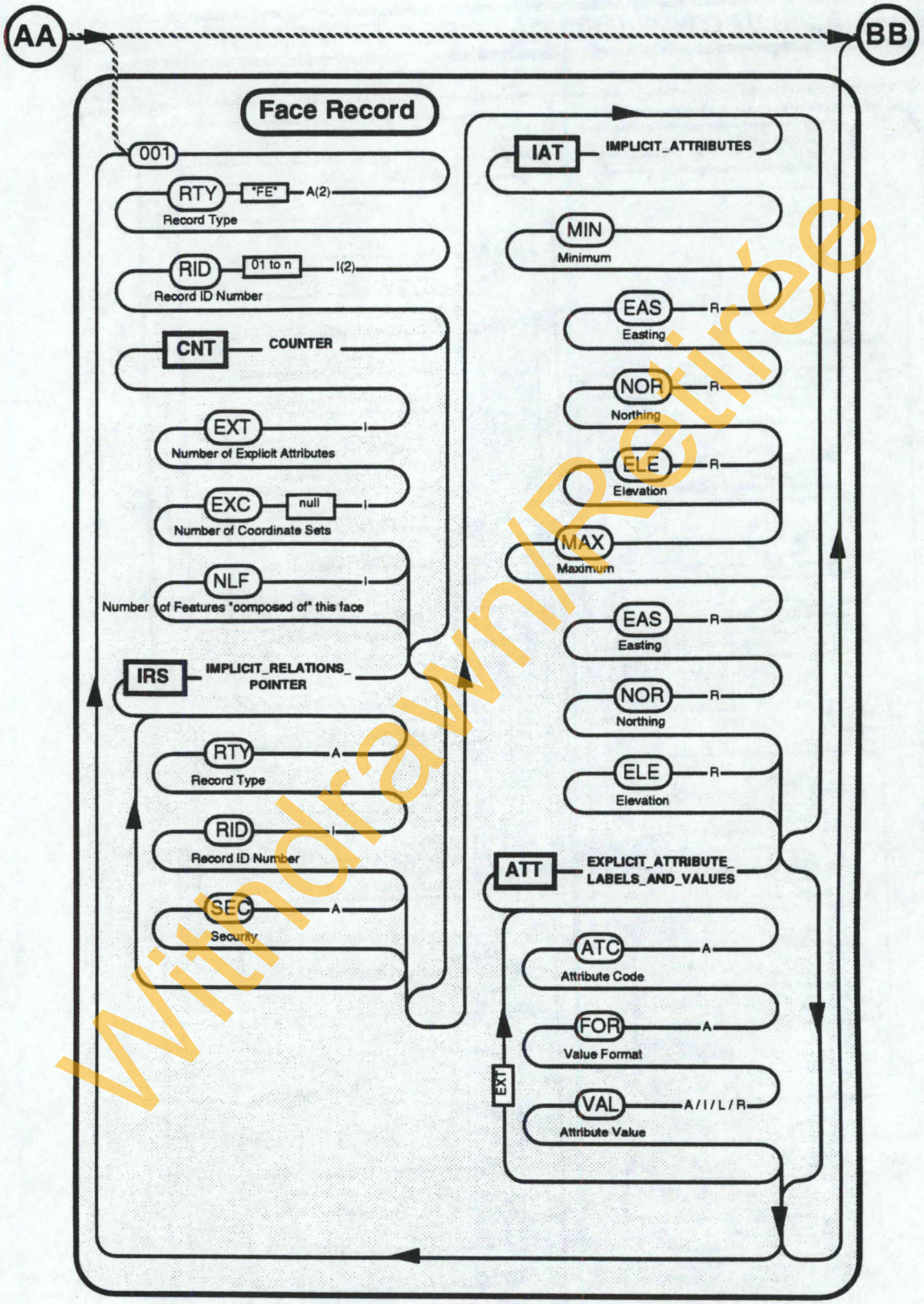


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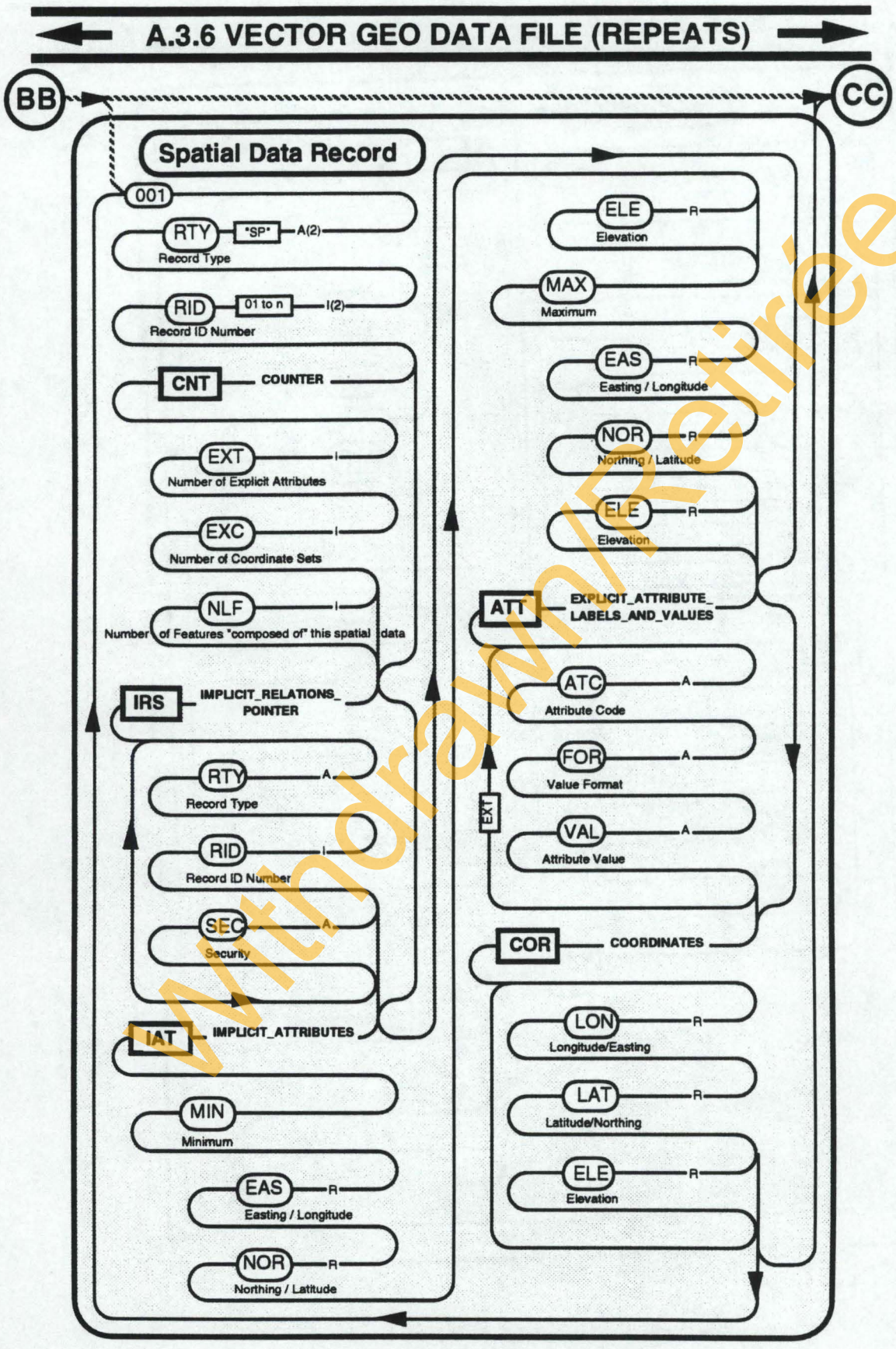
A.3.6 VECTOR GEO DATA FILE (REPEATS)



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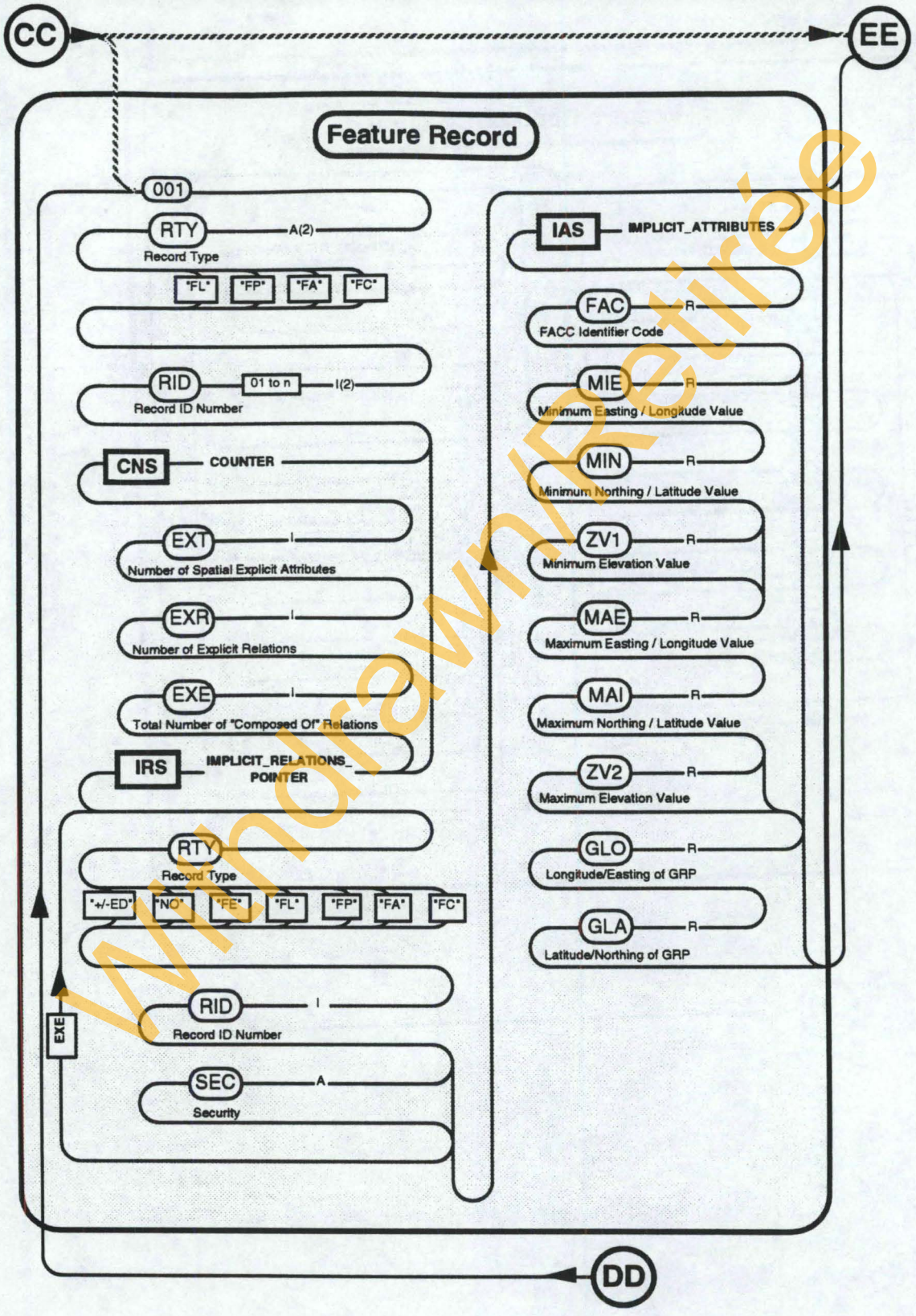


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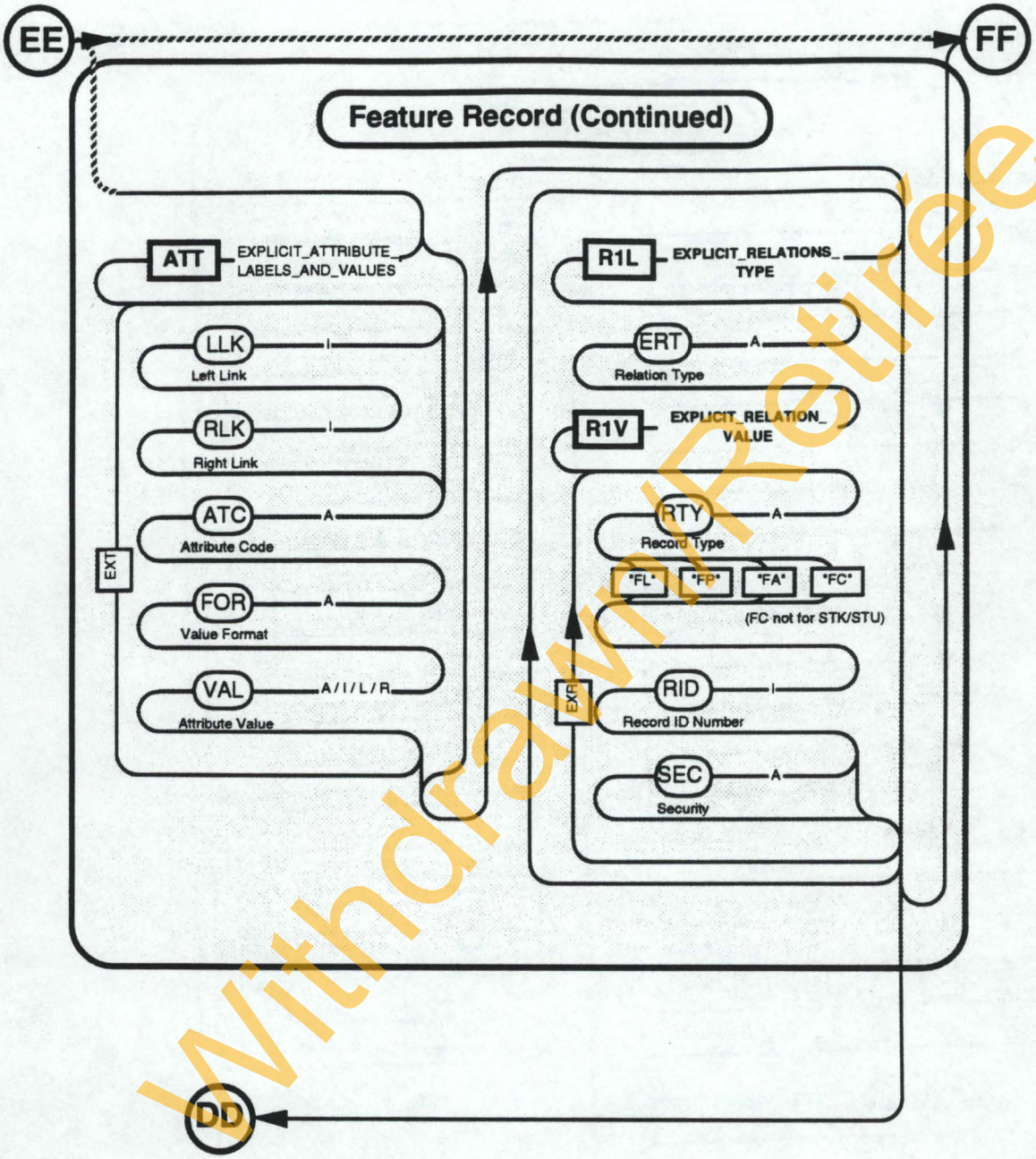
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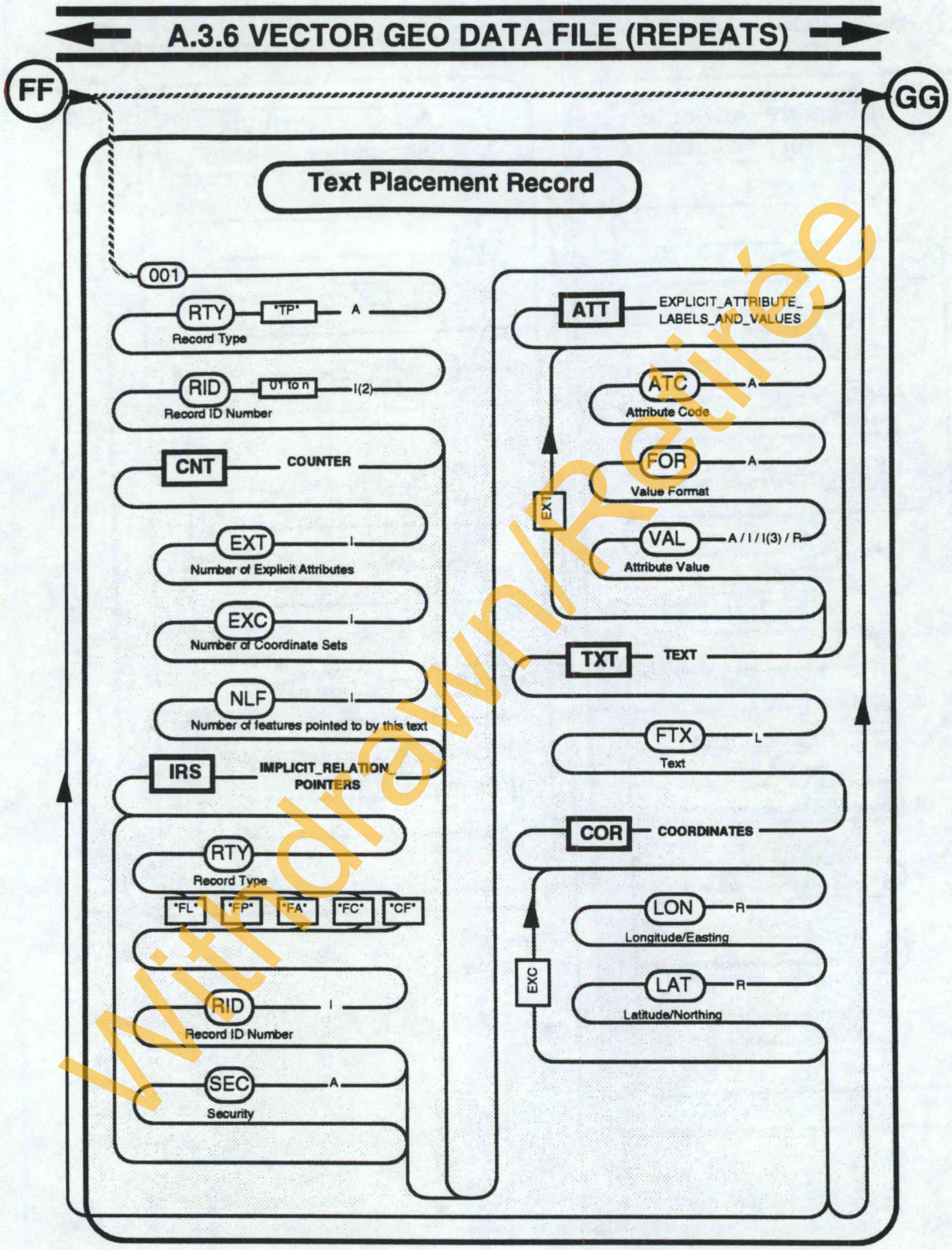


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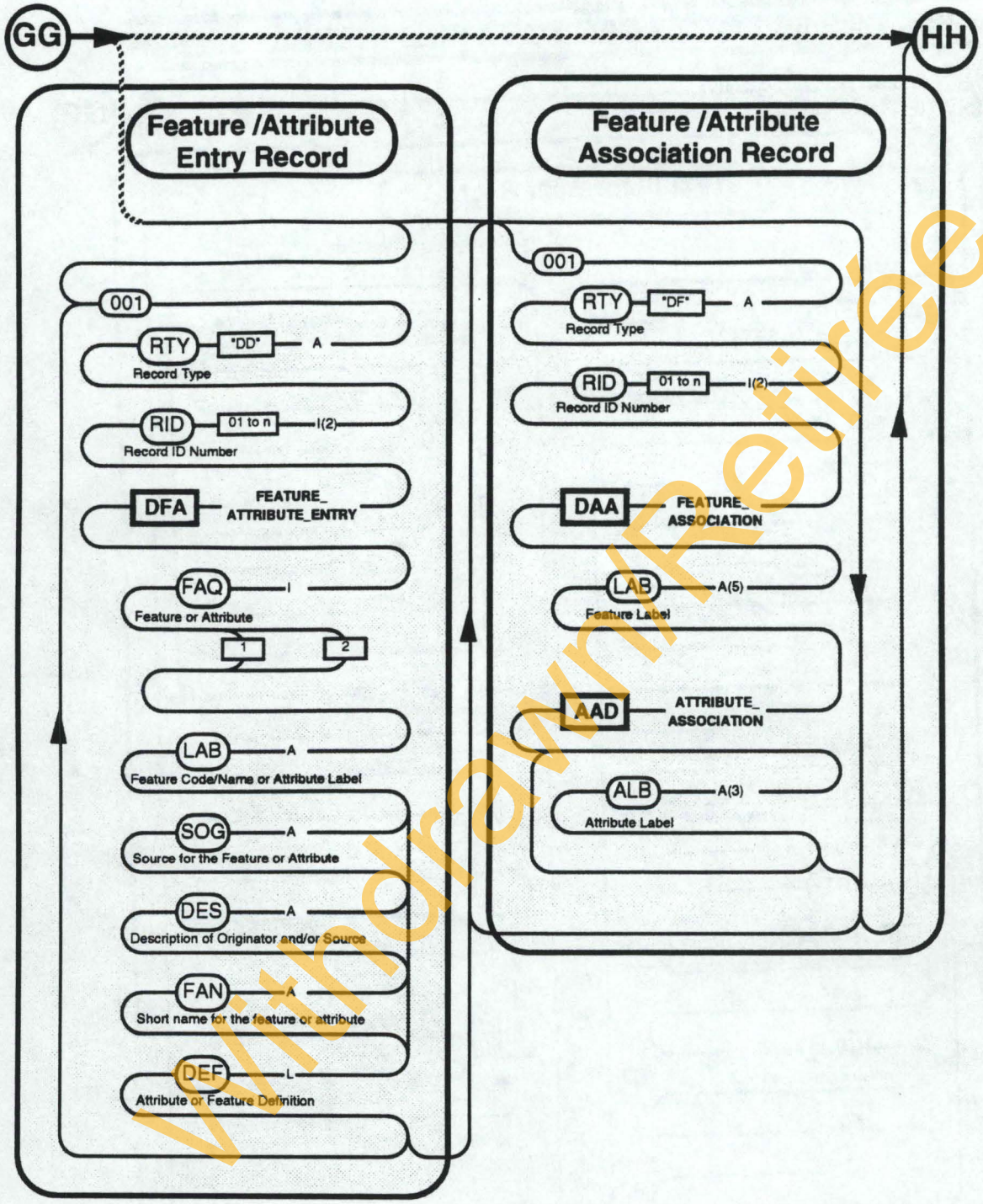
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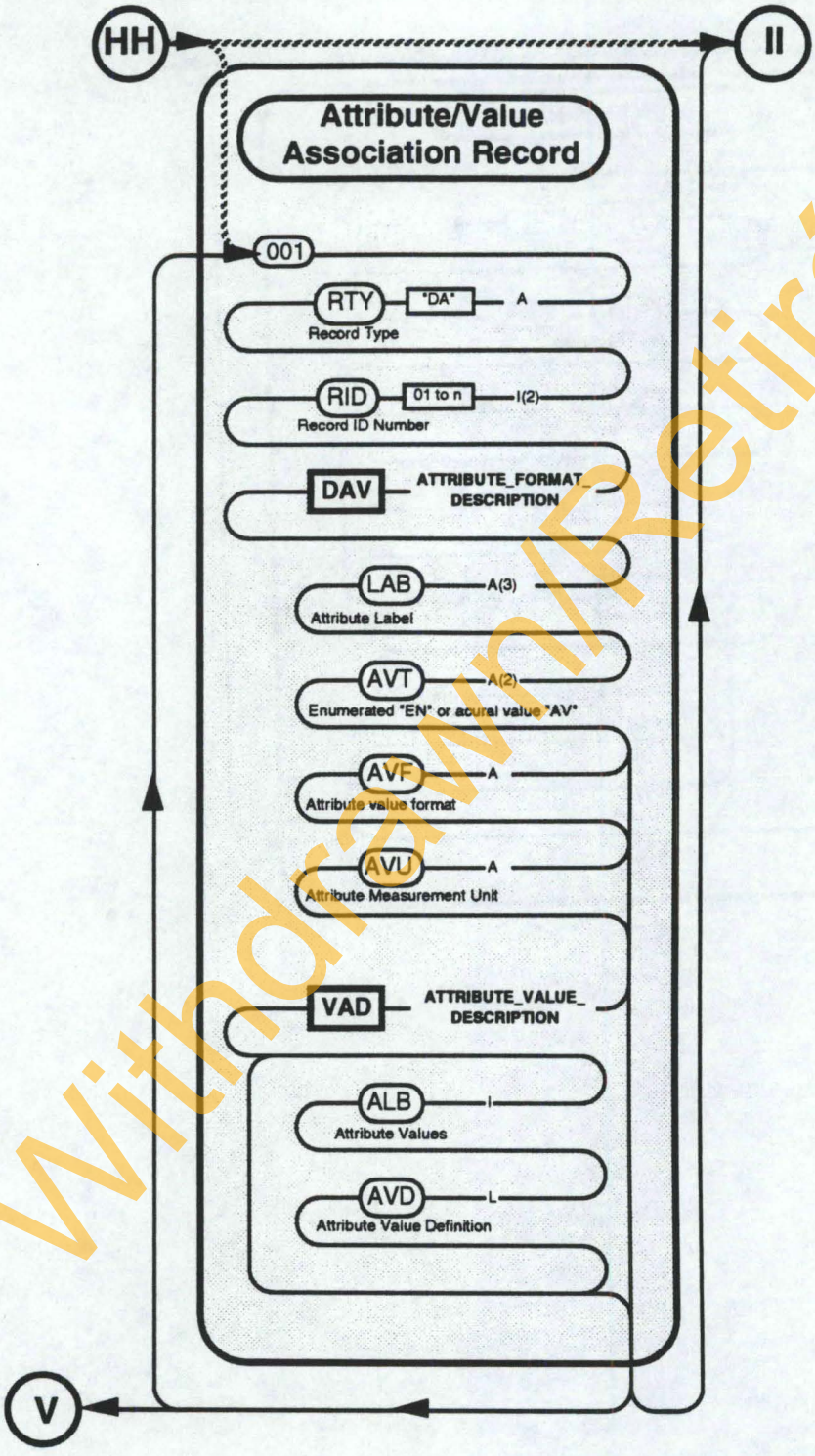


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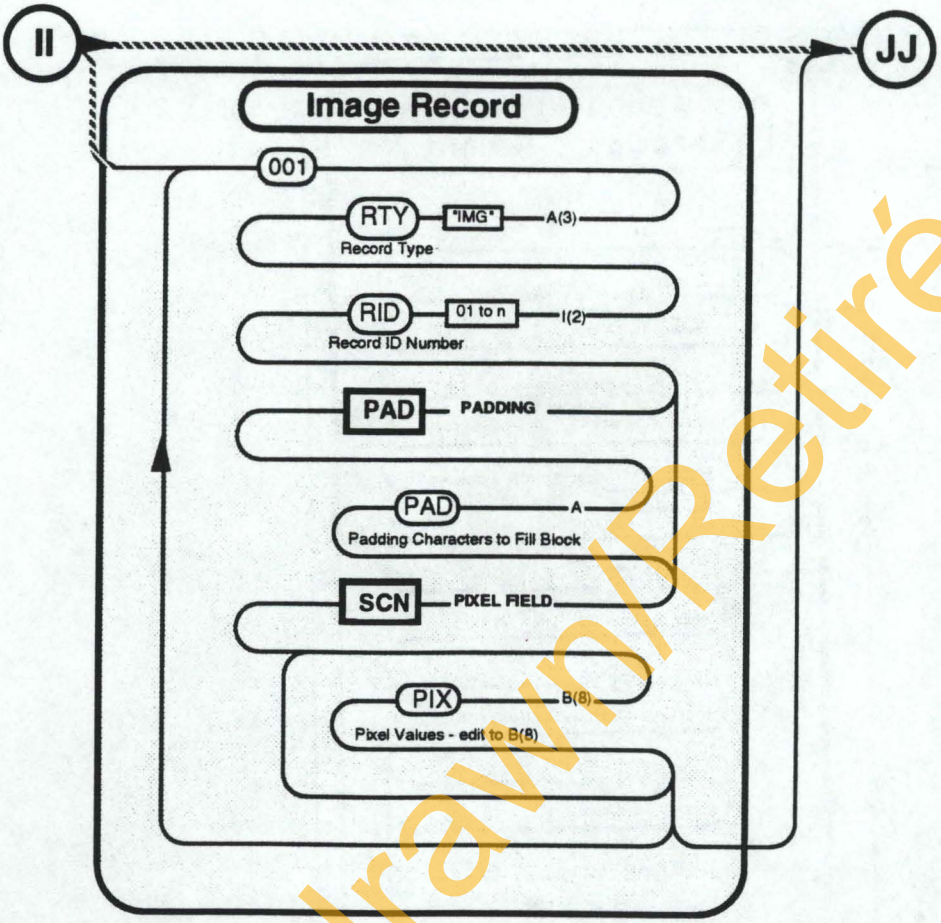
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A.3.6 VECTOR GEO DATA FILE (REPEATS)



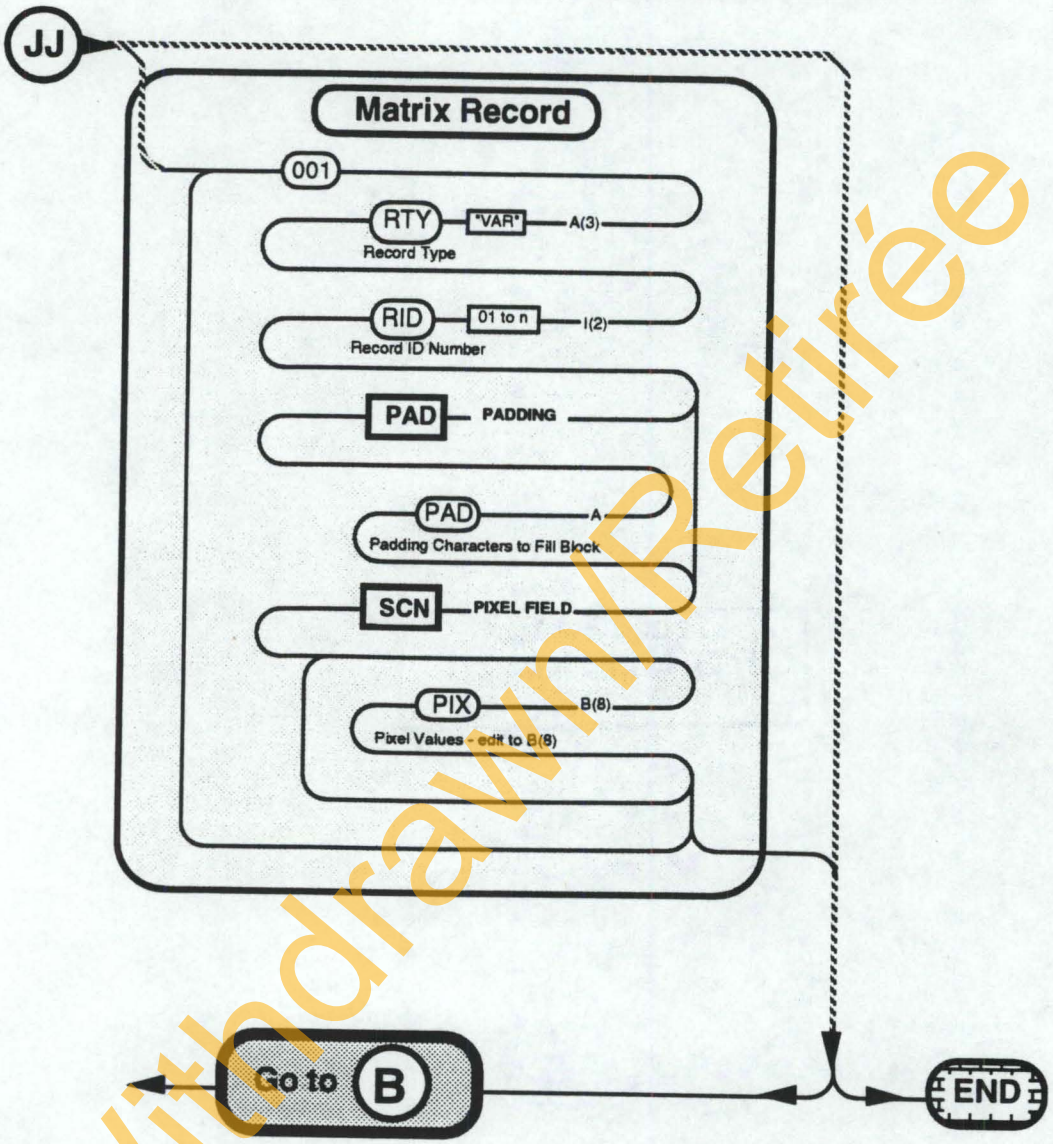
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A.3.7 RASTER GEO DATA FILE (REPEATS)



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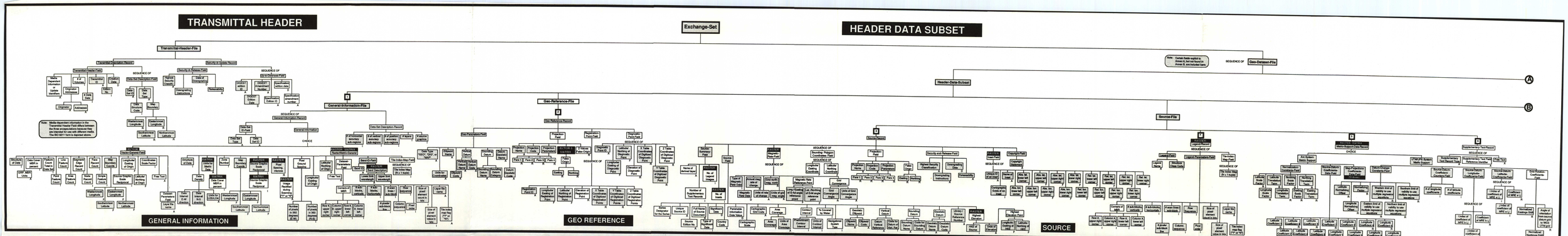
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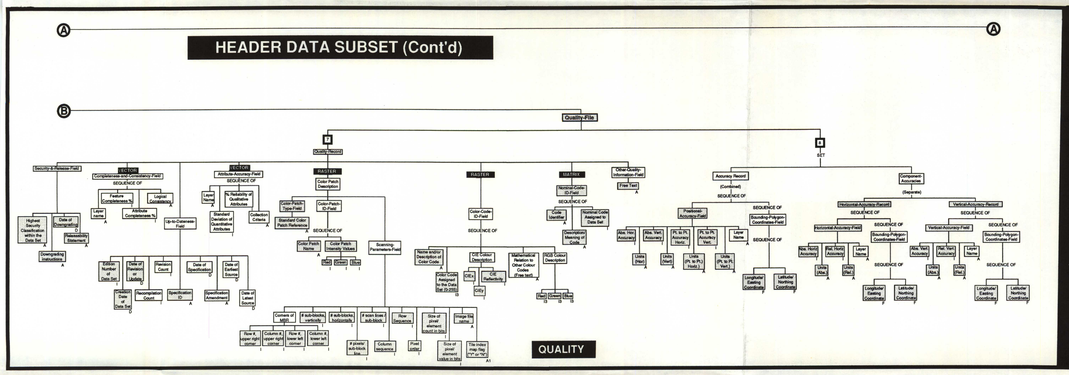


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LEGEND

Unshaded Box	=	OPTIONAL Items
Shaded Box	=	Mandatory Items
Round Box	=	Notes
#	=	Application Tags as used in ISO 8824
——→	=	Implicit Relations Pointer
- - - →	=	Explicit Relations Pointer
◊	=	See note below
○	=	Connector

In the ISO 8211 representation, the counters for the Explicit Attributes and Coordinates are contained in the DDR fields. These are considered as structural in the ISO 8324 representation and for this implementation are not required.

Interpretation:

1. The map proceeds from top left to bottom right.
2. The connectors identify a broken horizontal line which continues on from Strip to Strip.
3. The ISO 8824/25 ASN.1 terminology has been used to describe the syntactic tree, i.e.:
   (a) The SEQUENCE OF operator specifies that the number of elements is variable but the order is fixed. This is equivalent to the "R" (repeating) in ISO 8211.
   (b) CHOICE signifies that one item is to be chosen from a list. This is implicit in ISO 8211.
4. Items hanging from a horizontal bar are to be selected from left to right.
5. An OPTIONAL Item with MANDATORY sub-Items indicates that if the OPTIONAL Item is used the MANDATORY sub-Items are then necessary.
6. The characters "A", "I", "R", "F", "D" or "B" at the bottom right of a box indicate the format.
   A = Character, I = Integer, R = Real, F = Fractional, D = Date (8 characters), B = Binary.
7. Record ID numbers in the Topological Elements and Features are implicit in ISO 8211.

Prepared by:
Director of Geographic Operations
Department of National Defence
in cooperation with
IDON Corporation

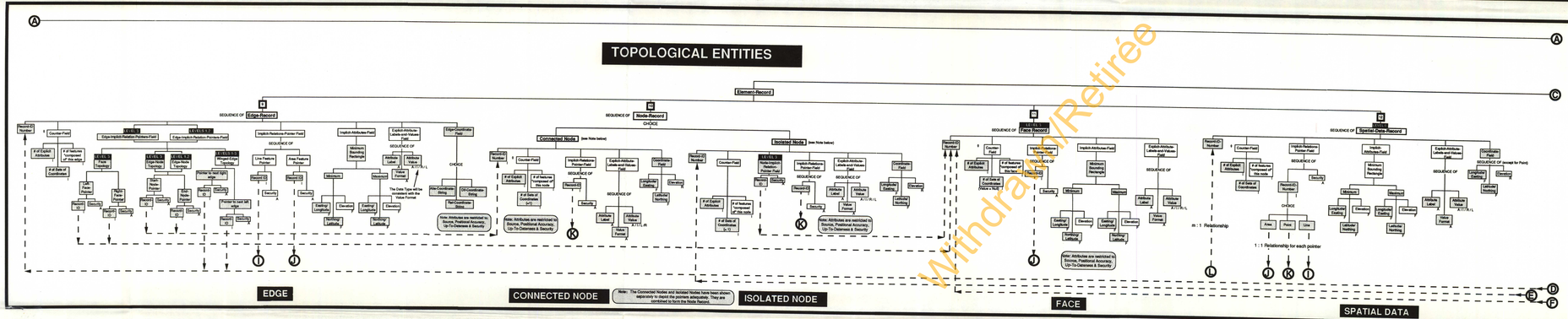
STRUCTURAL MAP OF DIGEST

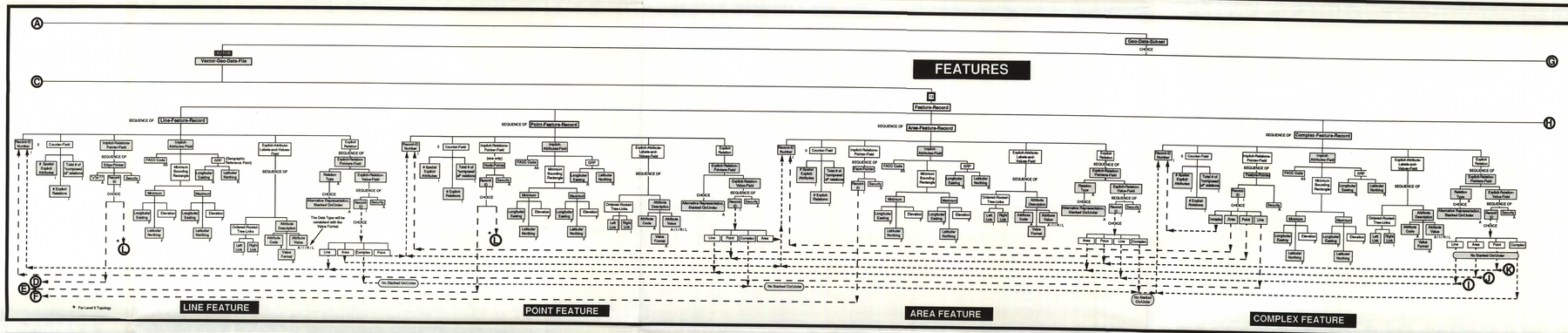
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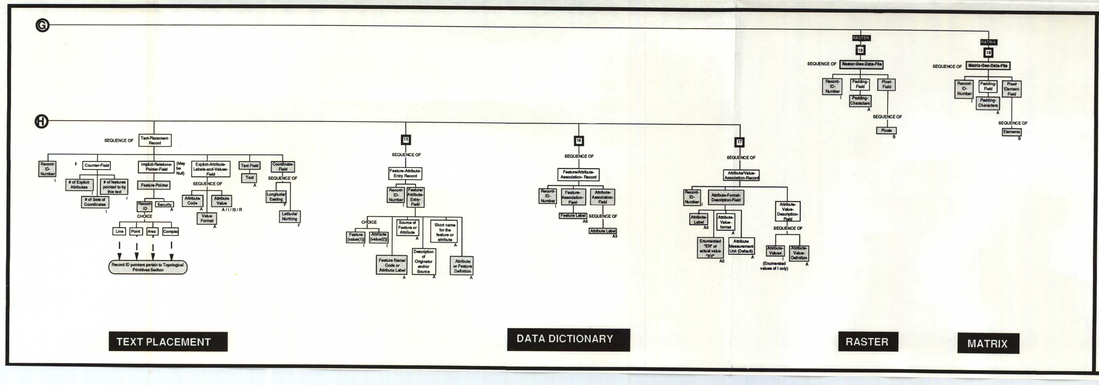
DIGEST is a product of the Digital Geographic Information Working Group (DGIWG).

Minor inconsistencies between the various encodings of DIGEST have been depicted in accordance with the ISO 8211 formulation

Compiled April 7, 1994







The
DIGITAL GEOGRAPHIC INFORMATION EXCHANGE STANDARD
(DIGEST)

Support Document:
Structural Map

Produced and issued under the direction of the Directorate of Geographic Operations, Department of National Defence, Canada on behalf of the Digital Geographic Information working Group.

Edition 1.2 January 1994

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CAN/CGSB-171.1-95

Supersedes 171-GP-1P

CGIS-SAIF Canadian Geomatics Interchange Standard — Spatial Archive and Interchange Format: Formal Definition

(Release 3.2)

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Ministry of Environment, Lands and Parks
British Columbia



National Standard of Canada

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NATIONAL STANDARD OF CANADA

CAN/CGSB-171.1-95

Supersedes 171-GP-1P
December 1992

CGIS-SAIF
CANADIAN GEOMATICS INTERCHANGE STANDARD — SPATIAL ARCHIVE AND INTERCHANGE FORMAT: FORMAL DEFINITION

(RELEASE 3.2)

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Prepared by the

Ministry of Environment, Lands and Parks
British Columbia

Reviewed by the

Canadian General Standards Board CGSB

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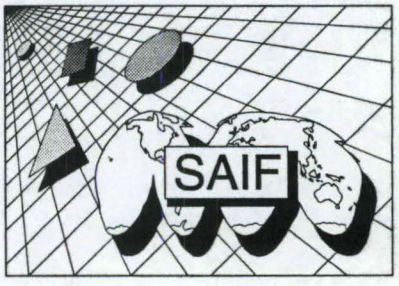
Reference Series
Volume 1

Spatial Archive and Interchange Format: Formal Definition

Release 3.2
January 1995

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Foreword

In 1991 the Spatial Archive and Interchange Format (SAIF, pronounced *safe*) was accepted as a draft standard for the exchange of geographic data by the Canadian General Standards Board, Committee on Geomatics. Since that time several upgrades have been made, culminating in the current document. SAIF has been approved (1993) through the CGSB process as a national standard in Canada.

The present document, Release 3.2, contains a number of significant changes made in response to two related efforts.

(i) The first involves the development of the ISO SQL Multimedia Spatial standard. A new release of SQL, SQL3, is being developed. SQL/MM will be a companion standard. The SQL/MM Spatial is a component of SQL/MM intended to address the management of spatial and spatiotemporal data in the context of database management systems.

(ii) The second effort concerns the development of the Open Geodata Interoperability Specification (OGIS) under the auspices of the Open GIS Foundation (OGF). The OGF has been designated (1994) by the U.S. Federal Geographic Data Committee as the lead organization responsible for defining an interoperability specification suitable for geoprocessing activities.

Harmonization of SAIF, SQL/MM Spatial and OGIS is leading to a common understanding of geomatics data. Integration with DIGEST and SDTS is also being addressed.

This document describes SAIF in four chapters.

Chapter 1: **Technical Overview**, including SAIF's design objectives, the major components of SAIF, and the notion of profiles.

Chapter 2: **Data Model**, consisting of the meta model, data model, modelling paradigm, and schema definitions.

Chapter 3: **SAIF Standard Schema**, consisting of the definitions of more than 300 data types based on the data model constructs.

Chapter 4: **SAIFtalk**, including: (i), a class syntax notation, serving as an object oriented data definition language, and allowing users to define their own classes as extensions to SAIF, and (ii), an object syntax notation, permitting the construction of ASCII representations of instances of objects.

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Companion documents in the reference series describe the SAIF dataset file format, SAIF profiles, and the SAIF Toolkit.

For further information about Release 3.2 and related materials, please contact:

SAIF Info,
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B.C. Ministry of Environment, Lands and Parks,
Fourth Floor, 1802 Douglas Street,
Victoria, BC CANADA V8T 4K6
Tel: (604) 387-1353
Fax: (604) 356-7831

or on the Internet at these URLs:

http://www.lii.crl.gov.bc.ca/saif/saifHome.html
http://www.wimsey.com/~infosafe/saif/saifHome.html
http://s2k-ftp.cs.berkeley.edu:8000/sequoia/schema

or send email to *infosafe@safe.com* to request a softcopy of the FAQ, which contains additional pointers to these documents.

Additionally, this document is published by the Canadian General Standards Board as a Canadian Geomatics Interchange Standard designated **CAN/CGSB-171.1-95**.

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Preface to the National Standard of Canada

This National Standard of Canada is Release 3.2, January 1995, of the Spatial Archive and Interchange Format (SAIF): Formal Definition developed within the British Columbia Government.

The CGSB Committee on Geomatics reviewed this standard, has approved it for Canadian use as a **Canadian Geomatics Interchange Standard**, CGIS-SAIF, and has agreed that it should be submitted to the Standards Council of Canada as a National Standard of Canada.

Throughout this standard, the expression CGIS-SAIF should be understood to replace SAIF wherever it appears.

It is expected that future releases of SAIF will also become National Standards of Canada, superseding this edition as the standard evolves.

The Committee on Geomatics acknowledges the work of the Surveys and Resource Mapping Branch, Ministry of the Environment, Lands and Parks, British Columbia, in the preparation of this document.

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Chapter 1

Technical Overview

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1.0 Technical Overview

1.1 High Level Design Objectives

The Spatial Archive and Interchange Format was developed as a means of sharing spatial and spatiotemporal data. SAIF's primary objectives are as follows:

1. it must be appropriate for modelling and moving data in general; that is, it should be able to deal with both spatiotemporal and traditional information,

2. it must handle virtually any kind of geographic data, including those: (i), with or without extensive attribute descriptions, and (ii), with geometry defined by vector or raster structures in two or three dimensions, (e.g., typical topographic, cadastral, and thematic data, but also, subsurface geologic data, climate data, hydrographic data, etc.),

3. it must address time such that temporal events and relationships can be handled (e.g., moving oil spills, vehicle navigation, general monitoring activities),

4. it must address data management requirements (such as support for updates, ability to integrate with multimedia data, applicability to both large and small data volumes, the ability to interface well with database queries, and compatibility with catalogue developments),

5. it must be suitable for effective operations in network environments, as well as appropriate for conventional file transfer on magnetic or optical media,

6. it must be easy to use and cost effective, and it must be easy to maintain and extend in response to users' needs and changing technology (without demanding major investments on the part of the data providers or data users),

7. it should harmonize with new SQL database developments and open GIS initiatives, as well as other geographic standards such as DIGEST and SDTS.

SAIF is designed to facilitate interoperability, particularly in the context of data exchange. It also represents an efficient means of archiving data in a vendor neutral format. An overriding consideration with SAIF is to be able to treat geographic data as simply another kind of data; that is, the roots of SAIF are in the information sciences.

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1.2 High Level Structure

SAIF follows a multiple inheritance, object oriented paradigm. It makes a very strong distinction between the way information is described and the way it is encoded. Three levels of description are recognized. At the most abstract level all information is defined as mathematical constructs, including abstract objects, lists, sets, enumerations, and primitives. Using these as building blocks SAIF introduces a number of spatial and temporal constructs. It then becomes possible to say that a real world phenomenon can be represented as a type of geographic object, existing in space and time and with various kinds of relationships to other geographic objects. SAIF standardizes such notions.

SAIF also provides the means of representing real world constructs, such as forest stands, environmental monitoring sites, ore bodies, a fleet of ambulances, etc. A user might state that a legal parcel is a type of geographic object with certain attributes, such as parcel identification number and owner, and with the restriction that the geometry must be represented as a polygon. A water usage license may include the name of the licensee, the quantity of water, the date, etc. Such definitions may be based directly on the mathematical constructs, on SAIF's generic spatial and temporal constructs, or on a combination of the two (Figure 1-1).

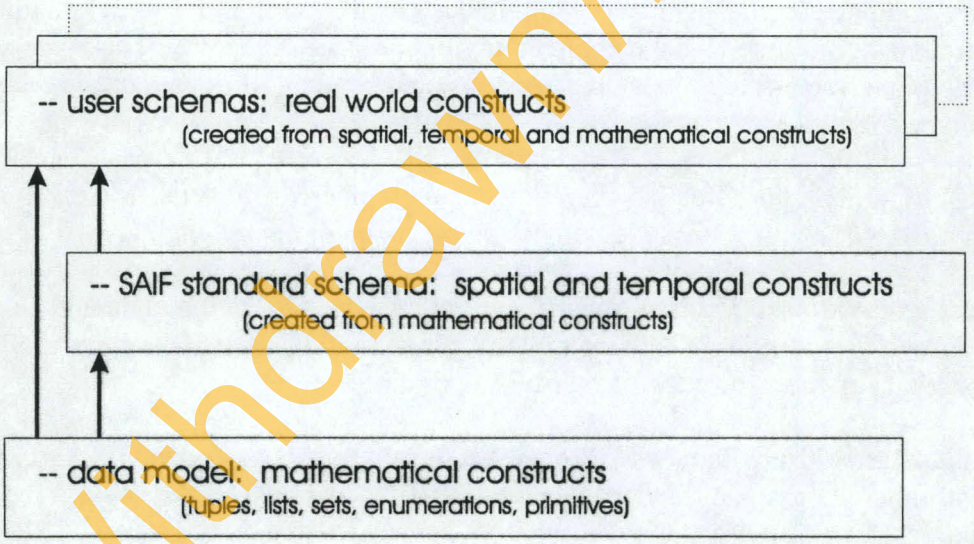


Figure 1-1 SAIF's Multi-layer Modelling Paradigm

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The generic spatial and temporal (including geographic) constructs in the middle layer constitute the bulk of the SAIF standard schema. Also in this schema are the structures needed to define additional types or classes. There is only one SAIF standard schema, consisting of more than 300 generic constructs.

Consider an agency involved in the production of topographic maps. It may wish to define notions of roads, streams, coastlines, place names, etc. pertinent to the data it has compiled. These constructs can be formally defined and considered as part of a topographic schema. An organization responsible for demographic data may establish a census schema consisting of the definition of census areas, provinces or states, etc. A researcher studying grizzly bear habitat may have another schema with the definitions of objects or features of importance to the study. The topographic schema, the census schema and the habitat schema are all defined through SAIF, but are not part of the SAIF standard. They may be considered as independent standards maintained by the responsible agencies or projects.

Using commercial object oriented CASE (computer aided systems engineering) tools, it is possible to describe constructs in both the SAIF standard schema and user schemas, using a graphics syntax. The graphical models shown in this book are based on the OMT approach (Rumbaugh, et al, 1991). It is summarized in Chapter 2. This graphical modelling technique may be considered as an extension to traditional entity - relationship diagrams.

In order to define constructs using a text based syntax, it was necessary to develop the Class Syntax Notation (CSN). The current version of SQL, ASN.1, and other mainstream languages could not be used since they lack the ability to represent complex structures (i.e., abstract data types). Object oriented languages such as Smalltalk were considered, but as programming languages, they were overly complex yet incomplete in the area of data management. CSN is written in ASCII and may be parsed by a computer program. (Ongoing efforts with the emerging ISO SQL/MM Spatial standard and the Open Geodata Interoperability Specification demonstrate the expression of SAIF constructs in other languages).

Specific instances of constructs, i.e. the actual data describing the objects of interest, may be encoded in either an ASCII or binary form. The ASCII form, known as Object Syntax Notation (OSN) is intended to be read directly by people (e.g. developers), as well as software. The grammar and syntax of CSN and OSN are compatible with one another, such that they may both be used in the same data stream or file. Together they may be considered a data definition language, termed SAIFtalk.

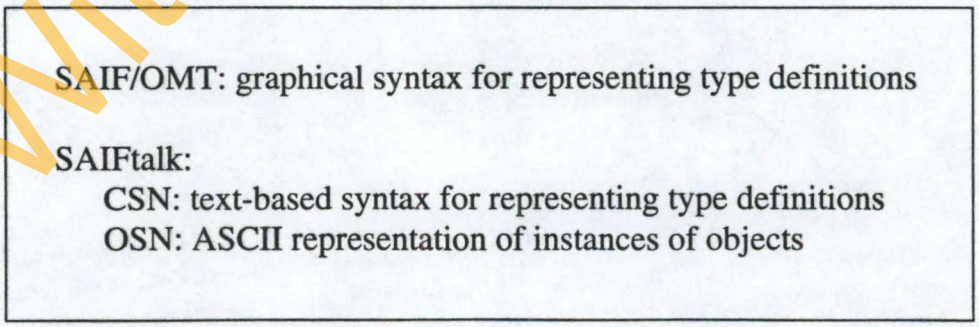


Figure 1-2 High Level Languages used by SAIF

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1.3 Defining Terms

In the world of traditional Geographic Information Systems people usually make a distinction between graphics data (which consists of polygons, arcs, points, displayed text, etc.) and attribute data (which consists of textual descriptions of the information). A typical GIS generally views spatial data as graphics with associated attributes. *A polygon has attributes such as species1, species2, etc.* With SAIF the separation between graphics and non-graphics is de-emphasized. SAIF introduces higher level structures which contain an arbitrary number of attributes; some of these attributes may describe space, time and topology, and still others traditional attributes. The italicized sentence above becomes the following. *A forest stand has several attributes, including species1, species2, and a position in space represented as a polygon.* Thus the term attribute is used regardless of the nature of the attribution.

With SAIF, the information is considered as a series of objects, each of which comes from a given type or class. South Moresby Island in British Columbia is an object representing an instance (i.e. an example) of the general notion of Park. The fact that South Moresby Island is an example of a park and not a resort or a restaurant is an inherent part of the data. We know it is a park without having to decipher it from the attributes and attribute values used to describe it. Thus the notion of an object is that of something which is directly meaningful to us: it is not necessary to look inside of it to decide what it is. The way we are likely to think about an object and the way it is characterized formally are semantically equivalent.

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Some Fundamental (Mathematical) Concepts

class: an abstract data type which describes a group of objects that share the same characteristics. A class defines a unique collection of attributes and methods which distinguish it from all other classes. A class does not store any data; it is merely a template from which objects are created.

object: a unit of data which may be treated as indivisible at a higher level of abstraction. It is an instance, i.e., a value, of a class. An object may have an explicitly provided object identifier.

Some Generic Spatial and Temporal Concepts

geographic object: an object representing a real world phenomenon which exists in a spatial or spatiotemporal domain. An object is considered a geographic object if its position in space, or in both space and time, forms an integral part of our understanding of the object.

spatial object: Consider a given geographic object defined as occupying a region in space. That region is represented by a spatial object. There are two aspects to a spatial object: geometry and spatial referencing. The geometry defines the object's shape and is expressed in terms of point, line, area and volume concepts. Coordinate values are provided as part of the geometry. The interpretation of the coordinates depends on the definition of the space in

which they reside. Spatial referencing provides that definition by stating the coordinate system and the horizontal and vertical reference systems.

spatiotemporal object: Next consider a given geographic object defined as occupying a region in both space and time. That region is represented by a spatiotemporal object. There are four aspects to a spatiotemporal domain: geometry, spatial referencing, time, and temporal referencing. Geometry and spatial referencing are as described above. Time values may indicate relative or absolute times or dates, as well as durations. Temporal referencing states whether the time values are based on Universal Coordinated Time (UTC), whether GPS timing applies, and the offset in hours and minutes from UTC.

annotation An annotation object is comprised entirely of text and/or symbols which may be spatially referenced. (Toponymy and swamp symbols are typical examples.)

South Moresby Island is a geographic object belonging to the class Park. More precisely we can say that it is a real world phenomenon represented as an object belonging to the class Park. The object may also be considered as a member of the class Island; that is, it may be an instance of several classes. The words "Pacific Ocean" on a map of the area comprise an annotation object.

1.4 Methods

The SAIF data model and the SAIF standard schema emphasize object structure. SAIF does not address explicitly the notion of methods or services, i.e., operations which can be performed on objects in a class, usually in response to some external message or request. Methods are considered as outside the purview of SAIF because of several reasons: (i) they are not required for data exchange, (ii) specification of the methods would be complex, (iii) those using SAIF, as a common data model for example, are free to add methods in the context of their programming language, database query language or interoperability specification. Nevertheless, a user may define a subclass because of behavioral or functional reasons.

Consider a method which determines whether an object is a member of a set, or another method which transforms the spatial data from one projection to another. A transmittal of data from one party to another should not be burdened with the overhead of moving these methods with the data. If a geographic information system is being built around SAIF, say in C++, the developer may have some very specific methods which he or she wishes to implement. This can be done as an extension to SAIF, but it would be of questionable value to transfer such methods with the data every time a data transfer occurs.

The ISO SQL/MM Spatial work is aimed at defining how spatial and spatiotemporal information will be addressed by databases. Expressed in SQL3, it borrows heavily from SAIF, but adds a number of functions to the type definitions. The Open Geodata Interoperability Specification (OGIS) is being designed to enable communications among geoprocessing applications. It includes a Virtual Geodata Model which is closely related to the "SAIF - ISOSQL/MM" Spatial

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model. Functions are an integral part of this work as well. Additionally, OGIS includes an Application Programming Model to specify a series of services which operate on the data.

1.5 Data Transfer

The modelling paradigm provided by SAIF is quite independent of the low level (binary) encoding scheme used to carry data in typical operations. A number of possible options exist which may be used for this purpose, including SAIF/ZIP (a very efficient technique based on compressed ASCII), another built on the eXternal Data Representation (XDR) specification, and still others based on other specifications. Typically all data relevant to the description of an object or a set of objects are encoded in the data stream or file. However, it is also possible to provide references to data held externally, in the same or different formats.

1.6 Structure and Semantics

SAIF supports the notion of object sharing. If for example an arc serves as part of the boundary of two polygons, it may be specified once and given an identifier value, and then referenced by the identifier when the polygons are defined. In this way the arc is shared by the two polygons. Other objects in SAIF may be shared in a similar fashion. By itself however, SAIF does not enforce sharing. The common arc need not be identified explicitly; instead, the values constituting the arc can be embedded directly in the data description for each polygon. Other major options related to data structuring and representation must also be considered. SAIF for example can represent forest cover in a polygonal form, or alternatively in a raster form. In the latter case, SAIF supports quadtree and run length encoding indexing schemes. Thus similar kinds of data could be placed in SAIF in quite different ways.

Similarly, features may be defined in ways which conflict semantically: one user may define lakes, bogs, fens, and swamps, while another user may define water bodies and wetlands, without any clear correspondence between the two sets of definitions. One user may include slope as an attribute, based on a given formula and transformed into a categorical value; another user may treat slope as a continuous value derived from another formula.

A decision to use SAIF will help identify the specific nature of such inconsistencies and facilitate their resolution. Additionally, procedures can be defined to ensure adherence to very strict ways of using SAIF, such as limiting the types of geometry which may be used.

If a central authority wishes to enforce a particular way of handling certain types of data, this may be done through the development of a schema, as described earlier. Two or more schemas may form a federated schema if the class definitions are harmonized so as to eliminate unwarranted or undesirable differences in meaning and structure. SAIF can be used effectively to help support the development of such federations.

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1.7 SAIF Profiles

As discussed above, SAIF provides a multitude of ways of depicting data. Where the intention is to share data, difficulties may arise due to different representations. Additionally, it is not expected that commercial database or GIS vendors will be able to handle the myriad of options available. The very richness of SAIF can lead to operational ineffectiveness if there is not some kind of agreement as to how SAIF is to be used.

To address this problem a distinction is made between a base standard and a functional standard. SAIF in all its entirety is considered a base standard. Various functional standards can be defined which provide strong guidelines as to just how SAIF may be employed. Each functional standard, termed a SAIF profile, is governed by a set of rules and restrictions.

For example, a SAIF profile may be established to handle spatial data where the geometry is represented by typical vector structures. It may recognize polygons, certain types of arcs, and certain types of points, but not any other geometric types. Particular types of coordinates and specific ways of handling time may be stated as allowed. As well, the profile may give limits on levels of recursion on objects defined as composites. Certain relationships may be identified as allowable. It could also specify a minimum set of metadata which must be completed. To aid processing, the order of objects in a data stream or file may be specified as part of the SAIF profile.

Through the development of SAIF profiles, data sharing among interested parties may be facilitated by agreement to use a common profile. Vendors may develop translators to work with certain profiles. Similarly, translation to and from other neutral formats such as SDTS or DIGEST will also be easier by using prescribed profiles. Detailed descriptions of SAIF profiles may be found in companion documents.

1.8 Significance of SAIF

When considering data modelling and exchange in the context of real projects, a number of issues are of interest.

1. Powerful Data Modeling: A chosen format must have a powerful data modeling capability which enables data to be modeled in a domain specific manner. Modeling of data in a domain specific manner requires that the data modeling format be extensible.

2. Architecture Portability: A chosen format must not be tied to any one computing or communications architecture. The format must enable data to be easily processed on many platforms (software and hardware).

3. Self Describing Data Format: Data is often kept for decades and may be used long after it has been collected. The original vendor products which processed the data may no

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longer exist. The data format should be open and self describing, with no dependence on any external files, secret data representations or vendor decoding software.

4. Vendor Neutral Format: The GIS and database tools being used in government and industry vary today and are likely to be diverse tomorrow as well. A vendor neutral format provides stability and ensures an open computing environment.

5. High Information Density: Given the expected data volumes, the data format must be quite compact, minimizing storage and transmission costs, while not degrading information content.

6. Software Support: A chosen format should have software tools such as API libraries and format validators available to assist the developer in creating systems for exchange and archival of spatial data.

The Spatial Archive and Interchange Format satisfies the above criteria. It is a Canadian national standard developed specifically to deal with these issues. A SAIF Toolkit has recently been released which greatly simplifies the creation and processing of SAIF datasets, providing significant help to developers writing translators, viewers or other specialized products.

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Chapter 2

Modelling Paradigm

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2.0 Modelling Paradigm

2.1 Meta Model

The information meta model of SAIF emphasizes the data structure of objects, expressed through an object oriented paradigm. Objects are considered as instances of types (classes) which follow a user extensible hierarchy. Three broad kinds of associations are recognized: (i), generalization (or generalization / specialization), dealing with supertype and subtype relationships; (ii), aggregation, concerned with objects as assemblies of components represented by other objects; and (iii), simple associations between objects.

Each object is unique and may be referenced through an object identifier. An object is characterized by the class to which it belongs, the values for any inherited attributes, and the values for any explicitly stated attributes. A class is defined through a given name, specification of one or more supertypes, and provision of zero or more attribute - domain pairs, where the domain provides the set of possible values for the attribute. SAIF does not address methods, messages, or behaviour. Conceptually, the meta model underlies both the data model and modelling techniques.

2.2 Data Model

In the literature, the term data model is used in different ways, sometimes in the context of type (i.e. class) definitions and sometimes in a more fundamental, lower level fashion. It is the latter notion which is used here. A data model is defined as a set of concepts and associated composition rules used to describe types and relationships among instances of these types. In a relational context, the basic data model consists of tables defined through records and attributes, following a number of rules. This is true regardless of the actual content of the tables and records. In an object oriented context the equivalent situation holds, but in this case we are dealing with abstract concepts of classes, objects, and the like and the associated rules are somewhat different. Note that the definition of a data model includes a series of composition rules. An integral part of the relational model holds that a record may have any number of attributes, but each attribute must be defined in terms of a primitive type (e.g., integers, reals, etc.). With an object oriented model this rule does not apply, but there are a number of other rules concerning inheritance, polymorphism, attribute domains and aggregation.

In Figure 2-1 the data model and its associated modelling techniques are without reference to any specific class of objects or discipline. As discussed in Chapter 1, the definition of a class usually pertains to a given field of expertise, to a project, or to the data holdings of a given organization. A number of these definitions are contained within a schema. A schema about topography might contain the class definitions of road, stream, coastline, elevation Point, etc. The definition of a new class may make use of other class definitions, so long as the data modelling rules are followed.

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The SAIF data model follows a multiple inheritance, object oriented design. This chapter provides definitions for the basic components of the data model and discusses the general approach to modelling provided by SAIF.

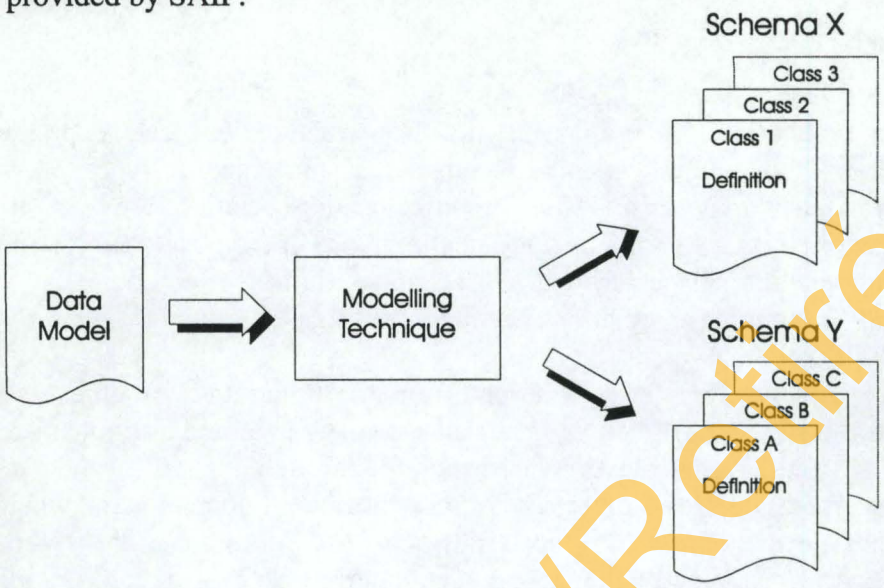


Figure 2-1 Data Model, Class Definitions and Schemas

2.2.1 Terminology

The data model recognizes four broad types: abstract objects, collections, enumerations, and primitives. Background terms and the types in the SAIF data model hierarchy are defined below.

data model: a set of concepts and associated composition rules used to describe types, including classes, and relationships among the instances of these types.

type: a general term referring to any particular kind of object, collection, enumeration or primitive. All classes are considered to be types. A type does not store any data; it is merely a template from which data values (or objects) are created.

class: an abstract data type which describes a group of objects that share the same characteristics. A class defines a unique collection of attributes and functions which distinguish it from all other classes. *Spot* and *Rover* may be objects belonging to the class *Dog*. The association between a class and its attributes is sometimes referred to as an aggregation (or HAS-A or CONTAINS) association.

superclass: a class which maintains a central concept, attributes and methods common to a number of other classes, referred to as subclasses (see below). *Dog* may be defined as the superclass of *Saint Bernard* and *Dalmatian*. If direct instances of a class are not permitted, i.e., all instances belong to a subclass, then the class is considered an **abstract superclass**.

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Because SAIF is based on a multiple inheritance model, every subclass has one or more superclasses, with one being the most common. A superclass is sometimes referred to as a parent class or a generalization of its subclasses.

subclass: a specialization of a superclass, typically defining additional attributes or methods, or a narrower central concept. *Saint Bernard* and *Dalmatian* are subclasses of *Dog*. A subclass inherits all attributes and methods of its superclasses. The association between a subclass and its superclasses is sometimes referred to as an IS-A (or an IS-A-KIND-OF or IS-A-TYPE-OF) relationship[1].

data value: an instance (i.e. a value) of a type, where the type is either a SAIF type as defined in the SAIF data model or standard schema, or a user-defined type.

object: an instance, i.e. a value, of a class. The class is either from the SAIF standard schema or from a user defined schema. Note that objects often relate to real-world entities; however, they may also pertain to more abstract concepts (such as a mapping projection). Objects may be considered as fundamental modelling primitives. They may be characterized by behaviour (the set of operations which can be performed on them) and by state (the values for the attributes defining the objects). The term object is used in SAIF to refer specifically to instances of AbstractObject. Any object may have an object identifier.

object identifier: a unique, immutable value associated with each object, and expressed in SAIF as either a character string or an integer. Other terms for object identifier are *oid* and *objectIdentifier*. If a value for an object identifier is given, it becomes possible to reference the object elsewhere in the data steam or file by using the specified value. Thus a given object may be defined once and referenced or shared by other objects many times. It is also possible that a reference may be given to an object which provides relevant information about data that does not exist in the data stream or file. That is, an object identifier may be given in the definition of another object, without the data to which the referenced object pertains being present in the data stream or file. In these cases, information about the external reference must be given. (See the discussion under ExternalReference in Chapter 3.)

AbstractObject: the base class from which all other classes are derived. All objects are instances of a class whose base type is AbstractObject. AbstractObject ensures that every object (i.e. every instance) may have an object identifier, which must be unique within the

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1 For convenience, the terms superclass and subclass are used in type definitions even if the type is not a class. Thus, in the PrimaryColor example described under Enumeration, PrimaryColor is a subclass of Enumeration, and Enumeration is the superclass of PrimaryColor. Similar relationships hold with the primitive types as well. In general discussion the terms *supertype* (or *parent type*) and *subtype* are used interchangeably for superclass and subclass, respectively.

transfer. More specifically, the AbstractObject class has an optional attribute, *objectIdentifier,* from the domain Primitive, which may take either a string or integer value.

Collection: A type consisting of a logically related group of data values. Collection may not be instantiated directly. It can only be instantiated through lists or sets (see below).

List: A type of collection in which the values have a specific order. The values are not necessarily unique.

Set: A type of collection in which the values are unordered and unique.

Relation: A type of Set in which the values are all direct instances of the same type of abstract object, and in which the abstract object attributes all have primitive domains.

Enumeration: an ordered collection of named values which permits the user to refer to values by their common (everyday) names, without the need to map them onto the data types of a particular programming language or database. An enumeration describes all possible values which may be assigned to the attribute in question. PrimaryColor may be defined as an enumeration consisting of the values *red, green,* and *blue.* The named values of an enumeration are sometimes referred to as enumerates.

Primitive: a simple data type. Primitives are the basic building blocks of data values. Included in the concept of primitives are strings, octetStrings, bitStrings, boolean, integers, and reals. Integers and reals are both considered as types of *numeric* data. Instances of integers may be categorized as *Integer8, Integer8Unsigned, Integer16, Integer16Unsigned, Integer32, Integer32Unsigned, Integer64,* or *Integer64Unsigned.* Instances of reals may be categorized as *Real32, Real 64,* or *Real80.*

nil: nil signifies the absence of a data value, regardless of whether the domain for the value is simple or complex. An object may leave the value for an optional attribute unspecified; i.e, the value is considered to be nil. Similarly, in the definition of a subclass, an attribute defined as optional in the superclass may be restricted in the subclass to be nil, i.e., as not to be used.

notNil: notNil signifies in a subclass definition that an attribute defined as optional in a superclass is not considered as optional in the subclass, i.e., a value must be provided.

attribute: a characteristic ascribed to an object; an attribute takes a value from a stated domain. Attributes and their associated domains are designated in the definition of a class. In the class definition it is indicated for each attribute whether provision of a value for a given object is considered as optional or mandatory.

class attribute: an attribute whose value pertains to all objects within a class; consequently, the value as well as the attribute is considered as part of the class definition. For any class which

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may be instantiated directly, specific class attributes values must exist. However, because their values are part of the class definition, they are not carried in a transfer for each object.

domain: the set of all possible values for an attribute. This may be addressed in a one of three ways.

- Typically, a domain is indicated by a type.

- Alternatively, a domain may be defined as a finite set of allowable values from a given primitive type. For example, say an attribute provides the units of currency of a product's price and its domain is defined as a character string. A subclass of the class containing the attribute may limit the possible values to "AmericanDollars", "CanadianDollars", or "JapaneseYen". These value together represent a domain for the attribute, as used in the subclass. This use of domain is similar to an enumeration; it is required in situations where the domain has already been specified in a superclass and it is desired to provide limitations in a subclass (without using a restricted clause). SAIF provides a special Domain construct to define domains in this fashion.

- SAIF also provides a number of types of restricted clauses which allow a user to specify a single value or type, a set of values or types, or a range of values. (This case includes the capabilities handled in the second case above; however, sometimes it is more convenient to use the above approach.)

schema: a collection of logically related type definitions. The definitions of the subclasses and enumerations described in the next section of this document together constitute the SAIF standard schema. The definitions corresponding to the features in the *National Topographic Database, 1:50 000* dataset serve as another schema. That is, the definitions of Tower, Pipeline, Road, etc. (and any associated type definitions such as the enumeration TowerFunctionType) together define that schema. (See the examples in the section of this chapter entitled "Modelling with SAIF.") Such schemas, including the SAIF standard schema, are not directly part of the data model. Instead, they are considered as extensions to the model, constructed to convey meaning about certain types of objects.

virtual inheritance: if the identical attribute is inherited more than once because of two or more superclasses having a common ancestor where the attribute is first defined, then only one copy of the attribute is recognized. The SAIF data model always assumes virtual inheritance.

2.2.2 Associations

2.2.2.1 Generalization

Generalization (and specialization) associations are reflected through the type inheritance or IS-A hierarchy of the SAIF data model is shown in Figure 2.2. Four basic types are defined: AbstractObject, Enumeration, Collection and Primitive. These four types are considered as four

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subclasses of an all encompassing type (Type) to which all values belong. All generalization and specialization of types is based on an understanding of these four base subclasses.

A value of Primitive may be of type Boolean, String, OctetString, BitString, or some kind of Numeric. Under Boolean are the values *true* and *false*. String includes all possible character strings. The characters may be from the ASCII, Unicode, or an international character set (with an ISO designation). OctetString is the domain for sequences of octets, where an octet is defined as an eight bit value. An octet may be considered as a machine independent notion of a typical byte. BitString is the domain for sequences of bits; it is of interest principally where none of the other primitive types are considered appropriate. A bit string may be applicable where the individual bits are meaningful, where the data is composed of bit sequences other than octets, or where a volume of data may be considered as opaque, that is, as simply an arbitrary number of bits. Integer and Real exist under Numeric. Though not shown on Figure 2-2, there are a number of different types of Integer and Real, as described in the definition of Primitive in the previous section.

Although the idea of an enumeration is closely tied to that of primitives, SAIF defines Enumeration as an independent type. Actual enumerations may be derived, i.e., subtyped from Enumeration. Note that all enumerations must be defined directly from Enumeration; that is, an enumeration cannot be a subtype of another enumeration. Enumeration is included in the SAIF data model, but all subtypes from it are considered as outside of the basic data model.

Collection and its subtypes handle collections of objects which may be required as the domain of certain attributes. Typically a collection is instantiated directly as a list or a set, both of which are considered as types of Collection. If certain conditions are met, a set may be a relation. No other types of collections exist and no subclassing from them is permitted. A collection may contain a single value or more typically many values. If the collection is empty, then the attribute using the collection as its value is considered to be nil.

The fourth basic type in the data model is the AbstractObject, the root class for all other single object classes. The SAIF data model does not include any particular subclasses of AbstractObject, but does include the concept of subclassing from AbstractObject, or from previously defined subclasses of AbstractObject.

In Figure 2.2 nil is not shown. Nevertheless, the concept of nil or null is an inherent part of the data model. For a given object, a value of nil for an attribute simply indicates *unspecified.* Conceptually then, nil may be considered to be a valid value for any attribute which does not have to be specified, regardless of whether the attribute's domain is a type of Primitive, Enumeration, AbstractObject or Collection.

The data model serves as the foundation for developing additional classes and enumerations. All classes supplied through the SAIF standard schema or user defined schemas are subclasses of abstract object either directly or through their lineage (e.g., a subclass of a subclass of AbstractObject). Included in such schemas may be a number of enumerations, each of which is derived from Enumeration. Thus, the inclusion of types from one or more schemas can be

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represented as extensions to the IS-A hierarchy under AbstractObject and Enumeration. Note that Collection and Primitive cannot be subclassed by the user and may only be used as attribute domains.

The SAIF data model follows a multiple inheritance scheme: every type has one or more parent type, with the exception of the base type (Type) which has no parent type. Most of the SAIF standard schema is based on single inheritance. User defined schemas may contain subclasses with multiple inheritance, however, it is recommended that multiple inheritance be used sparingly.

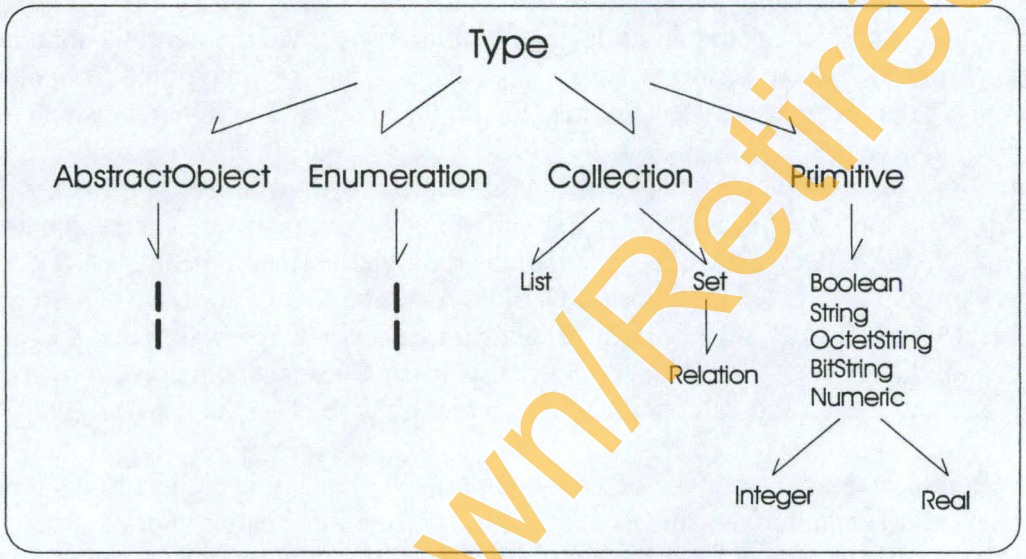


Figure 2-2 SAIF Type Inheritance Model

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2.2.2.2 Aggregation

Another kind of hierarchy may also be described, based on the attributes of objects. If a given object has or contains other objects, these other objects are considered to be aggregated into the primary object. In other words, an object may be considered an assembly with components defined by other objects.

Consider a house. A kitchen may be considered as an attribute of a house, or more simply, a house has a kitchen. In turn the kitchen has a sink, which has a faucet and a basin. The basin has a colour and a composition. It follows that a house has a sink, and because it does, it also has a faucet, etc. Component objects must be understood in the context of the object which directly contains them. The colour in the example pertains directly to the basin only; clearly it has nothing to do with the colour of the house.

This is a notion of hierarchy dealing with component parts or aggregation. It is independent of class inheritance. Such containment hierarchies pertain to objects only, not to classes. As with the previous example, aggregation associations between objects are transitive and asymmetric; additionally, the primary object and the component objects are typically semantically similar or consistent with respect to one another.

2.2.2.3 Simple Association

Objects may be related to one another without necessarily assuming that one is a component part of the other. For example, houses may be located on the right side or left side of a street. The street in question is not considered an intrinsic part of the house, and the house is not considered an intrinsic part of the street. Additionally, we might expect queries to be posed from either direction. On what street is the house located? What houses are located along the street?

In such situations the notion of aggregation as described above may be inappropriate. An alternative is to define a simple association explicitly, and reference the objects which are included in it. SAIF implements simple associations through the Relationship class and its subclasses. Consider the spatial relationship OnSide. As part of the definition of OnSide, two objects, objectA and objectB, may be defined as attributes, with the provision that they are referenced using their object identifiers. An instantiation of OnSide would contain the two object identifiers, and perhaps a third value indicating whether objectB is on the left or right of objectA.

It is a modelling decision whether an aggregation approach or a simple association is most appropriate. With aggregation, an attribute is used to hold the information. For example, as part of the definition of an arc (i.e. a line), the list of points defining the line can be specified for an attribute of the arc called *pointList*. The points are considered as an intrinsic part of our understanding of the arc, and it is assumed that the association is principally one way. That is, queries or operations are assumed to be from the perspective of the arc.

With explicit relationships the objects are typically considered of equal semantic importance, and it is assumed that queries or operations may be of interest from both directions. This is true whether the relationship is symmetric or asymmetric. Consider the following two cases. (1) If objectA is adjacent to objectB, then objectB is adjacent to objectA. (2) If objectA contains objectB, then objectB is contained by objectA. These relationships are symmetric and asymmetric, respectively. In both cases the relationship need be instantiated only once. In the latter case the order of the objects in the relationship is important.

The cardinality (or multiplicity) of the relationship may be of interest. Cardinality is a characteristic of the relationship in the context of the data under consideration. A number of houses may be on a given street. A given house is located on either one street or two (if it is on a corner of a block). Such cardinality information can be provided in the definition of the relationship type (or class). Consequently, it is considered a *class attribute* (see Section 2.2.1 and 2.2.3.1).

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2.2.3 Constructing New Types

Extending SAIF involves the definition of new types. Type definitions provide a means of modelling phenomena and ultimately of providing data in a meaningful way. A number of users can describe their data holdings in a highly consistent fashion through SAIF, easing the semantic problems associated with information sharing. New types may relate directly to spatial or temporal phenomena, or they may deal with other ideas altogether.

Type definitions may be formally expressed in SAIF using graphical techniques such as SAIF/OMT, the text based Class Syntax Notation (CSN), or both. Additionally, the interrelationships between classes and between objects are handled directly through the definitions. Later in this chapter a series of examples will be reviewed covering both graphical and CSN approaches.

The subsections below describes first the constituent parts of a class definition, then those of an enumeration definition, and finally those of a special domain construction. The discussion applies both to the formulation of the SAIF standard schema and user defined schemas.

2.2.3.1 Class Definitions

A set of objects belong to a class if their behaviour or function is similar and if they can be described in a like fashion. The class may be viewed as a subclass, that is, a more specialized version of another class called the superclass; conversely, the superclass is a more generalized version of the subclass. Each class has a name descriptive of the objects which are members of it. Objects in the class are typically characterized by certain attributes which are explicitly stated in the definition of the class (or a superclass). Certain restrictions and constraints may also apply to these objects.

The following items may be contained within a class definition. The first two must always be provided and the remainder are optional.

1 superclass
The name of the superclass from which the class is derived must be provided. That is, the class being defined is a subclass of the superclass. As discussed previously, this relationship is central to the type inheritance hierarchy in SAIF. If the superclass is not from the SAIF data model (i.e., AbstractObject or Enumeration) or the SAIF standard schema, the name of the schema of which the superclass is a part must also be specified.

2 class name
Next to be stated is the name of the class which is currently being defined, including the name of the schema to which it belongs. (If the class is part of the SAIF standard schema, the schema name is not provided.) User defined schema names should be approved by a central authority, if the classes defined in the schema are of interest to a wide audience. It is recommended that each class name be connotative and readily understandable. For

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example, if defining a class to handle towers from the Canadian National Topographic Database, the name of the class should be Tower and not a numeric code.

3 tag

Tags are not used in the encoding scheme recommended by this release of the SAIF formal definition. It remains in the specification for use by encoding schemes which require unique numeric type identification. A tag is an integer value which distinguishes one type from another in a transfer. References to a type in a binary encoding are through the tag value, and not through the name of the type. When tags are required, they must be explicitly provided in the definition of each user defined class. The user may consider his or her types as of general interest, in which case a central authority should authorize the tags, ensuring that they are unique across all recognized schemas.

4 subclassing

In the SAIF standard schema only certain classes may be used as the superclass of a new subclass defined by the user. These cases are clearly identified in Chapter 3. Any classes defined in other schemas may be used as superclasses, unless stated otherwise.

5 attributes

Attributes characterizing objects in the class are listed. The fact that attributes in the class may themselves have attributes is the basis of the object containment hierarchies reviewed earlier. With each attribute is an indication of whether provision of a data value is considered as optional or mandatory. If an attribute is considered as mandatory, a (non-nil) value must be specified in the encoding for each object belonging to the class. A domain is also provided for each attribute. The domain may be a type of primitive, a class or an enumeration, or a collection of one of these. From zero to n attributes may be specified. In addition to those attributes defined in the class definition, attributes may be inherited from the superclass. The order of the attributes in the class definition is up to the user; however, once the class is defined, the order is fixed in terms of the binary encoding of objects belonging to the class. (Inherited attributes precede explicitly given attributes. Of the inherited attributes those from the first or left most parent come before those from the second parent, etc.)

6 class attributes

Any class attributes, including their respective domains, are stated next. Where every object in a class has the same value for an attribute, and that value is considered an inherent part of the class definition, then that attribute should be considered a class attribute, distinct from a typical (object) attribute as described above. Alternatively, a class attribute may simply refer to the class as a whole and not specifically to instances of the class; this would be the case with class attributes expressing the cardinality of a relationship. Zero to n class attributes may be defined explicitly in the class definition or inherited from the superclass. The domain for a class attribute is always a type of primitive or enumeration. Values for class attributes may be specified either as a class attribute default or a class attribute value, as described below. As an integral part of a

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class definition, values for class attributes are not specified in the encoding of objects in a transfer.

7 defaults

Default values applicable to the (object) attributes may be provided. If an attribute is defined as optional and a default is given in the class definition, leaving it unspecified in the transfer implies to the receiver of the data that the default value applies. By providing a default, an unspecified value will never be interpreted as nil (i.e., null); consequently, if it is desired that nil be considered a legitimate value for the attribute, do not provide a default. That is, with an attribute as optional and no default given, the receiver will interpret an unspecified value as nil. If an attribute is mandatory, a value must be specified and a default should not be provided. A default supplied in a superclass may be overridden by a default provided in a subclass.

8 restricted

Domain restrictions may apply to the (object) attributes. It may be of interest to limit the domain of an attribute further than the domain statement provided with the attribute. The restriction may involve primitive values. For example, pH may be defined as an attribute with the domain Real; a restricted clause may specify that the values for pH are limited to the range between 0.0 and 14.0. Alternatively, a restriction may be based on more complex domains. An object's geometry may be restricted to come from either Point or Polygon. The restricted clause in SAIF follows a formal syntax which allows it to be parsed by computer programs, designed to aid quality and consistency checking for example. The syntax is described in detail in Chapter 4. Information provided in a restricted clause in a superclass may be refined or narrowed in a restricted clause in a subclass, but it cannot be contradicted. If the geometry in a superclass is restricted to come from Point or Polygon, in a subclass it may be further restricted to come from Polygon.

9 constraints

Constraints related to the (object) attributes may be supplied. A user may wish to provide a series of restrictions which are too complicated or inappropriate for expression in a restricted clause. It may involve a series of if-then-else statements or comparisons with other objects. It may involve limitations associated with data capture; e.g., only landslides longer than 200 metres are included in the data. For cases such as these, a constraints clause may be specified. The constraints clause is much more flexible than a restricted clause, but it is expressed as natural language text, not in a formal syntax. Like the restricted clause, information in a constraints clause in a superclass should be honoured within subclasses.

10 class attribute defaults

Default values may apply to one or more of the class attributes. A default value may be overridden in a subclass. A default value for a class attribute is referred to as a class attribute default. A class attribute default always assigns to the class attribute a single value from a primitive type or a description from an enumeration.

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11 class attribute values
A value for a class attribute which is not a default, is simply referred to as a class attribute value. Values for the class attributes must be given as class attribute values, if they have not already been addressed as class attribute defaults. Typically, a class attribute value is specified as a single value from a primitive type or a description from an enumeration. In the case of the definition of an abstract superclass, the value may be defined, as well, as a set of values, or a range of primitives, or simply as a primitive type. In any of these cases, any subclass which may be instantiated directly must have for each class attribute a single value from this range or set, defined in its class definition or inherited from a superclass.

12 comments
Comments may provide a common language definition of the class, the attributes, or other pertinent information. The comments may be short or long, and may include diagrams.

2.2.3.2 Enumeration Definitions

The structure of an enumeration is much simpler: five components are included, with the tag and comment component being optional.

1

2 enumeration name
Next comes the name of the enumeration which is currently being defined, including the name of the schema to which it belongs. (If the enumeration is part of the SAIF standard schema, the schema name is not provided.) As with class names, enumeration names should be meaningful.

3 tag
The recommended SAIF encoding scheme does not make use of tags. This optional component has been included for encoding schemes which require that each type have a unique tag, as discussed earlier.

4 values
The n enumerates contained within the enumeration are listed. Each of these consists of a one word textual description followed by a numeric value. The default numeric values are 0 through n-1. In the typical situation, where the user has no interest in the numeric values, they are not provided, and it is assumed that the defaults apply. For example, PrimaryColor consists of: blue green red. If the user wants certain integer values associated with the descriptions, these may be provided in parentheses following each description. PrimaryColor might be defined as blue (2) green (5) red (7). This may be of interest if it is desired to match some pre-existing numbering system.

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5 comments
Comments concerning the particular meanings of the values in the description may be provided, as well as any other relevant remarks.

2.2.3.3 Domain Definitions

Provision of a domain for an attribute can be handled entirely through attribute - domain statements, defaults, and restricted clauses. Sometimes however, it is convenient to treat a character string domain as if it were an enumeration. For example assume a class definition includes as an attribute the name of a test carried out on some data. Also assume that the domain of the name attribute has been declared as string. In the definition of a subclass of that class, it may be of interest to restrict the possible values carried in the string to the names of the tests which might actually be run against the data. This can be done with a restricted clause, as previously described. Alternatively, a domain statement may be used which is analogous to an enumeration.

1 Supertype
The supertype (i.e., superclass) is always Domain. Since Domain is part of the SAIF standard, the associated schema name is not specified.

2 domain name
The name of the domain which is currently being defined is specified, including the name of the schema to which it belongs. The domain name should be meaningful, as with the names of classes and enumerations.

3 tag
The recommended SAIF encoding scheme does not make use of tags. This optional component has been included for encoding schemes which require that each type have a unique tag, as discussed earlier.

4 base type
The type of primitive included in the domain statement must be stated. This is usually string, but any kind of numeric may also be given.

5 values
The allowable values contained within the domain are listed. Test names for example may be given as: *"closureTest" "directionTest" "referenceTest"*. If the base type were numeric, allowable values might be: *1 2 4 6.*

6 comments
Comments concerning the domain and the particular meanings of the values may be provided.

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2.3 SAIF/OMT Graphical Syntax

Both graphical and text based modelling approaches are practical with SAIF. Because SAIF incorporates mainstream object oriented concepts, several commercial CASE (computer aided systems engineering) or CASE-like tools are appropriate. Graphical modelling with SAIF is based on the the Object Modelling Tool (OMT) methodology as described below.

In Figure 2-3 each box represents a distinct class.

The text element in the top half of each box is the class name. The addition of {abstract} indicates an abstract superclass. (If an instance of a class must also be an instance of a subclass of that class, then the class is considered an abstract superclass.) The addition of {enum} indicates that the class is a type of Enumeration (e.g. PrimaryColor may be defined with values of red, green, blue).

A tilde (~) following the class name indicates that a more complete diagrammatic description of the class can be found elsewhere.

The text elements in the bottom half of the box may be either: (1) the names of attributes with primitive domains (e.g. age comes from the domain integer) for a given class, or (2) the values (red, green, blue) separated by spaces in the case of types of enumerations.

Lines connecting boxes indicate associations.

An open triangle represents a generalization in the direction of the triangle (e.g., Class 1 is a supertype of Class2) or a specialization (e.g., Class 2 IS-A *or* is a subtype of Class 1) in the opposite direction.

An open diamond represents a containment (HAS-A) or aggregation association. The class that is connected directly to the diamond 'contains' zero to n instances of the class at the opposite end of the connector.

- An open circle at the end of the connector denotes 'zero or one'.
- A closed circle indicates 'zero or more'.
- A integer (n) followed by a + indicates 'n or more'.
- An integer (n) indicates exactly 'n'.
- No symbol at the end of the connector indicates exactly 'one'.
- An 'i' immediately after the diamond indicates an inherited attribute.

A line without a diamond or a triangle represents a relationship between two objects.

In the example, Class 2 is an instantiable subclass of the abstract superclass Class 1 and inherits the Class 1 attribute. An instance of Class 1 is related to zero or more instances of Class 7 while

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an instance of Class 7 is related to one instance of Class 1. Class 2 'contains' one instance of the Class 3 (an enumeration), one or more instances of Class 4 (an inherited attribute), zero or one instance of Class 5 and zero or more instances of Class 6.

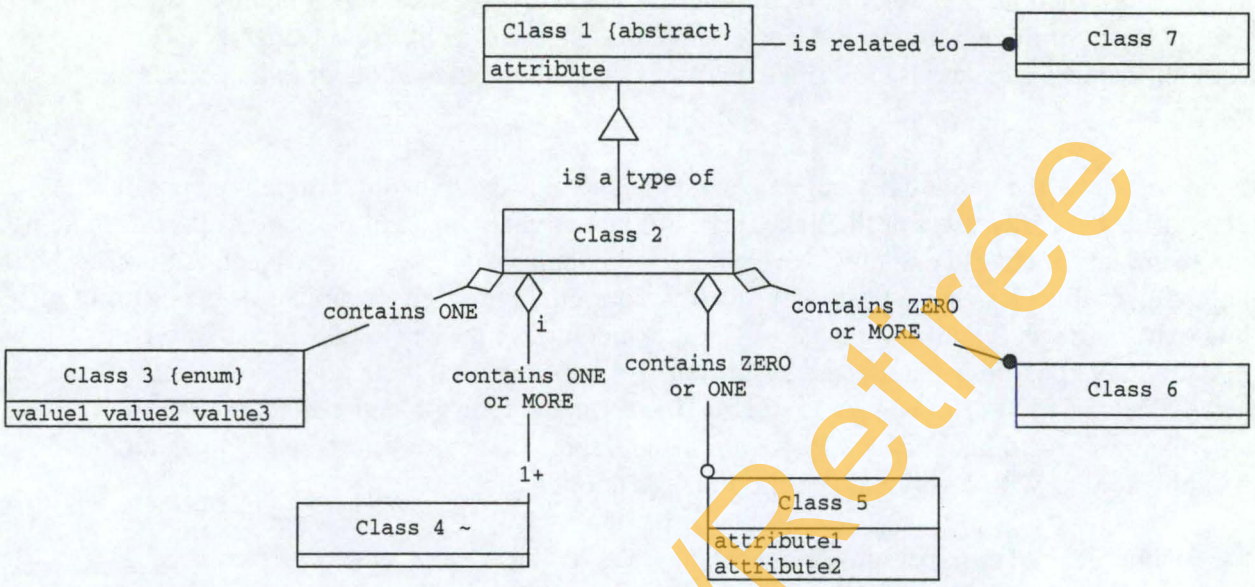


Figure 2-3 General example of a graphical model

2.4 High level constructs in the SAIF standard schema

At the highest level, SAIF distinguishes between representations of real world phenomena and representations of the space and time in which (during which) they exist. Representations of real world phenomena are referred to as geographic objects. Roads, forest stands, geological strata, oil spills, and temperature readings are examples. Such objects may have various relationships to one another, including spatial and temporal relationships. Two streets intersect. An oil spill occurred during a storm.

The position of each phenomenon in space is represented by a spatial object. If both space and time are considered, the position of the phenomenon is represented by a spatiotemporal object. Thus, if a particular type of geographic object is considered as spatial in nature, it will have a corresponding spatial object. If it is considered as spatiotemporal in nature, it will have a corresponding spatiotemporal object.

SAIF provides a large number of spatial and spatiotemporal constructs, many of which may be subclassed by users to define new classes of direct utility to them. Detailed, more technical textual and graphic descriptions of the classes below may be found in Chapter 3.

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2.4.1 GeographicObject

An object belonging to the class GeographicObject represents some part of the real world. It has an actual or potential position in space and time, which is represented by a member of SpatialObject or SpatiotemporalObject. Users can subclass directly from GeographicObject or from its standard subclasses, described below. Four general cases of geographic objects are recognized.

In the first case, the geographic object corresponds to a discrete feature or phenomenon in the real world. Typically users defines subclasses of GeographicObject of particular interest to them. For example, MountainPeak may be specified as a subclass of GeographicObject. An object belonging to this class has a position probably represented through a spatial object as a point on the earth's surface. Another subclass of GeographicObject may be Road. Objects of type Road probably have positions manifested as lines or perhaps long, thin rectangles. Roads, mountain peaks, fleets of trucks, forest stands and the like are geographic objects corresponding to concrete, real world phenomena. However, a geographic object may correspond to an artificial phenomenon, as with a political jurisdiction or school district.

The second general case pertains to spatial data sets, collections of spatially referenced data which are grouped together for reasons of convenience. The third general case of geographic objects refers to coverages, that is, descriptions of regions of space which may not necessarily correspond to distinct features. Coverages are described below. The fourth case concerns graphs, including networks; graphs consist of a series of geographic objects which are connected to other geographic objects. They are also described below.

2.4.1.1 SpatialDataSet

Members of the class SpatialDataSet each contain a series of geographic objects. All such objects are considered to belong to the same data set, generally because of similarities in metadata or referencing. For example, typically the same spatial referencing would pertain to all geographic objects in a spatial data set.

SpatialDataSet is a subclass of GeographicObject. An object belonging to this class contains other geographic objects and, consequently, a given spatial dataset may contain other spatial datasets. For example, a watershed may be defined as a spatial dataset, containing subbasins. Each subbasin could be a spatial dataset composite consisting of ecosystem zones. As with the previously reviewed classes, a user is expected to define meaningful subclasses of SpatialDataSet where appropriate. Thus, a user may specify Watershed and Subbasin as subclasses of SpatialDataSet, and EcosystemZone as a subclass of GeographicObject.

Through inheritance, an object belonging to any subclass of SpatialDataSet may include an object from the class SpatialObject. Because a spatial object incorporates both geometry and spatial referencing, the spatial referencing for the area of interest may differ from the various objects contained in the data set. For example, in some jurisdictions a series of mapsheets are based on latitude and longitude values, even though the data described on each sheet is specified

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using the Universal Transverse Mercator grid system. A spatial dataset typically pertains to a collection of geographic objects which define some survey project or which represent a complete description of some general region of space. Cataloguing or high level repository descriptions (outside the scope of SAIF) may reference available spatial datasets.

Note that SpatialDataSet groups GeographicObjects only. Annotation is not a type of GeographicObject, and therefore cannot be aggregated with geographic objects within a SpatialDataSet container. To accomplish this, SAIF defines a subclass of SpatialDataSet named AnnotatedSpatialDataSet.

The class AnnotatedSpatialDataSet allows for the collection and inclusion of textual objects into a spatial dataset. An annotated spatial dataset is distinguished from a spatial dataset because of semantics, and possibly externally available services. The annotated spatial dataset may contain text and/or symbol information alone, however, more typically it will contain text and/or symbols as well as related geographic objects. For example, a toponymic place name required to cartographically annotate a river might simply be floating in space and not directly associated in the dataset with the river system or its branches. This cartographic text can be defined as a type of Annotation while the river is defined as a member of a GeographicObject class. To handle all relevant data for the river system both the textual and the geographic elements can be grouped as an AnnotatedSpatialDataSet. This situation should be distinguished from one where labels can be directly associated with individual geographic objects. If the text associated with the river were handled in this way then each label would be defined as an attribute of the river and not as a separate object in its own right; the significance of this would be that the geographic objects (with their labels) would be grouped into a SpatialDataSet.

2.4.1.2 Coverage

A coverage describes some geographic phenomenon distributed over an arbitrary region of space. In terms of behaviour, it maps a position in space to a value (as described in the discussion of spatial function below). A Landsat satellite image can be considered a coverage of the reflectance of various wavelengths from a section of the earth's surface. Barometric pressure across a given area is usually treated as a coverage. Data describing land use across a broad area may also be considered a coverage.

The most distinguishing aspect of a coverage is that it has a spatial function, responsible for the mapping from a position to a value. A spatial function is a function defined on positions in space. It can be used to model: either continuous phenomena like barometric pressure or altitude, or discrete phenomena like land use or soil type. Its domain (i.e., input into the function) is always a spatial object, but its range (i.e., output from the function) can be anything, from a number to a spatial object to a geographic object. The function may be very simple, such as an assignment of image values to grid positions in the case of a raster. Alternatively, the function may be sophisticated, involving for example the interpolation of values at arbitrary locations.

In a mathematical context, a coverage is equivalent to the graph of a function. For example, a graph of a quadratic equation provides a y value for any arbitrary x value. Similarly, a spatial

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function provides a value for any arbitrary location in space, where the location may be a single point or a larger region. A given spatial function may provide the land use at a specified point. The input for another function may consist of an area of interest and a tree species of interest; the output may be Douglas Fir dominated forest stands, and include complete attribute descriptions. Alternatively, the function may be designed to return only the places of occurrence of those stands, that is, only their corresponding spatial objects.

SAIF does not provide direct support for methods or functions. Nevertheless, coverage types can be described in SAIF by emphasizing the structural aspects of the data.

2.4.1.2.1 Raster

Three subclasses of Coverage are recognized in the base standard: Raster, Field, and PartitionedCoverage. User defined subclasses of Raster are intended to describe typical raster data, where a series of values are assigned to the positions in a grid. The values may indicate reflectance values, vegetation type, or just about anything else. The grid is defined in terms of a regular, multi-dimensional, rectangular, hexagonal or triangular structure. In addition to the values pertaining to the grid positions and the grid itself, a raster may be defined with other attributes as well, such as the height of a satellite, the time of observation, etc. In addition to the most general raster case, three more specific uses of raster are identified by SAIF.

The first of these is the GeneralRaster. This is the most typical use of the Raster class. It involves a group of one or more two dimensional grids with the indexing scheme restricted in all cases to be either band interleaved or band sequential. GeneralRaster is most suitable for rasters developed in the image analysis domain where they can be characterized by a series of row ordered grids with the grid origin and the reference point for each cell assumed to be the upper left hand (northwest) corner. For example, one layer the GeneralRaster dataset might contain the normalized vegetation index, another might contain the results of simple image arithmetic, while yet another might contain the primary axis of a principal component analysis. The database could also contain classification results, bit masks, and graphic layers. However, the GeneralRaster class is not restricted to image analysis applications; general rasters may be defined using grid geometry other than the 2D image grid default.

The second Raster subclass defined by SAIF is the CategoricalRaster. Instances of this class are typified by rasters where each cell value can be correlated to a themed category. In a typical geographic information system, a coverage may be stored or transformed into one or more rasters where the data represent categorical descriptions of the landscape. Each category is defined by a unique combination of attribute values which is correlated to a set of user defined codes.

A third type of raster is the RasterDEM. RasterDEM has been included in this specification for convenience when defining a grid structure for which each cell contains an elevation. The cell values must either be an octetString (a string of bytes) or be contained in an externally referenced file.

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2.4.1.2.2 Field

User defined subclasses of Field describe the distribution of a single phenomenon over a given portion of space. The geometry of the spatial object for a field represents a continuous region in space. It may for example correspond to a set of isolines, a set of velocity vectors at irregularly spaced points, a triangulated irregular network, a regular grid or a digital elevation model. Because of the nature of a field, estimated values for a phenomenon at arbitrary locations may be determined through interpolation. The way in which the interpolation proceeds will depend on the kind of field and the particular spatial representation being used.

A subclass of Field named IrregularDEM is defined by SAIF. This specialized type of field describes the set of irregularly distributed points with elevation which is commonly known as an irregular DEM. Although the coverage is not space filling, a surface is implied by the elevation differences within point neighbourhoods.

2.4.1.2.3 PartitionedCoverage

User defined subclasses of PartitionedCoverage are applicable where the coverage consists of a series of discrete features, such as forest stands or census tracts, or combinations of discrete features, such as roads and railroads. The features composing the coverage are not necessarily space filling. Areal features (such as forest stands) in a 2D space cannot overlap, and similarly, volumetric features (such as ore bodies) in a 3D space cannot overlap. PartitionedCoverage is a subclass of both Coverage and SpatialDataSet.

In some situations such overlap may reasonably exist, as with a map showing both surface and subsurface rights. Such a situation can be handled in different ways. The surface rights may represent one partitioned coverage and the subsurface rights another. If it is desirable to treat both coverages together, they can both be incorporated into a spatial dataset. The surface and subsurface rights may be integrated into a single partitioned coverage only if an overlay (i.e. intersection) procedure has been carried out, such that every resultant area has a value for both surface and subsurface rights.

2.4.1.3 Graph

Graph is a subclass of GeographicObject. An object belonging to Graph contains a set of connections between geographic objects. These connections are defined as relationships. For example, a graph may establish the connections between destinations for a given airline. Other common examples are road and stream networks; a special type of network is a single line network, appropriate for modelling these examples. Users are expected to define subclasses of Graph where appropriate for their applications. Some possible subclasses of Graph include: AirlineRoutes, StreamNetwork and HighwaySystem. Note that geographic objects referenced in a graph (like the airline destinations example) need not be physically connected.

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2.4.2 SpatialObject

Another class, SpatialObject, contains two objects, one from GeometricObject and the other from SpatialReferencing. Thus, a member of the class SpatialObject carries information on both pure geometry and the interpretation of the geometry in the context of a real world framework. For example, a two dimensional coordinate (*c1,c2*) value may be interpreted as longitude and latitude, Easting and Northing, etc., depending upon the value for spatial referencing.

Users are not permitted to define new subclasses of SpatialObject.

2.4.3 GeometricObject

SAIF considers abstract mathematical objects, like points, arcs, polygons, and tetrahedra to be members of a class of objects known as GeometricObject. An arbitrary collection of such geometric objects may also be considered a geometric object in its own right. SAIF provides an extensive type hierarchy of zero through four dimensional geometric objects. It includes zero, one, two and three dimensional vector structures, as well as two, three, and four dimensional grids with rectangular, hexagonal, or triangular structures.

Members of the class GeometricObject are specified ultimately through one or more points, each of which is given a one to four dimensional (*c1,c2,c3,t)* coordinate. For example, a polygon may have a series of arcs defining its boundary, with each arc defined by a list of points. In three dimensional space the coordinate for one of the points might be (12.5, 3.9, 46.8). So long as the necessary geometric constructs are available, any shape may be specified through appropriate values of the coordinates. However, without additional information the coordinates are purely abstract in nature.

Users are not permitted to define new subclasses of GeometricObject.

2.4.4 SpatialReferencing

In order for the *c1, c2,* and *c3* coordinate values to have real world meaning, spatial referencing must be provided. The primary function of a spatial referencing object is to provide coordinate system information. The coordinate system refers to the method with which positional coordinates are located with respect to some planar or ellipsoidal reference surface.

In its most simple form, the coordinate system need only specify that coordinates are located on a plane rectangular surface and have no relation to positioning on the earth. More complex forms of spatial referencing define the relationship between coordinate location and earth position providing both the horizontal and vertical datum. A number of CoordinateSystem subclasses are defined for this purpose. These subclasses range in complexity from the ConventionalTerrestrialSystem (for providing earth position using ellipsoidal x, y and z), through the GeodeticCoordinateSystem (for providing position using latitude, longitude and elevation), to the PlanarProjectionCS (for providing position using a rectangular projection such as Mercator or Lambert Conformal, etc.). The final subclass is the SegmentedProjectionCS

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which allows the definition of location using standardized segments of a planar projection. An example of this type of coordinate system would be UTM which standardizes and segments a Transverse Mercator planar projection.

2.4.5 Coordinate

Each point has a given position which may or may not be known. If it is known, it can be specified through an object belonging to the class Coordinate. Several types of coordinates are recognized, corresponding to subclasses of Coordinate. Positions in space can be established using Coord1D, Coord2D, and Coord3D. For example, any position defined by two spatial dimensions is considered to come from Coord2D, regardless of the coordinate system, projection, etc.

SAIF also addresses time in the coordinate hierarchy. In addition to Coord1D, Coord2D, and Coord3D, CoordT is also a direct subclass of Coordinate. Coord1DT is defined through multiple inheritance as a subclass of both Coord1D and CoordT. Coord2DT is a subclass of Coord2D and CoordT, and Coord3DT is a subclass of Coord3D and CoordT.

Users are not permitted to define new subclasses of Coordinate.

2.4.6 SpatiotemporalObject

A spatial object is composed of a geometric object (e.g. point or polygon) and spatial referencing. A temporal object is composed of a time object (e.g. time or date) and temporal referencing. The class SpatiotemporalObject is defined as a subclass of both SpatialObject and TemporalObject. Consequently, a member of SpatiotemporalObject includes objects belonging to the following classes: GeometricObject, SpatialReferencing, TimeObject, and TemporalReferencing.

Time may be specified as part of a coordinate. Since geometry contains coordinates, time may be included directly in the geometry. This is practical where the geographic object occurs at a single point specified for example in terms of an (*c1,c2,t*) coordinate. Time may also be specified independently as a value for TimeObject. If the geographic object is an areal feature, then defining every point on a polygon's boundary with an (*c1,c2,t*) coordinate is inappropriate. Instead, (*c1,c2*) coordinates should be used and a value for TimeObject should be provided.

Users are not permitted to define new subclasses of SpatiotemporalObject,TemporalObject or TimeObject.

2.4.7 TimeObject

A member of this class carries a value for a time, a date, an interval, a duration, or a collection of such values. Date and 24 hour time may be used separately or together, in which case the object carrying both values belongs is considered a timestamp. Two kinds of intervals are recognized, year-month intervals and day-time intervals. Date, time, timestamp, year-month interval and

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day-time interval are concepts borrowed from SQL. SAIF adds the notion of duration, which is defined by a starting point in time and an interval extending beyond that point. SAIF also separates the value for a time object from its temporal referencing, described below.

2.4.8 TemporalReferencing

Temporal referencing should be given when values are provided under either TimeObject or the coordinate classes incorporating time. Temporal referencing provides information on (1) whether Universal Coordinated Time (UTC) is being used and whether GPS timing applies (in which case leap seconds are ignored), and (2) the offset from UTC in hours and minutes.

2.4.9 Annotation

Spatial information often includes text and symbols. Text may be used as a label. It may also refer to a general region with an ill defined boundary, such as "Pacific Ocean" or "Blue Ridge Mountains". Symbols may be used to indicate swamps, airports, historic sites, etc. The definition of text or symbols includes at least one point to indicate where the text is to be placed. In the case of text on a curve or multiple lines of text, a series of points are given.

Text and symbols must also be spatially referenced. An object from the class Annotation includes an object from the class TextOrSymbolObject, as well as an object from the class SpatialReferencing. The structure of Annotation is analogous to that of SpatialObject, which has one object from the class GeometricObject and another from SpatialReferencing. Note that Annotation is not related through the type hierarchy to either GeographicObject or SpatialObject.

2.4.10 SpatialRelationship

SAIF provides a means of defining explicit relationships between two objects. A subclass of Relationship is SpatialRelationship, which acts as the parent class for a number of topologic and metric (involving measurements) associations. The two objects referenced in a spatial relationship must both be geographic objects. Spatial topology introduces concepts such as adjacent, contains, surrounds, boundedBy, on the left side of, and so on. The metric associations include relationships such as spatial neighbourhood, distance from, distance and angles, and relative linear distance.

Although the two objects in a spatial or temporal relationship (see below) are geographic objects, any calculations required to establish such a relationship will involve the spatial or spatiotemporal objects associated with the geographic objects. For example someone might ask whether one street intersects another street. The mechanism for answering the query, hidden from the user, will involve comparisons of their respective geometries.

2.4.11 TemporalRelationship

TemporalRelationship is a subclass of Relationship. As such, temporal relationships are always implemented as relationships between two geographic objects. The geographic objects

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referenced in the temporal relationship should have positions specified from the class SpatiotemporalObject. Several subclasses of TemporalRelationship are specified in SAIF, including TemporalTopology, Precedence, TemporalProximity, TemporalNeighbourhood, and TemporalOffset. Users may add their own subclasses of TemporalRelationship.

2.5 Modelling Typical Projects

2.5.1 A Land Use Coverage Example

The Clayoquot Sound covers a 264,000 ha area on the west coast of Vancouver Island, British Columbia. The government made a decision regarding what kind of land use will be permitted in various parts of the Sound. The study area refers to the entire Sound, as covered by the decision. It is broken into a series of decision units, each of which has an allowed use, such as integrated management, wildlife, recreation, etc. It was of interest to compare the decision units with present land use / land cover (PLU) as determined through recent satellite imagery and digital topography. For each PLU unit, the actual use category is given, as well as a summary of topographic statistics (average elevation, average slope, percent of area facing each compass direction, etc.).

On Figure 2-4 many of the class names are followed by two colons and the letters CS. The letters give the name of the schema. The schema name must always follow the class name (separated by two colons), if the class is not part of the SAIF data model or standard schema.

A PLU unit is a subclass of GeographicObject and therefore inherits the attribute *position*. This attribute is taken from the domain SpatialObject. As shown on Figure 2-4, *position* for a PLU unit is instantiated from SpatiotemporalObject which is a subclass of SpatialObject. (Although not shown, spatiotemporal objects include both geometry and time. For this project, geometry and time are restricted to come from the classes Polygon and Date, respectively.) Because it occupies a region of space, an instance of PLU clearly requires the spatial attributes *geometry* and *spatialReferencing*. Additionally, because the PLU category pertaining to the unit is with respect to the date of the satellite imagery, the unit also requires the temporal attributes *timeObject* and *temporalReferencing*. In other words, only at the time the image was taken can we claim that the present land use is as specified. (The next day fires or logging may have altered it.) If time referred to anything other than mere existence, such as date of harvesting or replanting, then we would not consider the object in question to require temporal attributes as part of its position. (In this case the object might have two explicitly stated attributes, *harvestingTime* and *replantingTime,* each of which would come from the domain *Date.*)

Each PLU unit also has a value from the enumeration PLUCategory. A series of topographic attributes are given for the unit, two of which have primitive domains (*pluArea* and *pluPerimeter*) and therefore are shown as part of the PLU unit in the diagram. The domains for these attributes are not specified; because the attributes are given in the lower part of a box, they are all primitives of some type. The other attributes come from complex domains, including the percent of the area facing various aspect directions, the average slope, average elevation, etc.

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On the left side of the figure can be found StudyArea. This class has only one instance, the entire Clayoquot Sound study area. It contains a series of instances of DecisionUnit. (Although not shown, for each decision unit the geometry is restricted to come from the class Polygon.) A decision unit also has a value from the enumeration AllowedUse, as well as the attribute decisionUnitArea.

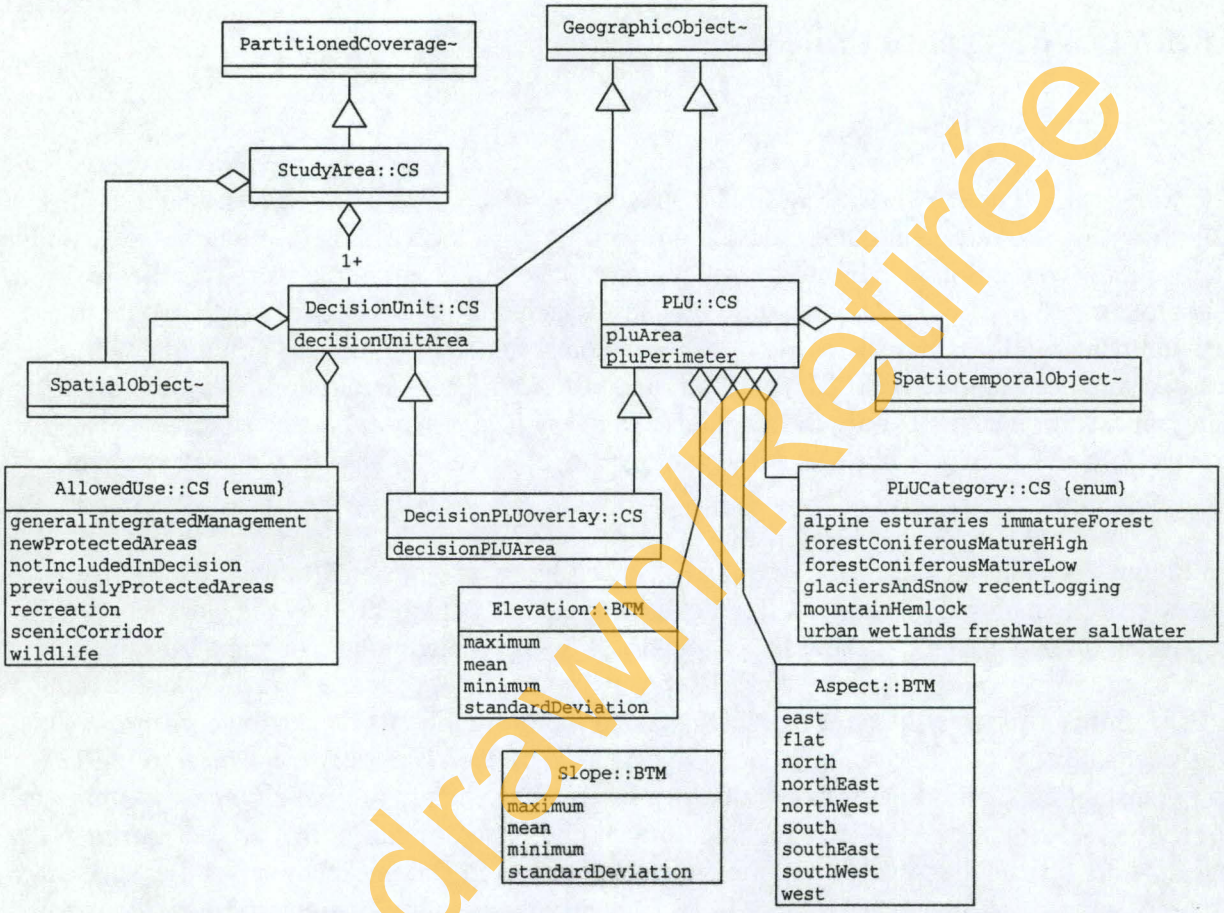


Figure 2-4 Graphic Model of Clayoquot Sound Project

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The decision units were overlayed with the PLU units, creating a large number of resultant units, each a member of the class DecisionPLUOverlay. Objects in this class inherit all the attributes from the two parent classes, DecisionUnit and PLU. It might be expected that the new class would contain two attributes pertaining to geometry and two attribute pertaining to spatialReferencing, since both DecisionUnit and PLU should contribute one copy of each to this new class. However, because Decision Unit and PLU are both subclasses of the same parent (GeographicObject), virtual inheritance is automatically assumed. With virtual inheritance only one copy of an attribute is retained, even if it is inherited many times from a common ancestor.

(The class DecisionPLUOverlay has three area attributes: decisionPLUArea, decisionUnitArea, and pluArea. Only the first of these is likely to be considered of interest; the other two relate to

the original polygons. Additionally, pluPerimeter is also inherited and is also of questionable value. To minimize such confusion, the attributes *area* and *perimeter* could have been added to a higher level class and then inherited by DecisionUnit, PLU, and DecisionPLUOverlay. By virtual inheritance, DecisionPLUOverlay would have only one area attribute.)

Another analysis on Clayoquot could involve comparing satellite images of various years to monitor the changes in the area. The resulting units from the overlay of the different snapshots might initially contain all the information of the parents, and in this case, the overlay would be comparable to what was described above. However, if the overlay involved change detection processing such that only changed areas are depicted, we would have a very different situation, since the resultant units would not be able to respond to all the queries which could be directed to the original units. Multiple inheritance would be inappropriate.

One way to model this change detection work would be as follows. All the PLU units for each time could be placed in a partitioned coverage, with position specified as a spatiotemporal object. For example, define a LandUseAtTimeX class in this way. The various coverages at different times (that is, instances of this new class) could then be placed in a spatial dataset. Define LandUseThroughTime as a subclass of SpatialDataSet.) This new composite can be visualized as a multilayer structure, where each layer is a time tagged coverage of the same area. The change detection process will determine that a number of areas have been altered. These areas belong to a new class, AlteredArea. The altered areas can be put into a final coverage containing all the altered areas. An instance of this new coverage belongs to the class DetectedChanges, defined as a subclass of PartitionedCoverage. The relationship between objects belonging to DetectedChanges and those belonging to LandUseThroughTime can be stated explicitly with the relationship DerivedFrom, a class in the SAIF standard schema, or a user-defined subclass of that class. Alternatively, appropriate metadata can be defined under the class Lineage in the SAIF standard schema.

2.5.2 Multiple Inheritance and New Classes Defined Through Overlays

When an overlay is carried out, it is assumed that the comparison is legitimate, spatially and temporally. For example, it would be reasonable to overlay a geology map with a vegetation map. However, if the geology map described the bedrock as it was 200 million years ago and the vegetation map referred to current conditions, the comparison would be meaningless. When we overlay, typically we are looking at the conjunction of different phenomena in both time and space. Alternatively we may have different snapshots in time of the same region of space. The former case pertains to the decision unit - PLU overlay, and consequently, we must assume that the decision units exist at the time the satellite image was taken.

All overlays should not necessarily be assumed to be best represented by multiple inheritance. In the Clayoquot example the overlay involved two different phenomena which both pertained to the same space and the same time. The resultant units, existing in space at a given time, could be viewed as specialized versions of the parent units. Any question that could be posed to each parent could also be posed to the child.

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Consider next the watersheds in the Clayoquot. It may be of interest to consider watersheds as hydrologic objects. We can envision such queries as what is the estimated discharge at the outlet of the watershed. We might also consider each watershed as a wildlife habitat object. If we had previously defined a hydrologic class and a habitat class, then Watershed could be considered to be derived from both, i.e., use of multiple inheritance would be appropriate.

In another scenario habitat areas might be defined independently of the watershed boundaries, or the they might involve much more detailed mapping. In either of these cases we may wish to overlay the two coverages. The resultant units however are no longer watersheds - they are parts of watersheds, inappropriate for addressing a number of hydrologic queries. In this case multiple inheritance should not be used. When breaking something up into smaller parts, we must decide whether the semantics of the constituent pieces are the same as for the whole object. In this particular case, pieces of a watershed are different conceptually from an entire watershed.

Multiple inheritance can be a powerful tool with spatial and temporal data as well as many other kinds of information. Nevertheless, considerable care must be used if the results are to be valid. The following overlapping Points are of interest if multiple inheritance is being considered.

1 Do the central concepts of the superclasses also apply to the subclass?

2 Can objects in the proposed, new class respond to all queries which can be put to objects in the original classes?

3 Do an original object and the parts into which it is broken have the same essential meaning (if processing results in disaggregation)?

4 Are there any conceptual spatial or temporal inconsistencies which might arise from creating the new class?

2.6 Creating a Schema

As previously discussed, the actual use of the SAIF data model (and SAIF standard schema) to represent a specific application requires extensions through *subclassing*. As with the SAIF standard schema, a user defined schema must be expressed in a text based language. This section explains how to define a schema using the Class Syntax Notation. Further detailed information about CSN is available in Chapter 4.

The following material focuses on examples based on the TRIM schema, which describes types defined for 1:20 000 topographic data in British Columbia. The examples include the definition of subclasses of GeographicObject and SpatialDataSet, as well as various types of enumerations.

The first line in the example begins with an angled bracket and gives the name of the superclass from which it is derived, in this case GeographicObject. The angled brackets are used to indicate the beginning and end of a class definition. The second line in the example provides the name of

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the subclass being defined and the name of the schema containing the class definition. In this case the subclass is Feature and the schema is TRIM, and they are separated by two colons. The complete name of the subclass is considered to be: Feature::TRIM.

```
<GeographicObject
    subclass:           Feature::TRIM

    subclassing:        "The user may define subclasses of this class."

    defaults:           position.geometry.qualifier: definite

    restricted:         position.spatialReferencing: nil
                        position.geometry*Coordinate: ^Coord2D | ^Coord3D

    comments:           "This is an abstract superclass. All features within
                        the TRIM program are defined as subclasses of
                        Feature::TRIM. Spatial referencing is provided at
                        the composite level. Features are defaulted to be
                        default. Features may be encoded with either 2 or 3
                        dimensional coordinates."

>
```

In general, the next step in subclassing would be to define attributes for the objects belonging to the Feature subclass; however, in this example there are no object attributes. Note that as a subclass of GeographicObject, Feature inherits all of the characteristics associated with a GeographicObject. (See Chapter 3 for the definition of GeographicObject.)

The example contains a **defaults clause**, which provides the common values for an attribute. In this case the inherited attribute *qualifier* is defaulted to *definite* which means that, in the majority of cases, the geometry of the feature was readily evident when captured. If an instance of this type or a subclass of this type is instantiated and the attribute default is used, then that attribute need not appear. Therefore the attribute *qualifier* only appears when the assigned value is not *definite*.

This sample definition also has a **restricted clause**, which as previously described, can be simple or complex. The restriction referring to *position.spatialReferencing* is necessary because, as a subclass of GeographicObject, Feature inherits this attribute through the complex domain SpatialObject. As noted in the comments, the spatial referencing for TRIM features is provided by the composites that contain the feature of interest. Therefore, this inherited attribute is restricted to be *nil*.

The second restricted clause refers to the dimensionality of the coordinates that may be used to define the geometry of any TRIM feature. In this case, coordinates may be either 2 or 3 dimensional, thus any coordinate must come from either the Coord2D or the Coord3D coordinate subclass.

The final clause in this example is the *comments*. Comments are provided as a means to document the intended use of the classes that have been defined and to explain the semantics of

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```
<Enumeration
    subclass:           SurfaceType::TRIM

    values:             loose paved rough

    comments:           "A choice of road surface types by composition of
                        the material."

>
<Enumeration
    subclass:           TravelDirection::TRIM

    values:             oneWay twoWay

    comments:           "A choice of pattern of movements of vehicles on a
                        roadway."

>
<Feature::TRIM
    subclass:           Road::TRIM

    attributes:         [surfaceType]       SurfaceType::TRIM
                        [numberOfLanes]     Integer8
                        [travelDirection]   TravelDirection::TRIM
                        [divided]           Boolean
                        [underConstruction] Boolean

    defaults:           surfaceType:paved
                        numberOfLanes:2
                        travelDirection:twoWay
                        divided:false
                        underConstruction:false

    restricted:         position.geometry:^Arc
                        position.geometry*Coordinate:^Coord3D
                        numberOfLanes: 1 | 2 | 3 | 4 | 6

    constraints:        "Minimum length of 400 metres for a cart track,
                        access road or gravel driveway. Maximum lane
                        separation of 50m for divided roads; otherwise
                        captured as separate one-way roads."

    comments:           "A specially prepared route on land for the movement
                        of vehicles, other than railway vehicles, from place
                        to place".

>
```

the information encoded within the class structure. In the example the comments provide some background regarding the structure of TRIM and help to explain the restricted clauses. The comments must be enclosed in double quotation marks (" ") . The class definition ends with a closing angled bracket (>).

The example that follows concerns the class Road, a subclass of Feature. Two enumerations are defined first, as they are required as domains of attributes in the Road definition. SurfaceType and TravelDirection illustrate how to create new enumerations by subtyping directly from Enumeration. As before, class and enumeration definitions start and end with angled brackets.

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Also as before, the schema containing the types must be specified, as TRIM is an external schema.

After the subclass clause (and tag clause, if used) in an enumeration comes the values clause, listing the possible descriptions which may apply to an object. In our first example the descriptions represent the surface types that a road may have, according to the TRIM schema. As with every subtype there is also a comments component which is used to clarify the enumeration and the terms within it.

The definition of Road begins with an opening bracket and the name of the superclass, in this case Feature::TRIM. The subclass name follows. Again the subclass name must include the schema. As a subclass of Feature::TRIM, Road::TRIM inherits all the attributes, restriction and defaults from its superclass. An attributes clause is used to specify new attributes and their associated domains. The first new attribute is surfaceType and the domain specified is SurfaceType::TRIM, as previously discussed. Syntactical concerns include: the use of a lower case letter to begin the name of the attribute and the use of an upper case letter to begin the domain. Also, the attribute name is enclosed in square brackets ([ ]), indicating that entry of values for the attribute is optional.

All of the new attributes for Road::TRIM are considered as optional, as indicated by the brackets. Note that the attribute travelDirection has a domain defined within the TRIM schema (TravelDirection) while the remaining attributes have primitive domains defined within the SAIF data model. Integer8 is any integer of 8 bits in length (with possible values ranging from -128 to +127), while Boolean identifies a logical value (true or false).

If specific values for these attributes are not supplied, the default values defined in the next clause of the definition apply. This means that unless otherwise specified, surfaceType will be paved, numberOfLanes will be 2, travelDirection will be twoWay, and the road will be considered as not divided and not under construction. Each of the default values supplied must come from the appropriate domain defined above. If values are not given for an optional attribute, no values are encoded, regardless of whether or not defaults are specified. The receiver of the data will understand the implied values through the definition of the class.

The first restricted phrase (position.geometry:^Arc) requires that the geometry attribute must be a direct instance of the class Arc, and not one of the subclasses of Arc. The second restricted phrase (position.geometry*Coordinate:^Coord3D) further specifies that the coordinates which define the position of the Arc must be direct instances of the class Coord3D. The third restricted phrase refers to the attribute, numberOfLanes; the restriction applies to possible numeric values which may be applied to the attribute. The vertical line, (|), separates valid alternative values, in this case, 1, 2, 3, 4 or 6. Any other values are not legal.

As previously noted, restricted clauses have a very rigid formal syntax. The next statement is the constraints clause. which does not have a formal syntax and is meant to convey the meaning of information that may be too complex for expression in the restricted clause. In this case the constraints, given in double quotes, are related to the way in which the data were captured. The

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constraints clause contains the information that in TRIM digital files, cart tracks are not captured unless their length exceeds 400 metres. The last clause in the example, the comments, provides a general understanding of what a Road is and gives an example of how this class of objects may typically be used.

The remaining examples illustrate the use of SpatialDataSet, a subclass of GeographicObject. Instances of this class are geographic objects which contain other geographic objects. Instances of a spatial dataset class may be considered as containers, which may or may not have other attributes provided. The following example shows the definition of a spatial dataset class dealing with composites of TRIM features and the definition of one such composite dealing with land transportation.

Features captured for the TRIM program were compiled on a 1:20 000 mapsheet basis. It is therefore useful to group together all geographic objects of a particular type for each mapsheet. To accomplish this, a general composite abstract supertype is created to provide attribution and spatial referencing restrictions that can be inherited by subclasses. The supertype is named TrimComposite::TRIM and contains one attribute named *mapsheetDefinition*. This complex attribute carries information about the mapsheet such as its name, the date of last submission and the approximate mapsheet centre. This class inherits the attributes *geometry* and *spatialReferencing* from GeographicObject. The first restriction set the value for position.geometry to nil. (This may not be the case, for example, if the spatial dataset contained the geographic elements that made up a park where the park can have geometry independent of the components that it contains.) The next two restrictions set the value of the coordinate system to UTM and the zone to be a value between 8 and 11.

```
<SpatialDataSet
    subclass:           TrimComposite::TRIM
    subclassing:        "The user may define subclasses of this class."
    attributes:         mapsheetDefinition      MapsheetDefinition::TRIM
    restricted:         position.geometry: nil
                        position.spatialReferencing.coordSystem: UTM
                        position.spatialReferencing.coordSystem.zone: 8..11
                        geoComponents{}: Feature::TRIM
>

<TrimComposite::TRIM
    subclass:           RoadComposite::TRIM
    restricted:         geoComponents{}:        Road::TRIM
    comments:           "An instance of this TRIM feature composite will
                        contain all instances of Road::TRIM for a particular
                        mapsheet."
>
```

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The next restriction (*geoComponents{}:Feature::TRIM*) provides the type of GeographicObject that may serve as the domains for objects included in *geoComponents. The* braces ({}) after the word *geoComponents* represent the syntax for referencing members within the collection. In this case all subclasses of TrimComposite::TRIM may only contain components that are subclasses of Feature::TRIM.

Each type of geographic object that is modelled for the TRIM schema can be grouped as a subclass of this general SpatialDataSet. For example, the roads defined by the Road::TRIM geographic object subclass are grouped together for a mapsheet under the RoadComposite::TRIM subclass. The map definition attribute and spatial referencing restrictions are inherited from the parent SpatialDataSet class TrimComposite::TRIM. The inherited attribute *geoComponents* is further restricted to instances of Road::TRIM. As a result, an instance of RoadComposite::TRIM will contain all the Road::TRIM objects for a particular mapsheet. The mapsheet in question is provided by the map definition attribute.

As with all subclass definitions, this one opens with an angled bracket and the name of the superClass (TrimComposite::TRIM). The subclass name including the schema follows

```
<AnnotatedSpatialDataSet
    subclass:              Mapsheet::TRIM
    attributes:            mapsheetInfo    GeneralLocation
    restricted:            mapsheetInfo.range.coordSystem:
                                  GeodeticCoordinateSystem
                           mapsheetInfo.range.coordSystem.horizontalReference.
                                  datumAdjustmentSystem: nad83
                           mapsheetInfo.tiles{}.mapSheetNumber: notNil
                           mapsheetInfo.tiles{}.mapNumberingSystem: "BCGS"
                           mapsheetInfo.tiles{}.publicationDate: nil
                           mapsheetInfo.tiles{}.mapSeriesName: "TRIM"
                           mapsheetInfo.tiles{}.inverseScale: 20000
                           geoComponents{}: ControlPointComposite::TRIM |
                                            PhotoCentreComposite::TRIM  |
                                            CoastlineComposite::TRIM    |
                                            FallsComposite::TRIM        |
                                                  .
                                                  .
                                            RoadComposite::TRIM         |
                                                  .
                                                  .
                                            ContourComposite::TRIM      |
                                            ToponymyComposite::TRIM     |
                                            OtherTextComposite::TRIM
        constraints:       "All components must come from the same mapsheet."

        comments:          "This spatial data set contains all data pertaining
                           to a given mapsheet from the British Columbia
                           1:20 000 topographic mapping program."

>
```

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(RoadComposite::TRIM). The subclass RoadComposite::TRIM has no new attributes but it has inherited *position* (*geometry* and *spatialReferencing*) from GeographicObject, as well as *geoComponents* from SpatialDataSet.

Mapsheet, the final example, is a subclass of AnnotatedSpatialDataSet. An attribute called *mapsheetInfo* is specified from the domain GeneralLocation. Each mapsheet in the TRIM database has its own mapsheet information object which is an instance of GeneralLocation. This type provides referencing, name and mapping program information pertinent to a particular mapsheet.

The comments clause tells us that each object belonging to this class represents all the data pertaining to a given mapsheet in the British Columbia 1:20 000 topographic mapping program. Although not shown here, a subclass of SpatialDataSet is defined, consisting of all such data for the entire province; at that level we have a single geographic object which contains all 1:20 000 topographic data for British Columbia.

In this particular example, the concept of a mapsheet is emphasized, as the 1:20 000 topographic data is currently being managed on a mapsheet basis. Whether or not a user wishes to do this is entirely a modelling decision. The user may wish to define a series of spatial dataset or coverage classes based on other criteria, or may find that her requirements are met without spatial datasets or coverages.

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Chapter 3

SAIF Standard Schema

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Chapter 3, Section 1

Geographic, Spatial, Temporal, and Annotation Classes

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3.1 Geographic, Spatial, Temporal and Annotation Classes

// The parent class AbstractObject includes an optional object identifier, consequently, so do all
// of its subclasses. See Chapter 2 Section 2.2.1 for further discussion on AbstractObject and
// object identifiers.

<AbstractObject

subclass: **GeographicObject**

subclassing: "The user may define subclasses of this class."

attributes: position SpatialObject

comments: "This class represents the central concept in SAIF. The high level structure of GeographicObject is shown below. Not depicted in the figure are relationships which geographic objects may have with other geographic objects.

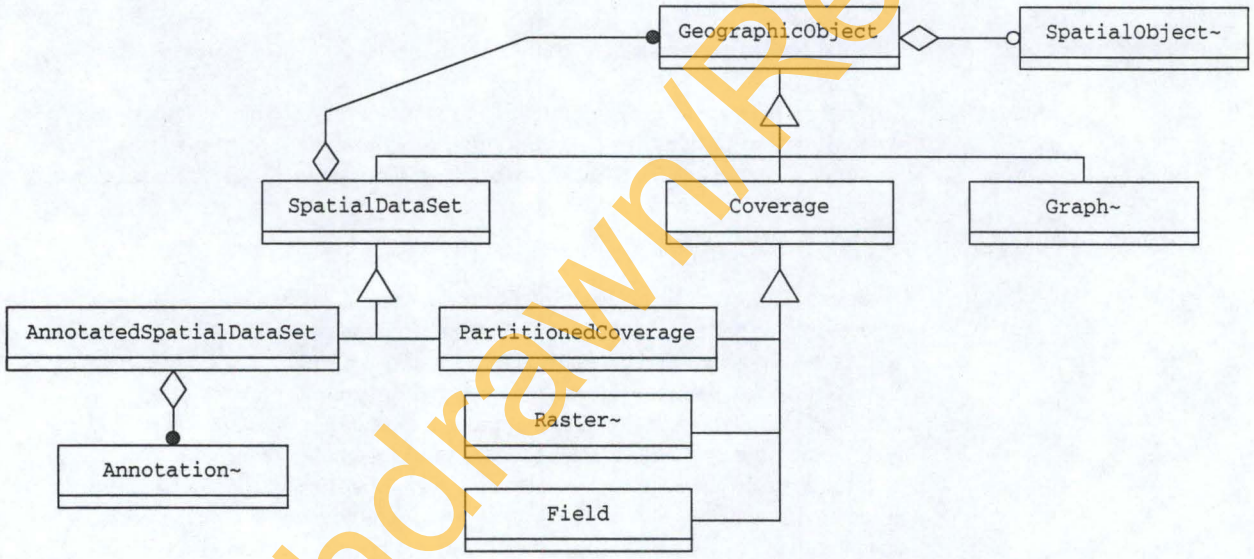


Figure 3-1 High Level Structure of GeographicObject

A geographic object is an object representing a real or artificially defined phenomenon which has, or potentially may have, some kind of spatial or spatiotemporal position.

position: the region of space, or space-time, which is occupied by the geographic object. If space alone is of interest, then position comes from SpatialObject directly. If both space and time are of interest, position comes from SpatiotemporalObject, a subclass of SpatialObject.

The value for position specifies where (and when) the geographic object exists."

>

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<GeographicObject

subclass: **SpatialDataSet**

subclassing: "The user may define subclasses of this class."

attributes: [geoComponents] Set(GeographicObject)

comments: "An object from the class SpatialDataSet contains other objects from GeographicObject. Because SpatialDataSet is a subclass of GeographicObject, recursion is possible. That is, a spatial data set can contain other spatial data sets."

>

<SpatialDataSet

subclass: **AnnotatedSpatialDataSetz**

subclassing: "The user may define subclasses of this class."

attributes: [annotationComponents] Set(Annotation)

comments: "An object from the class AnnotatedSpatialDataSet may contain instances of type Annotation and/or inherited instances of type GeographicObject. Because AnnotatedSpatialDataSet is itself a subclass of GeographicObject, recursion is possible. That is, an annotated spatial data set can be defined in terms of other annotated spatial data sets.

The class AnnotatedSpatialDataSet allows for the collection and inclusion of textual objects into a spatial dataset. An annotated spatial dataset is distinguished from a spatial dataset because of semantics, and possibly externally available services. The annotated spatial dataset may contain text and/or symbol information alone, however, more typically it will contain text and/or symbols as well as related geographic objects. For example, a toponymic place name required to cartographically annotate a river might simply be floating in space and not directly associated in the dataset with the river system or its branches. This cartographic text can be defined as a type of Annotation while the river is defined as a member of a GeographicObject class. To handle all relevant data for the river system both the textual and the geographic elements can be grouped as an AnnotatedSpatialDataSet. This situation should be distinguished from one where labels can be directly associated with individual geographic objects. If the text associated with the river were handled in this way then each label would be defined as an attribute of the river and not as a separate object in its own right; the significance of this would be that the geographic objects (with their labels) would be grouped into a SpatialDataSet. "

>

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<GeographicObject

subclass: **Coverage**

comments: "This is an abstract superclass. A coverage describes some geographic phenomenon distributed over an arbitrary region of space. The most distinguishing aspect of a coverage is that it has a spatial function. A spatial function is a function defined on positions in space. It can be used to model: either continuous phenomena or discrete phenomena. Input to the function is a spatial object. Output from the function is unrestricted. The function may be very simple, such as an assignment of image values to grid positions in the case of a raster. Alternatively, the function may be sophisticated, involving for example the interpolation of values at arbitrary locations.

SAIF does not provide direct support for methods or functions. Nevertheless, coverage types can be described in SAIF by emphasizing the structural aspects of the data. Thus the spatial function is interpreted in SAIF as a simple assignment of thematic or topographic values to specific positions within a given region."

>

<SpatialDataSet, Coverage

subclass: **PartitionedCoverage**

subclassing: "The user may define subclasses of this class."

comments: "A partitioned coverage consists of a series of discrete geographic objects, which may be of the same class or of different classes. Because PartitionedCoverage is a subclass of GeographicObject, recursion is possible. That is, a partitioned coverage can be defined in terms of other coverages.

The components composing the coverage are not necessarily space filling. Also, overlap of n-dimensional components in an n-dimensional space is not allowed. For example, areal features in a 2D space cannot overlap although they may be adjacent."

>

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<Coverage

subclass: **Field**

subclassing: "The user may define subclasses of this class."

restricted: position.geometry: VectorSurface | Grid

comments: "A field describes the distribution of a single, continuous phenomenon over a given portion of space. The geometry of the spatial object for a field represents a continuous region in space. It may for example correspond to a set of isolines, a set of velocity vectors at irregularly spaced points, a triangulated irregular network, a regular grid or a digital elevation model."

>

<Field

subclass: **IrregularDEM**

subclassing: "The user may define subclasses of this class."

restricted: position.geometry: MeasuredSurface
position.geometry.masspoints{}: ^Point | DEMpoint

comments: "This specialized type of field describes the set of irregularly distributed points with elevation which is commonly known as an irregular DEM. Although the coverage is not space filling, a surface is implied by the elevation differences within point neighbourhoods. The geometry of this coverage is restricted first to be a type of measured surface and second, because elevation is surface of interest, the components of the masspoint attribute of MeasuredSurface is restricted to be of type Point or of type DEMpoint."

>

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<Coverage

subclass: **Raster**

subclassing: "The user may define subclasses of this class."

attributes:

contentValues	Type
[indexScheme]	IndexScheme

defaults: indexScheme: sequentialArray

restricted: position.geometry:Grid
contentValues:ExternalReference | BitString | OctetString

comments: "Raster is a type of coverage for which (i) the geometry is restricted to some type of Grid and (ii) the values pertaining to each position in the specified grid are provided by contentValues. An instance of Grid defines the cellular structure in n-dimensional space (or space/time). An instance of contentValues contains the bit string values, octet string values or an external reference. The organization of the data within the instance of contentValues is always described either by a user defined subclass or a SAIF subclass. It is therefore necessary in all cases for a subclass to be used when defining data of this type.
The subclasses which follow are intended to address common raster structures. Other raster structures may be handled by user-defined subclasses of Raster. For example, a given application may call for a triangular or hexagonal grid, or a series of specific locations in a grid. Such situations can readily be handled with the appropriate choice of a subclass of Grid as the domain for geometry.

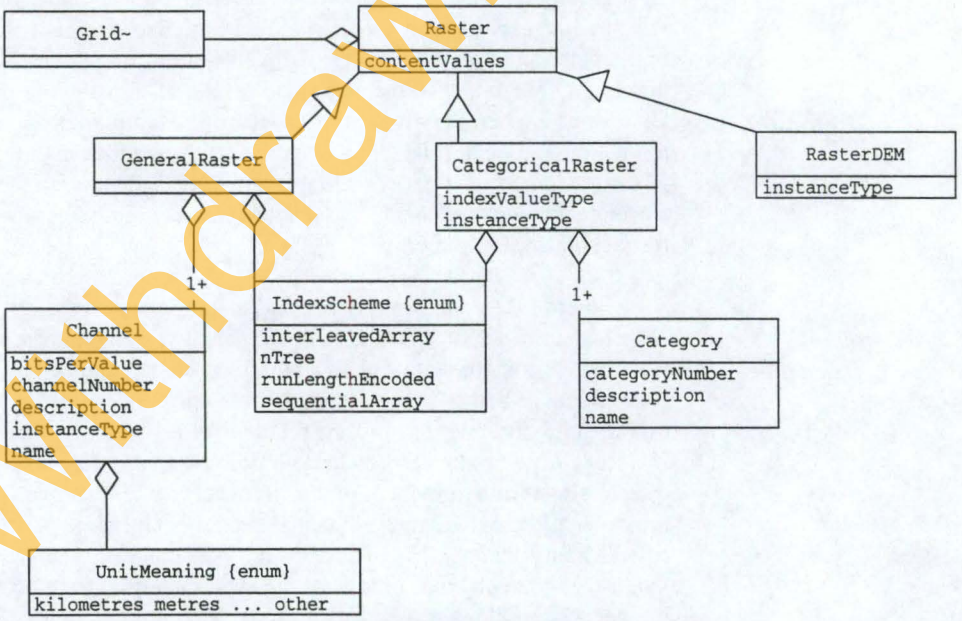


Figure 3-2 Structure of Raster

"

>

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<Raster

subclass: **GeneralRaster**

subclassing: "The user may define subclasses of this class."

attributes: channels List(Channel)

defaults: position.geometry: ImageGrid2D

restricted: indexScheme: sequentialArray | interleavedArray

comments: "The most typical use of this Raster class will involve a group of one or more two dimensional grids with the indexing scheme restricted in all cases to be either band interleaved or band sequential.

The default geometry ImageGrid2D implies rasters developed in the image analysis domain where they are a series of row ordered grids with the grid origin and the reference point for each cell assumed to be the upper left hand (northwest) corner. However, the GeneralRaster class is not restricted to image analysis applications; general rasters may be defined using grid geometry other than the default.

As an example, consider a typical project involving image analysis. Such a project may define a number of layers of data, all within a single database and a single analysis environment. The layers may contain seven bands of Landsat TM spectral data where each pixel is a digital number between 0 and 255 representing the relative intensity of a particular wavelength range. In addition, the database may contain data derived through enhancement and/or some form of image processing. The values may still be digital numbers between 0 and 255, but might now represent the computed results of statistical or algebraic algorithms applied to two or more layers. For example, one layer the dataset might contain the normalized vegetation index, another might contain the results of simple image arithmetic, while yet another might contain the primary axis of a principal component analysis. The database could also contain classification results, bit masks, and graphic layers.

Each layer of the database is defined as a component of the attribute *channels* which contains a list of instances of the subclass Channel. Each instance of Channel is provided with a channel number, channel name and channel description. In addition, the meaning if the units is provided. This is typically a digital number representing some relative value, however, there may be instances where some other value is required such as degrees or radians in the case of slopes or azimuths or metres in the case of elevations. Two other attributes are provided in the Channel subclass. Only one of these should be filled for any channel. If values carried by the channel are byte oriented integer values, then the *instanceType* attribute should be used to indicate the type of integer. If the values carried by the channel are not byte aligned, then the *bitsPerValue* attribute must be used to define the number of bits required to interpret each value.

Note though that the coordinate for the starting cell is not necessarily (1,1); if the raster is part of a larger raster structure - as with a tiling system for example - the

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coordinate value for the starting cell could take on any value. See the comments under GridReference fro further discussion."

>

<Raster

subclass: **CategoricalRaster**

subclassing: "The user may define subclasses of this class."

attributes:

category	List(Category)
[instanceType]	PrimitiveInstanceType
[indexValueType]	PrimitiveInstanceType

defaults: position.geometry: CellGrid2D

restricted:
indexScheme: sequentialArray | runLengthEncoded | nTree
instanceType: integer8 | integer8Unsigned | integer16 | integer16Unsigned | integer32 | integer32Unsigned | integer64 | integer64Unsigned
indexValueType: integer8 | integer8Unsigned | integer16 | integer16Unsigned | integer32 | integer32Unsigned | integer64 | integer64Unsigned

comments: "Instances of this class are typified by rasters where each cell value can be correlated to a themed category.

The default geometry for this class assumes the origin of the grid and the reference point for each cell to be the lower left hand (southwest) corner (as typically organized in geographic information systems). Band sequential, run length encoded, and quadtree structures for the actual values are accommodated through appropriate use of the inherited attribute *indexScheme*.

In a typical geographic information system, coverage may be stored or transformed into one or more rasters where the data represent categorical descriptions of the landscape. Each category is defined by a unique combination of attribute values which is correlated to a set of user defined codes. For example, a forest stand polygon whose attribution represents those characteristics associated with label 'old growth' is assigned to the user defined category 6. Therefore, all cells in the raster with a value of 6 are 'old growth'.

Each category is described by an instance of the class Category which contains the category number, its name and a description. The categories are further defined by the attributes:

instanceType - provides the form of integer being used

indexValueType - refers to the type of integer used to indicate the number of times a given value occurs sequentially in a series of run length encoded values, or the value of an n-tree number in a quad tree or octree series. This attribute is not used if the data is stored as a sequential array or values.

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Note though that the coordinate for the lower left hand cell is not necessarily (1,1); if the raster is part of a larger raster structure - as with a tiling system for example - the coordinate value for the lower left hand cell could take on any value. See the comments under GridReference fro further discussion."

>

<Raster

subclass: **RasterDEM**

subclassing: "The user may define subclasses of this class."

attributes: [instanceType] NumericInstanceType

restricted: contentValues: ExternalReference | OctetString

comments: "RasterDEM has been included in this specification for convenience when defining a grid structure for which each cell contains an elevation. The cell values must either be an octetString (a string of bytes) or be contained in an externally referenced file.

Note that no restrictions are placed on the grid geometry. For example, a typical raster digital elevation model might be defined through Grid with a lower left origin and row ordering. Another DEM might be defined with an upper right origin and column ordering."

>

<GeographicObject

subclass: **Graph**

subclassing: "The user may define subclasses of this class."

attributes: connections Set(ConnectedTo)

comments: "A graph is a set of instances of the ConnectedTo relationship. It establishes connections between pairs of geographic objects. A given geographic object may appear any number of times in the *connections* attribute. Two subclasses of Graph are defined in the standard schema: AcyclicNetwork and SingleLineNetwork.

The term graph does not necessarily imply that the related geographic objects are contiguous in space or time. However, the term network typically does imply such

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contiguity. Use of AcyclicNetwork, SingleLineNetwork, or any user defined network classes should take this into account.

For each instance of ConnectedTo, a connection direction may be provided through the enumeration ConnectionDirection.

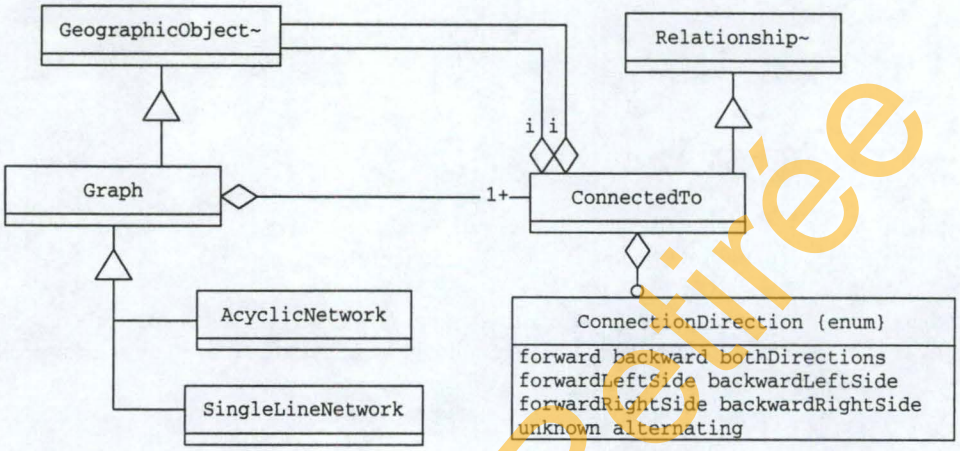


Figure 3-3 Structure of Graph

"

>

<Graph

subclass: **AcyclicNetwork**

subclassing: "The user may define subclasses of this class."

comments: "A graph which is acyclic contains no closed paths. Typical stream networks are formally described as AcyclicNetworks, even if they are braided or have distributaries."

>

<Graph

subclass: **SingleLineNetwork**

subclassing: "The user may define subclasses of this class."

restricted: connections{}.objectA.position.geometry:VectorLine
connections{}.objectB.position.geometry:VectorLine

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comments: "A single line network consists of a set of connections between geographic objects where the geometry of the positions in space of the objects are vector lines. This class may be appropriate for road and stream networks."

>

<AbstractObject

subclass: **SpatialObject**

attributes: [geometry] GeometricObject
[spatialReferencing] SpatialReferencing

comments: "A spatial object represents a region of space. The space is defined through the value for spatialReferencing. The region in the space is defined by the value for geometry.

geometry: the position of the object, as represented by some kind of vector or cellular structure.

spatialReferencing: the spatial framework for positional data defined in terms of the coordinate system, control and transform information, etc.

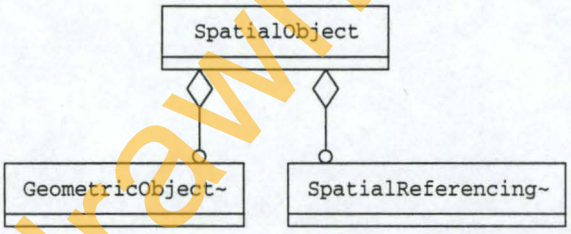


Figure 3-4 Structure of SpatialObject

"

>

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<AbstractObject

subclass: **TemporalObject**

attributes: [timeObject] TimeObject
[temporalReferencing] TemporalReferencing

comments: "Consider time in the context of a time line. A temporal object represents a specific portion of the time line. The time domain is defined through the value for temporalReferencing. The portion of the time line is defined by the value for timeObject.

time: the position of the object on a time line, i.e., the time or date or duration indicating the existence of the object.

temporalReferencing: the temporal framework for time data defined in terms of time type, offset from UTC, etc. Time type indicates whether the data is referenced to an arbitrary time, to Universal Coordinated TIME (UTC), or to GPS timing. (With GPS, time is treated as UTC, but without any adjustments for leap seconds. See the enumeration TimeType for further clarification.

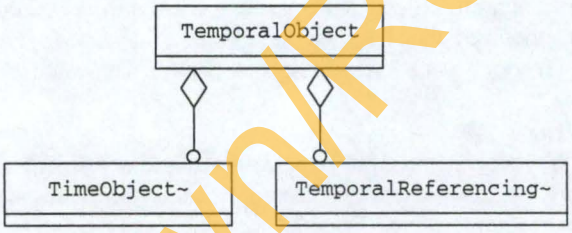


Figure 3-5 Structure of TemporalObject

"

>

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<SpatialObject, TemporalObject

subclass: **SpatiotemporalObject**

comments: "The class SpatiotemporalObject is defined as a subclass of both SpatialObject and TemporalObject. Consequently, a member of SpatiotemporalObject includes objects belonging to the following classes: GeometricObject, SpatialReferencing, TimeObject, and TemporalReferencing.

Time may be specified as part of a coordinate (see below). Since geometry contains coordinates, time may be included directly in the geometry. This is practical where the geographic object occurs at a single point specified for example in terms of an (x,y,t) coordinate. Time may also be specified independently as a value for TimeObject. If the geographic object is an areal feature, then defining every point on a polygon's boundary with an (x,y,t) coordinate is inappropriate. Instead, (x,y) coordinates should be used and a value for TimeObject should be provided.

Geometry may include time in coordinate value, and a value for timeObject may be given as well. This is practical in two situations. In both cases, the timeObject value provides a duration during which the geographic object existed. In the first case, time values in the coordinates refer to specific times or dates during that duration when the geographic object was observed. Consider the duration of a bicycle trip with the route defined by an arc with (x,y,t) coordinates for the points on the arc. The values for the time coordinate refer to actual time.

In the second case, time values in the coordinates come from the class Interval; that is, they represent relative time, measured in seconds, minutes, hours, etc. are given. These interval values represent time from the start time, as specified in the value for the duration. Consider the bicycle trip again, but in this case the values for the time coordinate represent minutes and seconds relative to the beginning of the trip.

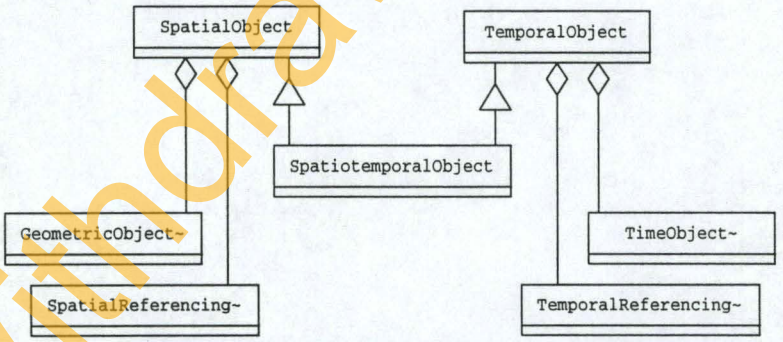


Figure 3-6 Structure of SpatiotemporalObject

"

>

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<AbstractObject

subclass: **Annotation**

subclassing: "The user may define subclasses of this class."

attributes: [textOrSymbol] TextOrSymbolObject
[spatialReferencing] SpatialReferencing

comments: "An annotation is an artificially defined entity typically used to describe a spatial entity, which may or may not be explicitly defined. Instances of this class are used typically as place names or cartographic symbols.

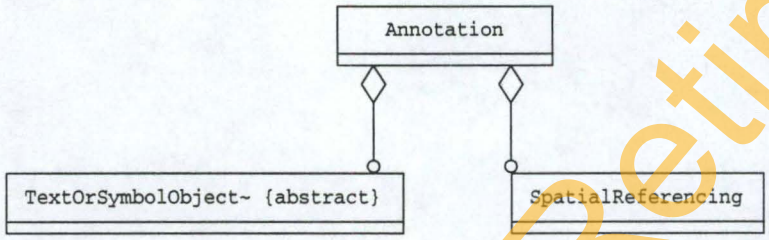


Figure 3-7 High Level Structure of Annotation

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Chapter 3, Section 2

Geometric Classes

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3.2 Geometric Classes

<AbstractObject

subclass: **GeometricObject**

attributes: [qualifier] LocationalQualifier

comments: "This is an abstract superclass within which all geometric objects are spatially referenced in SAIF. All objects belonging to this superclass have position specified directly or indirectly through their constituent components. The high level structure of GeometricObject is shown below.

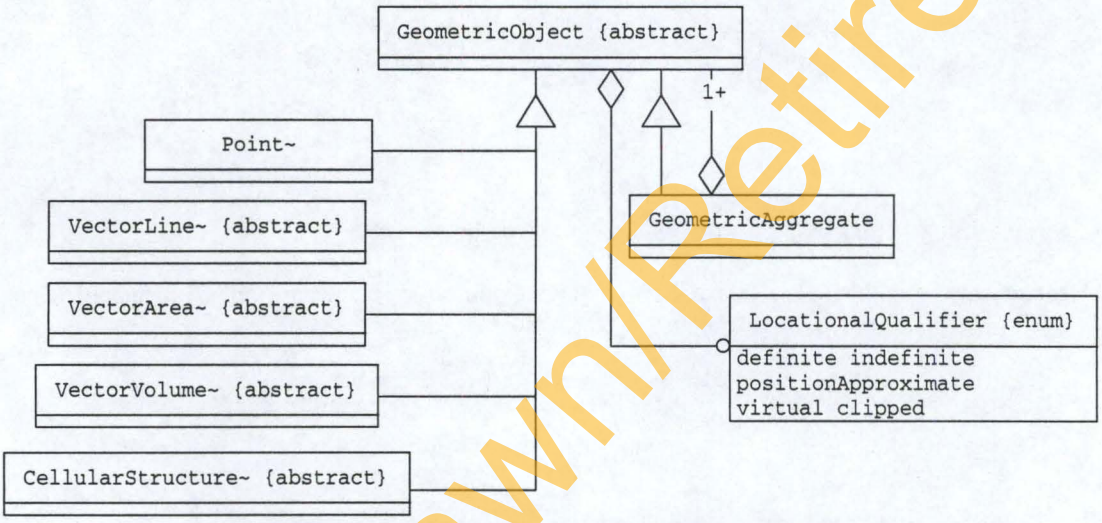


Figure 3-8 High Level Structure of GeometricObject

qualifier: this provides for a categorical notion of fuzziness with regards to position.

If used, qualifier typically would pertain to all aspects of the geometry of a geographic object. However, it may also be used with only a portion of the geometry. For example, consider a marsh with one side of the marsh considered as definite and the other side as indefinite. The geometry of the marsh would be a polygon with qualifier not specified; however, for the arcs constituting the boundary of the polygon, a value for qualifier could be given. If used, qualifier should be specified at the highest level possible. Thus in the example, qualifier would be specified for the arcs but not their component points.

A quantitative notion of fuzziness may be given by using the likelyPositionalError attribute of *SpatialReferencing* or the *likelyTimeError* attribute of *TemporalReferencing* in the metadata."

>

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<GeometricObject

subclass: **GeometricAggregate**

attributes: objects Set(GeometricObject)

restricted: objects{}: Point |
VectorLine |
VectorArea |
VectorVolume |
CellularStructure

comments: "Recursion is not permitted in this subclass due to the above restricted clause."

>

<GeometricObject

subclass: **Point**

attributes: [coords] Coordinate

comments: "Point is a subclass of GeometricObject used for the position of single points, including nodes, origins of grids, placement of text, etc.

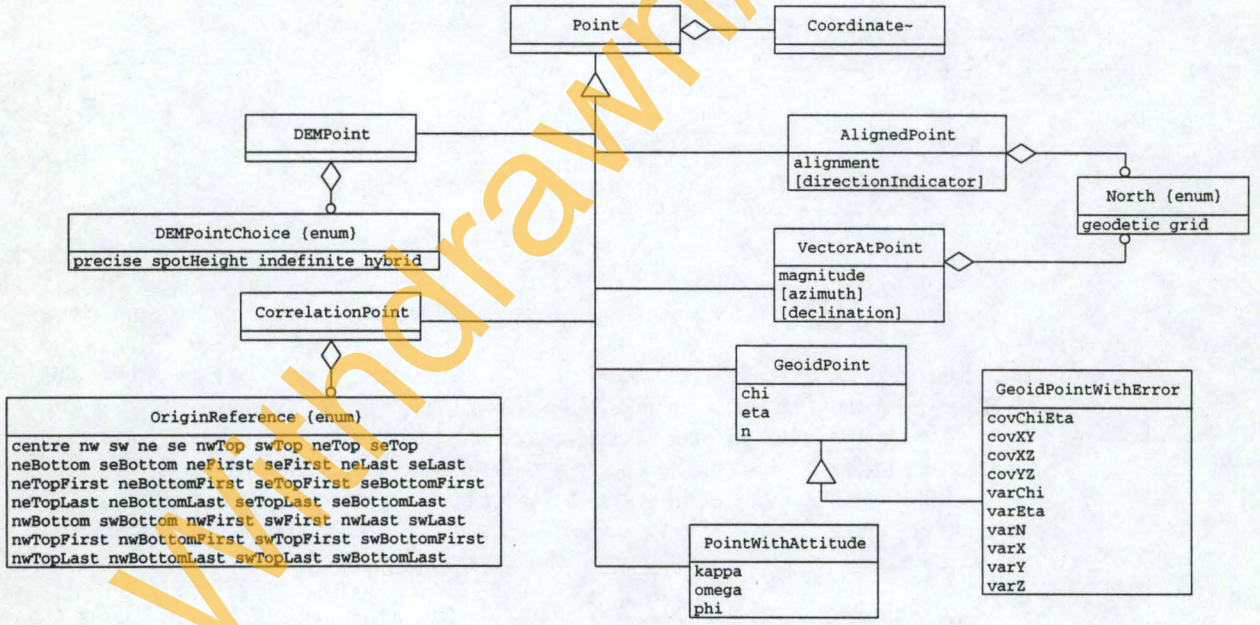


Figure 3-9 Structure of Point

"

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<Point

subclass: **AlignedPoint**

attributes:

alignment	Numeric
[north]	North
[directionIndicator]	Boolean

defaults:
north:grid
directionIndicator:false

comments: "Many spatial entities may be represented as a point geometrically (depending upon the compilation scale, application, etc.). Of these, some have an alignment naturally associated with them. In effect the alignment of the point is equivalent to a zero magnitude vector. Examples include rapids and sluice gates, tanks, swimming pools, etc. The alignment is assumed to be on (or projected on) the x-y surface defined by the coordinate system.

alignment: alignment (orientation or direction) is treated as an azimuth measured in degrees, with 0 degrees identified as North, and clockwise considered as positive.

north: this attribute specifies which notion of North is being used with respect to direction. The typical value is grid, which is the default.

directionIndicator: whether or not a particular direction is intended may be specified as either true or false.

true: this may be the case with rapids and sluice gates for example, if the alignment is meant to be meaningful with the direction of the water flow. The direction faced by the front of a building (and the building's position) may also be defined by an instance of AlignedPoint, with directed set to true.

false: this would be the case with horizontal water tanks, swimming pools, and other situations where the orientation of the main axis is intended but not a specific direction."

>

Withdrawn/Retiree

<Point

subclass: **VectorAtPoint**

attributes:

magnitude	Numeric
[azimuth]	Numeric
[declination]	Numeric
[north]	North

defaults: north:grid

comments: "This subclass is useful for providing magnitude and angle measurements at a given point. The magnitude for example may represent pressure, velocity, etc."

>

<VectorAtPoint

subclass: **VelocityAtPoint**

attributes: [units] UnitMeaning

defaults: units:kilometresPerHour

comments: "In this subclass magnitude is taken to mean speed."

>

<Point

subclass: **DEMpoint**

attributes: [demPoint] DEMpointChoice

comments: "DEMpoint is used by the surface subclass DEM. The type of DEM point may be specified."

>

Withdrawn/Retirée

<Point

subclass: **CorrelationPoint**

attributes:

gridCoordinates	List(Integer)
[locationInCell]	OriginReference

comments: "CorrelationPoint relates a real world position to a particular grid cell, as specified by a series of grid coordinate values. For example, in 2-D they represent the row and column of the cell of interest in the grid. The location within the grid may be further refined by providing a value for locationInCell, such as *nw* or *centre*, for the northwest corner or the centre of the cell, respectively.

An instance of CorrelationPoint, a number of such instances, or an explicitly defined instance of geometricAggregate (consisting of such points) may be used as the basis of geometrically rectifying an instance of Grid (or Raster). This may be indicated by using the Control relationship."

>

<Point

subclass: **GeoidPoint**

attributes:

chi	Real
eta	Real
n	Real

restricted: coords:^Coord3DT

comments: "This point subclass is used for the storage of geodetic control points, where more information is available than simply c1, c2, c3 and t. The units for chi and eta are seconds of arc, and for n the units are metres. Consider a normal to the ellipsoid and a normal to the geoid (the plumb line) constructed such that they intersect. Project the geoid's normal onto a north-south plane containing the ellipsoid's normal.

chi is the angle between the projected geoid's normal and the ellipsoid's normal.

eta is the angle, as measured on a plane defined by projecting the geoid's normal onto the plane orthogonal to the first and also containing the ellipsoid's normal, between the second projection of the geoid's normal and the ellipsoid's normal.

n is the geoid undulation, the difference in metres between the geoid and the ellipsoid, measured along a normal to the ellipsoid."

>

Withdrawn/Retirée

<GeoidPoint

subclass: **GeoidPointWithError**

attributes:

varC1	Real
varC2	Real
varC3	Real
varChi	Real
varEta	Real
varN	Real
covC1C2	Real
covC1C3	Real
covC2C3	Real
covChiEta	Real

comments: "This subclass includes variance and covariance estimates for geodetic positions. Note that a variance estimate for time (t) is not given."

>

<Point

subclass: **PointWithAttitude**

attributes:

omega	Real
phi	Real
kappa	Real

restricted: coord:^Coord3DT

comments: "This subclass is used for describing a point that provides the position of the lens or sensor used for airborne imaging. The additional attributes provide the geometry of the image plane of the camera. *omega, phi* and *kappa* refer to lateral tilt (rotation about c1 (primary) axis), longitudinal tilt (rotation about the c2 axis), and swing (rotation about the c3 axis), respectively. These definitions are all with reference to the photogrammetric, right handed coordinate system, c1,c2,c3, in the model space with the positive direction of the c1-axis close to the direction of the flight line and that of the c3-axis upward, as defined by the International Society for Photogrammetry, London, 1960. *(Albertz and Kreiling, 1975)*"

>

Withdrawn/Retirée

<GeometricObject

subclass: **VectorLine**

comments: "VectorLine is an abstract superclass for representing one dimensional geometric objects in the higher dimensional space defined through the coordinates.

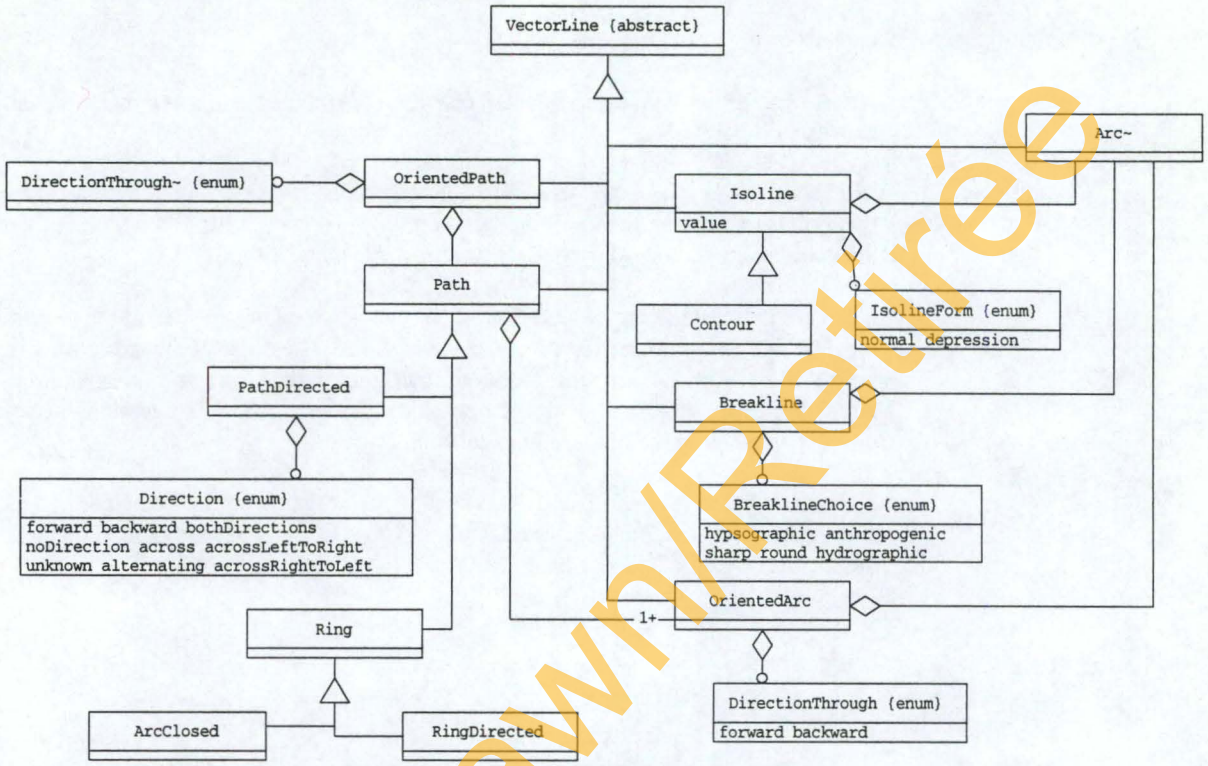


Figure 3-10 Structure of VectorLine

"

>

Withdrawn/Retirée

<VectorLine

subclass: **Arc**

attributes: pointList List(Point)
[arcDescription] ArcDefinition

defaults: arcDescription.type:line

constraints: "If arcDescription.type is *circularArc* or *ellipticalArc,* then *pointList* must contain exactly two points."

comments: "Arc is the locus of points connecting a list of points. Every arc must include at least two points in the point list defining position, as well as a description which defines the mathematical method used for generating the locus.

If the arc is a circular arc or an elliptical arc (as indicated under description), position must be defined as consisting of exactly two points. The order of the two points is such that a clockwise direction, from the first point to the second point around the circle or ellipse, specifies the arc. If a complete circle or ellipse is intended, the same point is repeated in the list of points defining position.

If the description is unspecified, the points on the arc are assumed to be connected by straight lines; that is, the choice of arc (from CurveChoice) as specified in the arc description is assumed to be *line.*

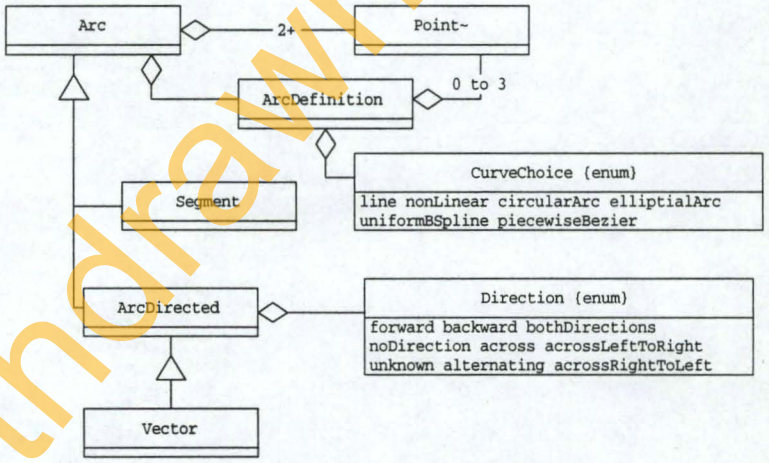


Figure 3-11 Structure of Arc

"

>

Withdrawn/Retirée

<Arc

subclass: **ArcDirected**

attributes: [flowDirection] Direction

defaults: flowDirection:forward

comments: "The class ArcDirected is used where some kind of movement or direction exists along or across the arc. A value of forward for direction implies movement from the first point in the list of points defining position to the last point, either directly on the arc or along one or both sides of the arc. Besides forward, backward, bothDirections, noDirection and unknown, the value of direction may be specified as across, acrossLeftToRight, and across RightToLeft. These last three options imply movement crossing the arc, instead of along the arc. Right and left are with respect to a traverse along the arc from the first point to the last point in the list of points. If direction is unspecified, it is assumed that it is forward."

>

<ArcDirected

subclass: **Vector**

restricted: arcDescription.type: line

constraints: "*pointList* contains exactly two points."

comments: "This defines the simplest form of a directed arc. (Note that if it is desired to use the concept of angle and magnitude, as related to force or velocity for example, the subclasses VectorAtPoint and VelocityAtPoint may be of interest.)"

>

<Arc

subclass: **Segment**

constraints: "*pointList* contains exactly two points."

comments: "The segment may be a straight line, a portion of a circle, or a portion of an ellipse, depending upon the value of description."

>

Withdrawn/Retiree

<VectorLine

subclass: **OrientedArc**

attributes:

arc	Arc
[traversalDirection]	DirectionThrough

defaults: traversalDirection:forward

comments: "referencing is used to specify whether the arc is traversed (or accessed) in a forward or backward direction. This subclass is required in the construction of the subclass Path, and indirectly, by Polygon."

>

<VectorLine

subclass: **Breakline**

attributes:

arc	Arc
[breaklineType]	BreaklineChoice

comments: "Breakline is used by the surface subclass MeasuredSurface. The type of breakline may be specified."

>

<VectorLine

subclass: **Isoline**

attributes:

value	Numeric
arc	Arc
[form]	IsolineForm

comments: "Isoline is used by the surface subclass Isolines. An isoline may relate for example to temperature or rainfall. Note that instances of this subclass must be used as part of an instance of Isolines.

value: value is constant along the arc. The type of numeric value expected is defined under Isolines.

arc: a single arc is provided for an isoline.

form: indicates the kind of isoline, either depression or normal."

>

Withdrawn/Retirée

<Isoline

subclass: **Contour**

constraints: "If specified, coords.c3 for every point on the arc must equal the value for elevation."

comments: "Contour is used by the surface subclass Contours.

value: value is interpreted as elevation. It specifies the z value for all points on the arc.

The other attributes are as defined under Isoline."

>

<VectorLine

subclass: **Path**

attributes: arcList List(OrientedArc)

constraints: "The arcs form a contiguous line. The points on the path are referenced sequentially."

comments: "The general notion of a path is a sequence of contiguous arcs such that adjacent arcs are joined at start points or end points only. Furthermore, the points composing all of the arcs together must be able to be referenced (or accessed) in a one-directional, sequential order; this is accomplished by the appropriate choice for referencing for each of the individual orientedArcs composing the path.

If adjacent arcs which compose the path are defined as uniformBspline or piecewiseBezier, the duplicated points at the start and/or end points of the arcs are treated as single points and the curve is fit smoothly through the point from arc to arc."

>

Withdrawn/Retirée

<Path

subclass: **PathDirected**

attributes: [direction] Direction

defaults: direction:forward

comments: "The class PathDirected is used where some kind of movement or direction exists along or across the entire path. If direction is unspecified, it is assumed to be forward."

>

<Path

subclass: **Ring**

constraints: "The ring is closed, such that the first and last referenced points are equal or identical (i.e, shared)."

comments: "A Ring consists of one or more contiguous arcs such that the initially referenced point in the first arc and the last referenced point in the last arc coincide to form a closed structure. No component arc in the ring structure may intersect, or cross, itself or another arc in the ring. The ring may be organized in either a clockwise or counterclockwise direction."

>

<Ring

subclass: **ArcClosed**

constraints: "There exists only a single arc on the path."

comments: "This subclass represents the simplest form of a ring."

>

Withdrawn/Retirée

<Ring

subclass: **RingDirected**

constraints: "All the oriented arcs composing the ring contain an arc of type ArcDirected"

comments: "The class RingDirected is used where some kind of movement or direction exists along or across the ring."

>

<VectorLine

subclass: **OrientedPath**

attributes: path Path
[traversalDirection] DirectionThrough

defaults: traversalDirection:forward

comments: "If referencing is forward, the points along the path are accessed beginning with the first orientedArc. If referencing is backward, the points on the orientedPath are referenced in the reverse order, i.e., beginning with the last orientedArc and the last point within that arc. (This construction allows the path forming the boundary of a polygon to be shared by another polygon as an inner boundary.)"

>

Withdrawn/Retirée

<GeometricObject

subclass: **VectorArea**

comments: "VectorArea is an abstract superclass for description of two dimensional geometric objects in the vector format. The dimensionality of the space in which area objects exist, 2 or greater, is defined through the choice of coordinates.

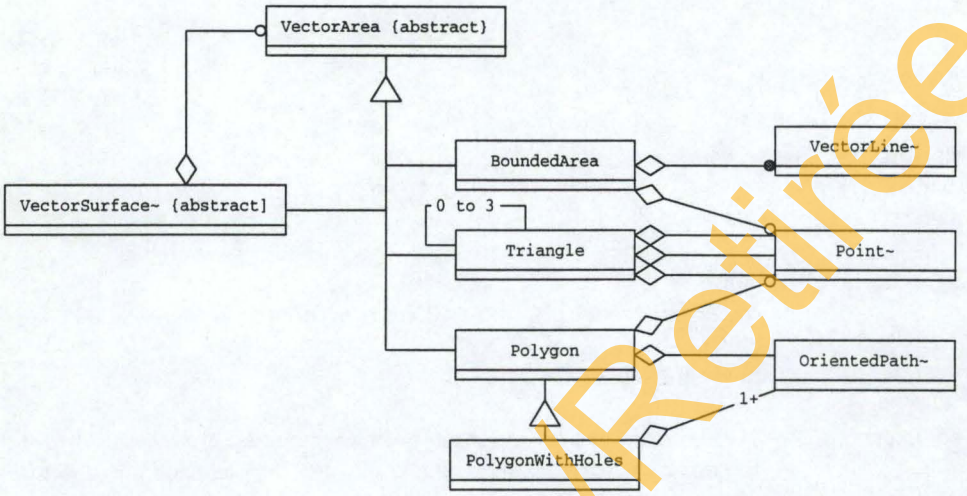


Figure 3-12 Structure of VectorArea

"

>

<VectorArea

subclass: **BoundedArea**

attributes: [boundary] Set(VectorLine)
[insidePoint] Point

comments: "The *boundary* consists of one or more lines which together completely bound a single, contiguous area. The lines may all join or intersect one another; alternatively, they may form an outer boundary and one or more inner boundaries.

The *insidePoint* is any arbitrary point which falls inside the bounded area and which does not intersect the boundary.

The concept of a BoundedArea is similar to that of Polygon or PolygonWithHoles. However with the latter classes, rigorous rules apply to the construction of boundaries."

>

Withdrawn/Retirée

<VectorArea

subclass: **Polygon**

attributes: boundary OrientedPath
[insidePoint] Point

restricted: boundary.path:Ring

constraints: "referencing for the boundary and its constituent orientedArcs is such that the polygon is circumscribed in a right-handed, clockwise fashion."

comments: "This is the primary class for specifying polygons. Note that because the *boundary* is treated as bounding an area in two dimensional space, the polygon is separate different from the *boundary*. The *boundary* must be constructed to ensure that the referencing of the path and the individual arcs is such that the polygon's interior is always to the right as the *boundary* is traversed.

The *insidePoint* is any arbitrary point which falls inside the bounded area and which does not intersect the boundary. An *insidePoint* is not required to establish the inside of a polygon, but it may be given if desired."

>

<Polygon

subclass: **PolygonWithHoles**

attributes: innerBoundaries Set(OrientedPath)

restricted: innerBoundaries{}.path:Ring

constraints: "referencing for each innerBoundary and its constituent orientedArcs is such that the polygon is circumscribed in a right-handed fashion."

comments: "A PolygonWithHoles consists of an (outer) boundary inherited from Polygon and one or more other (inner) boundaries. Each of the other boundaries must be constructed such that the polygon's interior is always to the right of the boundary, as the boundary is traversed."

>

Withdrawn/Retirée

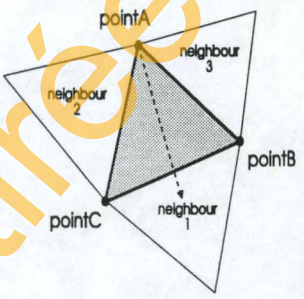
<VectorArea

subclass: **Triangle**

attributes:

pointA	Point
pointB	Point
pointC	Point
[neighbours]	List(Triangle)

constraints: "The points are given in a clockwise direction, such that the area of interest is on the right.
Neighbours consists of the object identifiers of the three adjacent triangles, listed such that the first is opposite *pointA*, the second is opposite *pointB* and the third is opposite *pointC*."



comments: "The three sides of the triangle are all assumed to be straight line segments, and thus, they need not be specified explicitly. If one or more neighbours do not exist, this may be indicted by the use of the *nil* value."

>

Withdrawn/Retirée

<VectorArea

subclass: **VectorSurface**

attributes: [arealExtent] VectorArea

comments: "Surface is an abstract superclass. Note that for many applications the arealExtent will be smaller than that implied by the positions of the objects identified in the subclasses. For example, a MeasuredSurface or TIN may extend beyond the arealExtent to help ensure appropriate interpolation. Note also that the arealExtent may have two or three dimensional coordinates. If 3-D coordinates are used, it is assumed that they fall on the surface.

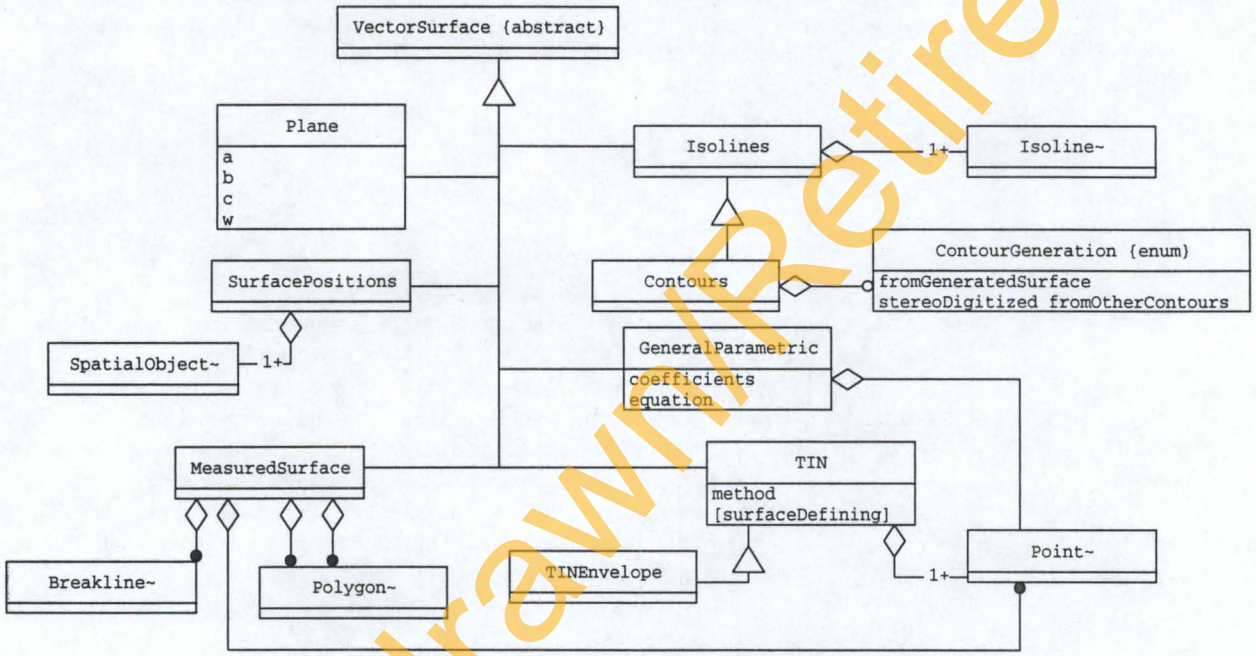


Figure 3-13 Structure of VectorSurface

"

>

<VectorSurface

subclass: **SurfacePositions**

attributes: objects Set(Point)

comments: "The positions of a set of points which fall on a surface are specified. Through subclasses of Point, SurfacePositions could pertain for example to a collection of points with associated velocity vectors."

>

Withdrawn/Retirée

<VectorSurface

subclass: **TIN**

attributes:

triangles	Set(Triangle)
[surfaceDefining]	String
[method]	String

comments: "This is a subclass for the description of triangular irregular networks. The triangles needed to define the TIN are provided. If the TIN is based on a specific set of surface defining features these may be provided by as a textual description by the attribute *surfaceDefining*. The method states the algorithm or scheme used to create the triangulation. The usual method is Delaunay triangulation; however, where the terrain has preferred directions, other techniques may result in a TIN which better approximates the surface."

>

<TIN

subclass: **TINEnvelope**

constraints: "All triangles have three adjacent triangles sharing a common (implicitly defined) arc."

comments: "This is a subclass for the description of triangular irregular networks that may be used to define an enclosing surface in 3 dimensional space. Note that every triangle will have three triangles as adjacent neighbours; that is, no triangle will have nil as a neighbour. Also, the surface defined by an instance of TINEnvelope is multivalued, having more than a single z value for any c1,c2 location (except for points on the periphery)."

>

<VectorSurface

subclass: **MeasuredSurface**

attributes:

[masspoints]	Set(Point)
[breaklines]	Set(Breakline)
[areasOfExclusion]	Set(Polygon)
[areasIndefinite]	Set(Polygon)

comments: "This subclass is for surfaces defined by a series of irregularly spaced points with possible breaklines, areas of exclusion and indefinite areas.

masspoints provide a general model of the surface being defined.

breaklines include linear features which define significant breaks in the surface trend.

Withdrawn/Retired

areasOfExclusion are areas where points are purposely missing, in the case of an irregular digital elevation model these might include lakes or open-pit mines.

areasIndefinite are areas where elevation values may be considered uncertain, as with the determination of elevation on some glaciers in an irregular DEM captured using photogrammetry"

>

<VectorSurface

subclass: **Isolines**

attributes: lines List(Isoline)

constraints: "The surface behaves in accordance with the concept of isolines."

comments: "The isolines are constrained such that no isoline can exist between two adjacent isolines unless the value associated with the isoline falls between the values associated with the adjacent isolines, or is equal to the value for one of the adjacent isolines."

>

<Isolines

subclass: **Contours**

attributes: [generationType] ContourGeneration

restricted: lines{}:Contour

comments: "Contours are a special case of isolines, referring specifically to elevation values. Note that as the elevation values are stated in lines, the z values for each point need not be provided; thus, for example, Coord2D may be used instead of Coord3D for the position of each point.

generation provides information about how the contours were generated, whether for example they were collected through stereo digitization or derived through interpolation."

>

Withdrawn/Retirée

<VectorSurface

subclass: **Plane**

attributes:

a	Real
b	Real
c	Real
w	Real

comments: "The equation is of the form: $0 = aX + bY + cZ + w$ where a, b and c are coefficients associated with x, y, and z, and w is a constant."

>

<VectorSurface

subclass: **GeneralParametric**

attributes:

equation	String
coefficients	List(Real)
side	Point

restricted: side:^Point

comments: "This subclass addresses the general case of a surface elevation defined parametrically and by its lateral extent. The equation used is described as a String. All coefficients and constants are given under coefficients, in the order of occurrence in the equation from left to right. The syntax of the equation follows that of the C programming language, with x, y, and z considered as reserved variables. The general form of the equation is defined as 0 = ... For example, 0 = a*x + b*y + c*x*y + d*z + e.

In cases where the arealExtent divides the surface into two or more surfaces occupying the same lateral extent, such as the top and bottom of a sphere, a point is used to indicate which one of the resulting surfaces are of interest. The point must reside on the surface section of interest.

If it is intended to describe a closed surface, such as a sphere, the arealExtent is left unspecified. If the equation defines a cylinder, the domain of the arealExtent is PolygonWithHoles with an outer and inner boundary; these boundaries are used to indicate the ends of the cylinder."

>

Withdrawn/Retirée

<GeometricObject

subclass: **VectorVolume**

comments: "VectorVolume is an abstract superclass for the description of three dimensional geometric objects. The dimensionality of the space in which they reside, 3 or higher, is defined by the choice of coordinates.

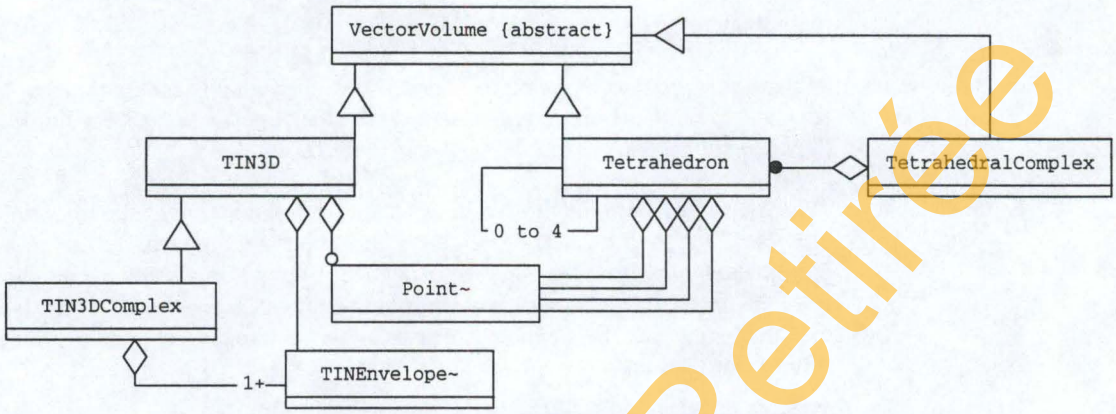


Figure 3-14 Structure of VectorVolume

"

>

<VectorVolume

subclass: **TIN3D**

attributes: boundary TINEnvelope
[insidePoint] Point

comments: "This is a subclass for the description of a volume bounded by a triangular irregular network. A point inside the volume may be specified."

>

<TIN3D

subclass: **TIN3DComplex**

attributes: innerBoundaries Set(TINEnvelope)

comments: "If a TIN3D has voids or holes in it, it may be modelled using this subclass. Each void is defined by an inner boundary."

>

Withdrawn/Retirée

<VectorVolume

subclass: **Tetrahedron**

attributes:

pointA	Point
pointB	Point
pointC	Point
pointD	Point
[neighbours]	List(Tetrahedron)

constraints: "*Neighbours* consists of the object identifiers of the four adjacent tetrahedra, listed such that the first is opposite *pointA*, the second is opposite *pointB*, the third is opposite *pointC* and the fourth is opposite *pointD*."

comments: "The four points defining the vertices of a tetrahedron are provided by *pointA, pointB, pointC,* and *pointD.* The 0 to four neighbouring tetrahedra are given by the attribute *neighbours.* (The relationship between the four points and the neighbours of a tetrahedron, as stated in the constraints clause above, is equivalent to that between the three points and the neighbours of a triangle. See the diagram under Triangle for further clarification.)

The four faces of the tetrahedron are assumed to be triangles defined by straight line segments; thus, neither the triangles nor the line segments need be specified explicitly. If one or more neighbours do not exist, this may be indicated by the use of the *nil* value."

>

<VectorVolume

subclass: **TetrahedronComplex**

attributes:

tetrahedra	Set(Tetrahedron)

constraints: "The tetrahedra occupy non-overlapping regions of space."

comments: "This is a subclass for the description of a volume enclosed by a series of tetrahedra which may or may not be contiguous."

>

Withdrawn/Retired

<GeometricObject

subclass: **CellularStructure**

comments: "CellularStructure is an abstract superclass for description of spatial or spatio-temporal gridded structures.

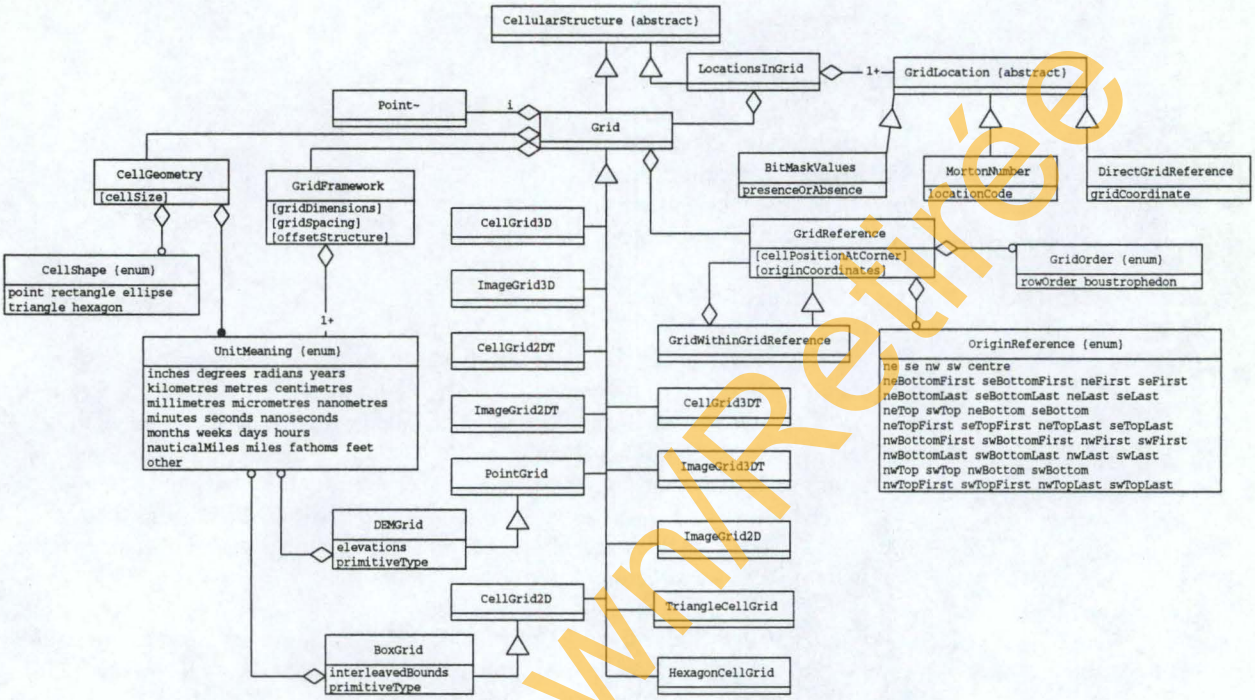


Figure 3-15 Structure of CellularStructure

"

>

Withdrawn/Retirée

<CellularStructure

subclass: **Grid**

attributes:

[positionOfOrigin]	Point
orderAndOrigin	GridReference
spacing	GridFramework
[cellGeometry]	CellGeometry

defaults:

cellGeometry.cellShape:rectangle
orderAndOrigin.ordering:rowOrder
orderAndOrigin.originCorner:nw
orderAndOrigin.cellPositionAtCorner:true
orderAndOrigin.originCoordinates{}:1
spacing.offsetStructure:none

restricted: positionOfOrigin:^Point

comments: "A variety of rectangular, triangular and hexagonal gridded structures are supported. Rectangular grids can be defined in two (c1,c2), three (c1,c2,c3) or (c1,c2,t), or four (c1,c2,c3,t) dimensions. Triangular and hexagonal grids are always assumed to be planar (i.e., two spatial dimensions), stacked versions of these two dimensional structures to define honeycombs for example, or even four dimensional structures, with time as the fourth dimension. In such cases the first two dimensions have a triangular or hexagonal structure, and the third and possibly fourth dimensions have a regular orthogonal structure.

positionOfOrigin: the real world position of the the local origin (i.e. starting point) of the grid is given by positionOfOrigin. For example, with typical satellite imagery, this point corresponds to the position on the earth of the upper left hand corner of the image, corresponding to the northwest corner of the first cell in the image.

orderAndOrigin: four items are specified through the complex domain GridReference: (i), whether the structure follows a row order, a column order, a boustrophedon ordering in the horizontal direction, or a boustrophedon ordering in the vertical direction; (ii), the corner of the grid to which the positionOfOrigin refers, e.g. northwest or southwest corner, (iii), whether the positionOfOrigin pertains to the centre or the corner of the cell to which positionOfOrigin is referenced; (iv), the grid coordinates of that cell, such as (1,1) or (0,0), or any arbitrary integers if the grid in question is located with respect to a larger grid.

spacing: four items are specified through the complex domain GridFramework: (i), the grid dimensions (number of columns, rows, etc.); (ii), the spacing (e.g. in metres or degrees) between grid locations in each dimension; (iii), the type of real world units (e.g. metres or seconds) corresponding to the grid spacing values given above; and (iv), whether a regular or offset structure applies (the latter is the case with triangular or hexagonal grids).

cellGeometry: if cellGeometry is not specified, the cell dimensions are assumed to correspond exactly to the spacing of the grid framework, and the units and shape of the cell geometry are as given in the defaults above. This describes

Withdrawn/Retirée

the typical situation. However, the cellGeometry does not have to fit precisely in the grid. The cells may be larger than the grid spacing, in which case they overlap, or smaller, in which case the grid is not space filling. The cells may be rectangular (or square) or elliptical (or circular) in n-dimensional space, or triangular or hexagonal in two dimensional space.

Subclasses have been included to provide formal restricted *Grid* definitions for many of the most common uses of cellular structures. Many other structures exist for which formal definitions have not been included.

SAIF provides support for rectangular gridded structures in two and three dimensions. As indicated above, it also allows specification of triangular and hexagonal gridded structures in two dimensions. With triangular and hexagonal structures there exists a set of three primary axes, which may be as compass directions either (i) 30° - 210°, 90° - 270°, and 150° - 330°, or alternatively, (ii) 0° - 180°, 60° - 240°, and 120° - 300°. The first case corresponds to triangles arranged in horizontal layers (and hexagons stacked vertically); in the second case the triangles are stacked in vertical columns (and the hexagons are arranged in horizontal layers).

For example, horizontal layering of hexagons (case two above) would be indicated by specifying:

cellGeometry.cellShape:hexagon
orderAndOrigin.ordering:rowOrder
orderAndOrigin.originCorner:nw
orderAndOrigin.cellPositionAtCorner:false
spacing.offsetStructure:in
"

>

<Grid

subclass: **PointGrid**

restricted: cellGeometry.cellShape:point
cellGeometry.cellSize{}:0
cellGeometry.units:nil

comments: "This class is for n-dimensional point grids. Note that the geometry of the cell at every location in the grid reduces to a point."

>

Withdrawn/Retired

<PointGrid

subclass: **DEMGrid**

attributes:

primitiveType	PrimitiveInstanceType
elevations	List(Primitive)
[elevationUnits]	UnitMeaning

defaults: elevationUnits:metres

restricted: orderAndOrigin.originCorner:sw
orderAndOrigin.ordering:rowOrder
positionOfOrigin.position:Coord2D

comments: "Both grid dimensions are spatial in nature. The units of measurement for the elevations are specified by elevationUnits, with a default of metres."

>

<Grid

subclass: **CellGrid2D**

restricted: orderAndOrigin.originCorner:sw
positionOfOrigin.position:Coord2D
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "Both grid dimensions are spatial in nature. This class is appropriate for defining the space occupied is typical non-image geographic raster data."

>

<CellGrid2D

subclass: **BoxGrid**

attributes:

primitiveType	PrimitiveInstanceType
interleavedBounds	List(Primitive)
[elevationUnits]	UnitMeaning

defaults: elevationUnits:metres

restricted: orderAndOrigin.ordering:rowOrder

comments: "This subclass provides for the specification of a complete grid of boxes. The upper and lower bounds of each box are provided in an interleaved form carried by the attribute interleavedBounds. The units of measurement for the elevations are specified by elevationUnits, with a default of metres."

>

Withdrawn/Retirée

<Grid

subclass: **ImageGrid2D**

restricted: orderAndOrigin.originCorner:nw
orderAndOrigin.ordering:rowOrder
positionOfOrigin.position:Coord2D
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "Both dimensions are spatial in nature. This class is appropriate for defining the space occupied by typical image data."

>

<Grid

subclass: **CellGrid3D**

restricted: orderAndOrigin.originCorner:swBottom
positionOfOrigin.position:Coord3D
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "All three grid dimensions are spatial in nature. This class is appropriate for defining the space occupied by typical three dimensional geographic raster data."

>

<Grid

subclass: **ImageGrid3D**

restricted: orderAndOrigin.originCorner:nwTop
positionOfOrigin.position:Coord3D
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "All three grid dimensions are spatial in nature. This class is appropriate for defining the space occupied by typical three dimensional image raster data."

>

Withdrawn/Retirée

<Grid

subclass: **CellGrid2DT**

restricted: orderAndOrigin.originCorner:swFirst
positionOfOrigin.position:Coord2DT
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "This structure consists of two spatial dimensions and one time dimension. This class is appropriate for defining the space and time of vertically stacked normal 2D rasters, where each normal 2D raster pertains to the same physical space at a different time. Note that to use this structure, the 2D rasters must be equally spaced in time."

>

<Grid

subclass: **ImageGrid2DT**

restricted: orderAndOrigin.originCorner:nwLast
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "This structure consists of two spatial dimensions and one time dimension. This class is appropriate for defining the space and time occupied by vertically stacked images where each image pertains to the same physical space at a different time. Note that to use this structure, the images must be equally spaced in time."

>

<Grid

subclass: **CellGrid3DT**

restricted: orderAndOrigin.originCorner:swBottomFirst
positionOfOrigin.position:Coord3DT
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "This structure consists of three spatial dimensions and one time dimension."

>

Withdrawn/Retired

<Grid

subclass: **ImageGrid3DT**

restricted: orderAndOrigin.originCorner:nwTopLast
positionOfOrigin.position:Coord3DT
cellGeometry.cellShape:rectangle
spacing.offsetStructure:none

comments: "This structure consists of three spatial dimensions and one time dimension."

>

<Grid

subclass: **HexagonCellGrid**

restricted: orderAndOrigin.cellPositionAtCorner:false
positionOfOrigin.position:Coord2D
cellGeometry.cellShape:hexagon
spacing.offsetStructure:in | out

comments: "This structure consists of a two-dimensional offset gridded structure composed of hexagons with grid locations positioned at the centre of each hexagon."

>

<Grid

subclass: **TriangleCellGrid**

restricted: orderAndOrigin.cellPositionAtCorner:true
positionOfOrigin.position:Coord2D
cellGeometry.cellShape:triangle
spacing.offsetStructure:in | out

comments: "This structure consists of a two-dimensional offset gridded structure composed of triangles with grid locations positioned at the corner of each triangle. The locating corner is consistent with the *originCorner* attribute."

>

< CellularStructure

subclass: **LocationsInGrid**

attributes:

grid	Grid
locations	Set(GridLocation)

Withdrawn/Retirée

comments: "One or more locations in a grid may be referenced (i) through the grid coordinates, (ii) by providing one or more morton numbers, or (iii) by providing a set of mask values, i.e. 0s and 1s, corresponding to the locations in the grid.

The assignment of the locations in the grid is dependent upon the value for *grid.orderAndOrigin.originCorner*. Consider the following two cases:

If the value for this attribute is *nw*, then the location with the smallest coordinate values, typically (1,1) or (0,0), is assumed to be the upper left corner. If a morton number is provided, the basic quad tree structure is assume to be based on 1 in the upper left, 2 in the upper right, 3 in the lower left, and 4 in the lower right.

If the value for this attribute is *sw*, then the location with the smallest coordinate values is assumed to be the lower left corner. If a morton number is provided, the basic quad tree structure is assume to be based on 1 in the lower left, 2 in the lower right, 3 in the upper left, and 4 in the upper right.

A similar situation holds if three or four dimensions are considered."

>

Withdrawn/Retirée

Chapter 3, Section 3

Time Classes

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3.3 Time Classes

<AbstractObject

subclass: **TimeObject**

comments: "This is an abstract superclass with subclasses which address a variety of time related concepts, including dates, time during a day, intervals and durations.

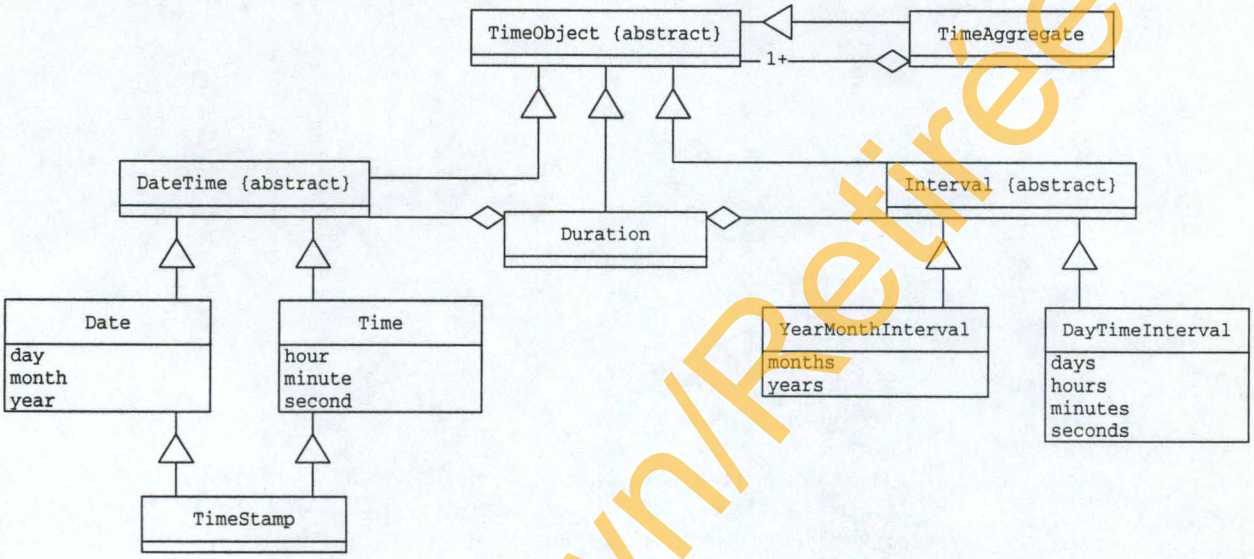


Figure 3-16 High Level Structure of Time Class

"

>

<TimeObject

subclass: **TimeAggregate**

attributes: objects Set(TimeObject)

restricted: objects{}:DateTime|Interval|Duration

comments: "Recursion is not allowed in this subclass due to the restricted clause above. Data must be defined as a list or set of TimeObject."

>

Withdrawn/Retiree

<TimeObject

subclass: **DateTime**

comments: "This is an abstract superclass dealing with date and time constructs. This corresponds to the SQL concept, DateTime."

>

<DateTime

subclass: **Date**

attributes:

[year]	Integer
[month]	Integer
[day]	Integer

restricted:
month: 1..12
day: 1..31

constraints:
"month - unsigned integer.
day - unsigned integer."

comments: "This corresponds exactly to the SQL type, Date, with the following exceptions. Unlike SQL, the year may be negative implying BC (or BCE) on the Gregorian calendar. Note also that the default for year, month and day is nil."

>

<DateTime

subclass: **Time**

attributes:

hour	Integer
minute	Integer
second	Real

restricted:
hour: 0..24
minute: 0..59

constraints:
"hour - unsigned integer.
minute - unsigned integer.
second - positive."

comments: "This corresponds exactly to the SQL type, Time."

>

Withdrawn/Retirée

<Date, Time

subclass: **TimeStamp**

comments: "This corresponds exactly to the SQL type, TimeStamp."

>

<TimeObject

subclass: **Interval**

comments: "This is an abstract superclass with subclasses designating different types of time intervals."

>

<Interval

subclass: **YearMonthInterval**

attributes:	[years]	Integer
	[months]	Integer
defaults:	years:0	
	months:0	

comments: "An interval is defined in terms of a number of years and months."

>

<Interval

subclass: **DayTimeInterval**

attributes:	[days]	Integer
	[hours]	Integer
	[minutes]	Integer
	[seconds]	Real
defaults:	days:0	
	hours:0	
	minutes:0	
	seconds:0.0	

comments: "An interval is defined in terms of a number of days, hours, minutes and seconds."

>

Withdrawn/Retirée

<TimeObject

subclass: **Duration**

attributes:

startTime	DateTime
lengthOfTime	Interval

comments: "A duration is defined in terms of a start date and time (startTime), and an interval (lengthOfTime) beginning at that point in date/time. The end of the duration may be calculated by adding the value for interval to that for dateAndTime."

>

Withdrawn/Retirée

Chapter 3, Section 4

Text or Symbol Classes

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3.4 TextOrSymbol Classes

<AbstractObject

subclass: **TextOrSymbolObject**

attributes: [qualifier] LocationalQualifier

comments: "This is an abstract superclass within which all text or symbol objects are spatially referenced in SAIF. All objects belonging to this superclass have position specified directly or indirectly through their constituent components. The high level structure of TextOrSymbolObject is shown below.

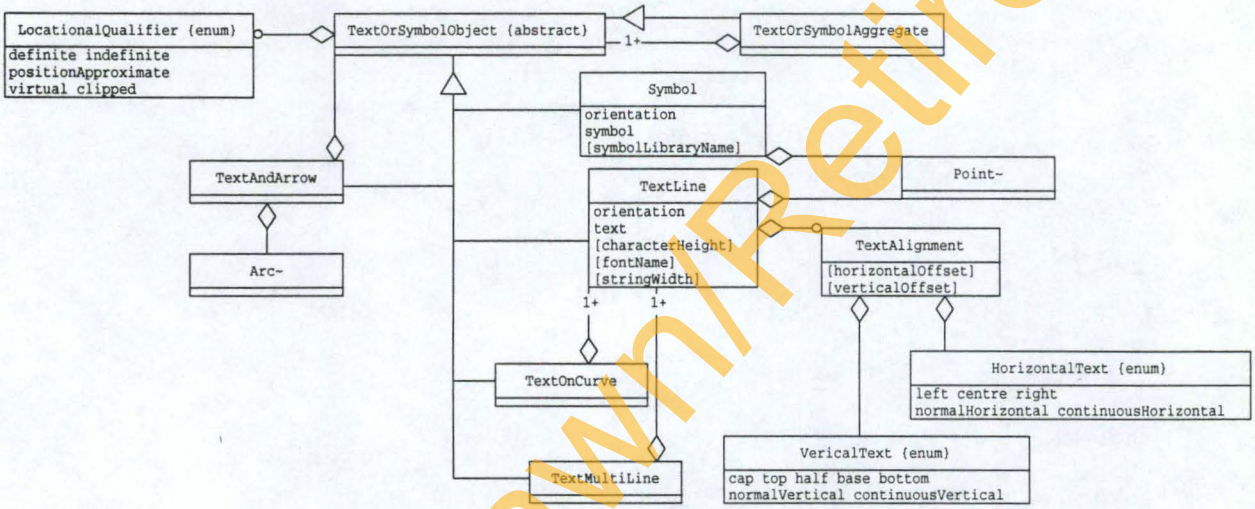


Figure 3-17 High Level Structure of TextOrSymbolObject

qualifier: this provides for a categorical notion of fuzziness with regards to position."

>

<TextOrSymbolObject

subclass: **TextOrSymbolAggregate**

attributes: objects Set(TextOrSymbolObject)

restricted: objects{}:TextLine | TextMultiLine | TextAndArrow | Symbol

comments: "Recursion is not allowed in this subclass due to the restricted clause above. Data must be defined as a List or Set of TextOrSymbolObject."

>

Withdrawn/Retired

<TextOrSymbolObject

subclass: **TextLine**

attributes:

position	Point
text	String
[characterHeight]	Real
[stringWidth]	Real
[orientation]	Numeric
[alignment]	TextAlignment
[fontName]	String
[other]	String

restricted: position:^Point

comments: "TextLine carries text referenced to positions with respect to a specified coordinate system. The coordinate for the origin of the rectangle containing the text is held by *position*. Note that all units are those of the spatial referencing system. The attribute *orientation* contains a numeric value defining the text rotation angle in degrees clockwise from the c2 axis."

>

<TextOrSymbolObject

subclass: **TextOnCurve**

attributes: characters List(TextLine)

constraints: "The text in each textline is a single character."

comments: "This subclass is designed for text which does not follow a straight line. Each character is specified individually."

>

<TextOrSymbolObject

subclass: **TextMultiLine**

attributes: textLines List(TextLine)

comments: "This subclass is useful where a series of text lines are directly associated with one another, as might be the case with a multiline label or with a block of text."

>

Withdrawn/Retirée

<TextOrSymbolObject

subclass: **TextAndArrow**

attributes:

textOrSymbol	TextOrSymbolObject
arrow	Arc

restricted: textOrSymbol:TextLine | TextOnCurve | TextMultiLine | Symbol | TextOrSymbolAggregate

comments: "If a leader line or arrow is required with text when being used as a label, then this subclass may be used."

>

<TextOrSymbolObject

subclass: **Symbol**

attributes:

position	Point
symbol	String
[orientation]	Numeric
[symbolLibraryName]	String
[other]	String

restricted: position:^Point

comments: "This class carries a descriptive map symbol with respect to a georeferenced position. The location of the symbol is provided by the Point geometry. The symbol is specified by a character string that correlates it to a symbol library. Non-circular symbols are oriented by the rotation angle defined by the *orientation* attribute. The rotation angle is measured clockwise from the c2 axis."

>

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Chapter 3, Section 5

Relationship Classes

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3.5 Relationship Classes

<AbstractObject

subclass: **Relationship**

subclassing: "The user may define subclasses of this class."

attributes: objectA AbstractObject
objectB AbstractObject

classAttributes: [cardinalityToTypeAInstances] String
[cardinalityToTypeBInstances] String

comments: "This is an abstract superclass under which a number of classes can be defined, where it is of interest to state that the objects of interest have a specific kind of relationship to one another. The objects in the relationship are given explicitly by providing the object identifiers of the two related objects, objectA and objectB. In the case of asymmetric relationships, objectA has

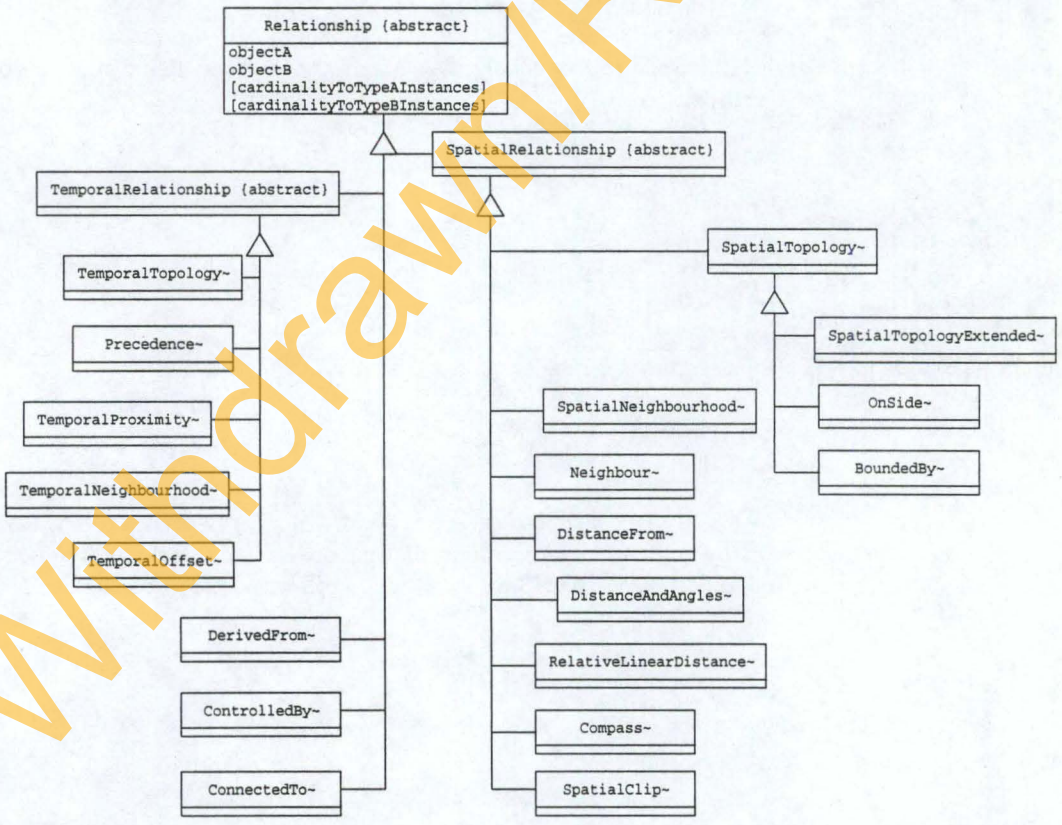


Figure 3-18 Relationship Inheritance Hierarchy

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the stated relationship to objectB. With symmetric relationships, each object has the stated relationship to the other object.

The optional class attributes cardinalityToTypeAInstances and cardinalityToTypeBInstances are used to define the cardinality (i.e. multiplicity) of the relationship. The values for these two class attributes characterize the relationship in the context of the data being described. They do not refer to individual instances of the class.

Consider a *StudentSchool* relationship, with objectA and objectB defined as coming from the domains Student and School, respectively. If a student goes to only one school, but the school is attended by many students, then the values for cardinalityToTypeAInstance and cardinalityToTypeBInstance are *n* and *1*, respectively. In a given jurisdiction there may be a policy that all schools have between 400 and 800 students. In this case the two cardinality attributes have the values *400 to 800* and *1*, respectively.

If it is of interest to specify the cardinality of the relationship, this may be accomplished by creating a user defined subclass (of Relationship or one of its subclasses) and providing values for the two class attributes in the class definition. This is accomplished using the classAttributeValues clause. For example, using the above example, the clause would be as follows:

classAttributeValues: cardinalityToTypeAInstances: *400 to 800*
cardinalityToTypeBInstances: 1

Note that in the clause above the values in italics should actually be in double quotes to be syntactically correct."

>

<Relationship

subclass: **SpatialRelationship**

subclassing: "The user may define subclasses of this class."

restricted: objectA: GeographicObject
objectB: GeographicObject

comments: "This is an abstract superclass under which a number of classes can be defined dealing with metric (involving measurements) and non-metric (topologic) spatial relationships. Both objectA and objectB are restricted to be instances of GeographicObject"

>

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<SpatialRelationship

subclass: **SpatialTopology**

attributes:

[iAiB]	Boolean
[iAbB]	Boolean
[iAeB]	Boolean
[bAiB]	Boolean
[bAbB]	Boolean
[bAeB]	Boolean
[eAiB]	Boolean
[eAbB]	Boolean
[eAeB]	Boolean

comments: "Spatial topology can be defined in a number of different ways. The approach used here was chosen because of its support for a number of queries and its grounding in set theory.

The spatial relationship between two geographic objects can be fully described by first starting with 9 point intersections that correspond to the two objects (A and B). The 9 sets represent how the two objects divide up space. Any location in space is in one of the 9 intersections.

	iB (interior of B)	bB (boundary of B)	eB (exterior of B)
iA (interior of A)	iA∩iB	iA∩bB	iA∩eB
bA (boundary of A)	bA∩iB	bA∩bB	bA∩eB
eA (exterior of A)	eA∩iB	eA∩bB	eA∩eB

A truth table may be defined in which each statement of intersection may evaluated as either equating to "the intersection is not empty ($\neq \varnothing$)" or "the intersection is empty ($= \varnothing$)". When the intersection is not empty the statement equates to "true"; when the intersection is empty (the null set) the statement equates to "false".

Truth Table	iB	bB	eB
iA	$iA \cap iB \neq \varnothing$	$iA \cap bB \neq \varnothing$	$iA \cap eB \neq \varnothing$
bA	$bA \cap iB \neq \varnothing$	$bA \cap bB \neq \varnothing$	$bA \cap eB \neq \varnothing$
eA	$eA \cap iB \neq \varnothing$	$eA \cap bB \neq \varnothing$	$eA \cap eB \neq \varnothing$

These intersections are defined formally using set theory and clear definitions of the boundary (b), the *interior* (i), and the *exterior* (e) of each object. These concepts in turn are based on the notion that every object may be considered as a set of points in space. The set of points corresponding to an object A is referred to simply as A, and for purposes here is completely equivalent to object A.

Consider a neighbourhood around a point, within a space of the same dimensionality as the object in question, defined such that:

(i) a subset of the points included in the neighbourhood is a subset of the points constituting the object in question, and

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(ii) a subset of the points included in the neighbourhood is not a subset of the points constituting the object.

The *boundary* of the object is defined as the union of the limiting case of all such neighbourhoods as their radii approach a length of zero. The boundary of the object (i.e., the boundary of A) is bA.

The *interior* of an object is the set of points defining the object which are not on the object's boundary. (The interior of A, iA = A - bA). An alternative but equivalent definition is based on the concept of neighbourhood. The interior of an object is the union of the limiting case, as the length of the radii approach zero, of all neighbourhoods whose corresponding sets of points are subsets of the set of points representing the object.

The *exterior* of an object is that portion of space not occupied by the boundary and the interior. (The exterior of A, eA = U - A). Note that an object of *x* dimensions which exists in a bounded *x* dimensional space can have no exterior.

It follows, therefore, that space (U) can be defined entirely by the interior, boundary and exterior of any object. (The space of A, U = eA + bA + iA).

The boundary, interior and exterior of objects whose geometry belongs to different classes is provided in the table below. These results stem from the point set approach.

geometry belongs to:	boundary	interior	exterior
Point	empty	interior of A equals A	≠ ∅ unless the object is point set equivalent to U
VectorLine, excluding closed curves	first point referenced and last point referenced	remainder of object	≠ ∅ unless the object is point set equivalent to U
closed curve including Ring	empty	interior of A equals A	≠ ∅ unless the object is point set equivalent to U
VectorArea excluding closed areas	bounding arcs	remainder of object	≠ ∅ unless the object is point set equivalent to U
closed areas including surface of volumes	empty	interior of A equals A	≠ ∅ unless the object is point set equivalent to U
VectorVolume	bounding areas	remainder of object	≠ ∅ unless the object is point set equivalent to U
GeometricAggregate (disjoint components)	boundaries of each object in aggregate	interiors of each object in aggregate	remainder of U
GeometricAggregate (not disjoint components)	the union of boundary sections of each object in aggregate which do not share point set space with other objects in the aggregate	interiors of each object in the aggregate unioned with the boundary sections which share point set space with other objects in the aggregate	remainder of U

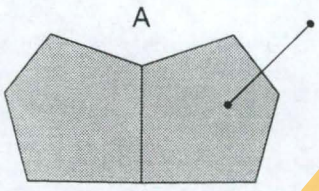
Withdrawn/Retiree

Note 2: The exterior of an object will always exist when the dimensionality of the space occupied by the object is unbounded.

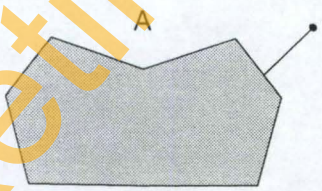
Note 3: The exterior of an object is the null set when the point set defining the object is equivalent to the point set of the universe. For example, this occurs where the universe consists of the surface of a sphere and the object in question is the surface of the same sphere.

Note 4: A point, closed curve (e.g., ring), and closed area (e.g., surface of a volume) are topologically similar in that they all have an interior, but no boundary.

Note 5: For components of a geometric aggregate which are not disjoint, any shared portions of space are considered as part of the interior



An aggregate (A) with 3 not disjoint components



The aggregate (A) as viewed by spatial topologic relationships

.

The attributes of the SpatialTopology class are optional. This allows the user to specify the relevant topologic relationship either by providing all or some of the 9 intersections, or by specifying a named relationship and dimensionality of intersection in the subclass SpatialTopologyExtended, or by both.

>

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<SpatialTopology

subclass: **SpatialTopologyExtended**

attributes: [commonName] NamedSpatialTopology
[dimensionalityOfIntersection] Integer

restricted: dimensionalityOfIntersection: 0..3

comments: "Topologic information may be gained by providing a common name for the relationship as well as describing the dimensionality of the intersection of the two objects. These common name comparisons are defined by the enumeration, NamedSpatialTopologys, the domain for *commonName*. The eight common names are:

<table>
<tr><td rowspan="5">encircles</td><td colspan="3">disjoint</td></tr>
<tr><td rowspan="4">intersects</td><td>contains</td><td>encloses</td></tr>
<tr><td colspan="2">overlaps</td></tr>
<tr><td colspan="2">adjacent</td></tr>
<tr><td colspan="2">equals</td></tr>
</table>

The above table can be described as follows:

i) - *encircles* can relate both *intersects* and *disjoint*,

ii) - *disjoint* and *intersects* are mutually exclusive,

iii) - *contains* is the more general form of *encloses*, and

iv) - *overlaps, adjacent, equals*, and *contains* and *encloses* are all mutually exclusive and are all forms of *intersects*.

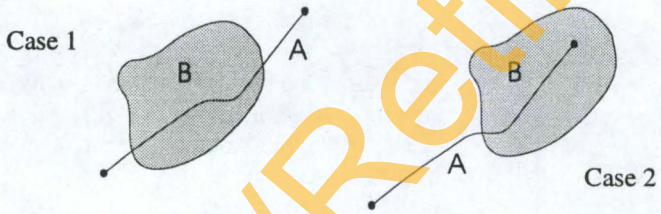
Eight named relationships are provided by the enumeration NamedSpatialTopology. They are *intersects, disjoint, equals, contains, encloses, overlaps, adjacent* and *encircles*. In many cases, the spatial relationship between two objects can be adequately described by providing the common name alone. For example, if two objects are disjoint, simply using the name *disjoint* to describe the relationship is enough. The use of the 9 intersections is not required.

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In other situations, the 9 intersections can distinguish between similar relationships that can be described using the same common name. Consider the case of *overlaps*. This concept is defined in general as:

A overlaps B *B overlaps A*	iB	bB	eB
iA	true	-	true
bA	-	-	-
eA	true	-	-

where 'true' means that there is intersection ($\neq \varnothing$) and '-' means that the presence or absence of intersection is not required to define the general case. This general definition of overlaps is sufficient to describe the following two cases.



However, the general case of *overlaps* cannot distinguish between these two examples. Completion of the boolean attributes provided by the parent class SpatialTopology is required.
Case 1 would be defined as:

A overlaps B	iB	bB	eB
iA	true	-	true
bA	false	-	-
eA	true	-	-

where the boundary of line A and the interior of area B do not intersect. In OSN this relationship would appear as:

```
SpatialTopologyExtended (
    iAiB:    "true"
    iAeB:    "true"
    bAiB:    "false"
    eAiB:    "true"
    commonName: overlaps )
```

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Case 2 would be defined as:

A overlaps B	iB	bB	eB
iA	true	-	true
bA	true	-	-
eA	true	-	-

where the boundary of line A and the interior of area B intersect. In OSN this relationship would appear as:

```
SpatialTopologyExtended (
    iAiB:    "true"
    iAeB:    "true"
    bAiB:    "true"
    eAiB:    "true"
    commonName: overlaps )
```

This above example could also have been described by simply using the common name intersects or by completing the intersection attributes alone. Thus, spatial relationships that involve intersection can be described in three ways.

i - the common name is used and all 9 intersection attributes are not specified, i.e. they are nil,

ii - some or all of the 9 intersection attributes are completed and the common name is not specified,

iii - both the appropriate 9 intersection attributes and the common name are specified.

The only exception is the common relationship *encircles* for which the 9 intersection model is not sufficient. This is because the term encircles defines the situation where one object such as a closed curve or an annulus completely surrounds one or more other objects. This relationship requires intersection with an assumed third object (the area within the closed space) and so cannot be applied to the strictly 2 object intersection matrix. The precise meaning of encircles is given later in this section.

The following comments describe each of the common topologic names in greater detail. The accompanying diagrams depict a sample of some of the common topological relationships between 0, 1, and 2 dimensional objects. Other examples of spatial relationships between 0, 1, 2, and 3 dimensional objects have not been shown.

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commonName

Intersects

this common topologic relationship implies the existence of an intersection between objects A and B. When used alone, i.e., without values ascribed to the inherited 9 intersections, this relationship implies that there is one or more boundary/boundary or boundary/interior intersection. When used with the inherited 9 intersection attributes the exact nature of the intersection can be described.

A intersects B *B intersects A*	iB	bB	eB
iA	true	true	-
bA	true	and / or true	-
eA	-	-	-

One or more of the four intersections of importance to the relationship intersects (i.e., iAiB, iAbB, bAiB, bAbB) must be true.

Disjoint

For two objects to be *disjoint*, neither object can share any portion of the space occupied by the other. To indicate this relationship using the nine intersection model, the following rules must apply:

i - the *interior of A* and the *interior of B* must not intersect,

ii - the *interior of A* and the *boundary of B* must not intersect,

iii - the *boundary of A* and the *interior of B* must not intersect, and

iv - the *boundary of A* and the *boundary of B* must not intersect

A and B are disjoint	iB	bB	eB
iA	false	false	-
bA	false	false	-
eA	-	-	true

Given that there is no intersection between the interiors and boundaries of either object, the exterior of one object will always intersect the exterior, interior and boundary of the other object. For this reason, the exterior comparisons are irrelevant. However, the addition of the rule:

v) - the exterior of A and the *exterior of B* must intersect

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is required to prevent semantic problems associated with spatial topologic relationships which include one or more objects which have no geometric representation.

Equals

The relationship *equals* requires that the set of points constituting one object is exactly equivalent to the set of points that constitute the other object. This can be described using the nine intersection model simply by comparing the exterior of one object to the interior and boundary of the other object. If both objects occupy the identical space then their exteriors cannot intersect either boundaries or interiors. This can be expressed as:

i) - the *exterior of A* and the *interior of B* must not intersect,

ii) - the *exterior of A* and the *boundary of B* must not intersect,

iii) - the *exterior of B* and the *interior of A* must not intersect, and

iv) - the *exterior of B* and the *boundary of A* must not intersect.

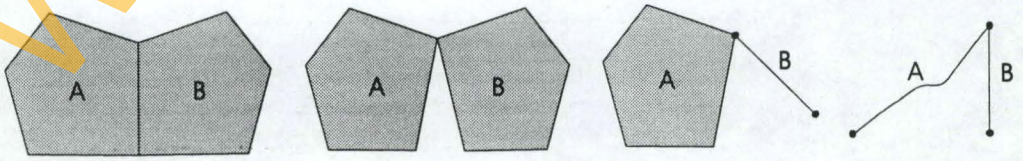
A equals B *B equals A*	iB	bB	eB
iA	true	-	false
bA	-	-	false
eA	false	false	-

The addition of the rule:

v) - the interior of A and the *interior of B* must intersect

has been included to prevent semantic problems associated with spatial topologic relationships which include one or more objects which have no geometric representation.

Adjacent



Adjacency is relevant only to the condition where boundaries are shared. No intersection can occur between the interior of either object and the boundary or

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interior of the other. Intersections between the exteriors of the objects is irrelevant. The rules that are applicable to *adjacent* are as follows:

i - the *boundary of A* and the *boundary of B* must intersect,

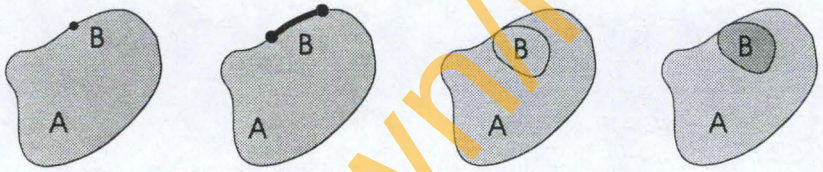
ii - the *interior of A* and the *interior of B* must not intersect,

iii - the *interior of A* and the *boundary of B* must not intersect, and

iv - the *boundary of A* and the *interior of B* must not intersect.

A is adjacent to B *B is adjacent to A*	iB	bB	eB
iA	false	false	-
bA	false	true	-
eA	-	-	-

Contains



+ diagrams for *encloses*

The above diagrammed examples of *contains* are in addition to the diagrams provided for *encloses*. In this relationship all of one object (*B*) is a subset of a part of but not all of another object (*A*). This is a more general case of the named relationship *encloses*. All that is required to define this relationship are the following three rules:

i) - the *exterior of A* and the *interior of B* must not intersect,

ii) - the *exterior of A* and the *boundary of B* must not intersect, and

iii) - the *boundary of A* and the *exterior of B* must intersect

A contains B	iB	bB	eB
iA	-	-	-
bA	-	-	true
eA	false	false	-

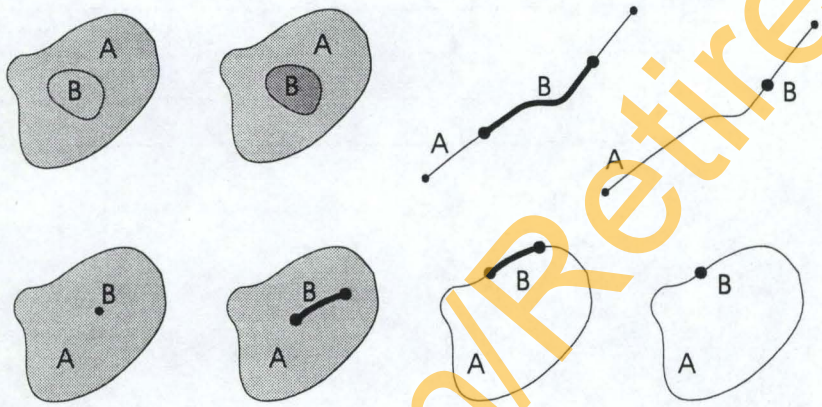
Withdrawn/Retirée

Rule *iii* which relates the *boundary of A* and the *exterior of B* is required to distinguish the relationship *contains* from *equals*. Using *contains* requires the contained object to occupy less space than the container.

Rules regarding the intersection of the *interior of A* and the *interior of B* cannot be made because even where they do not intersect, *A* can *contain B*. For example, a line that is coincident with a portion of the boundary of a polygon is contained in that polygon.

Withdrawn/Retirée

Encloses



The relationship encloses implies that the entire interior of one object (*B*) is a subset of the interior of another object (*A*) and that the boundary of *A* and the boundary of *B* do not intersect. These rules can be expressed as:

i) - the *interior of A* and the *interior of B* must intersect,

ii) - the *boundary of A* and the *interior of B* must not intersect,

iii) - the *exterior of A* and the *interior of B* must not intersect, and

These three rules establish that the *interior of B* is totally contained within the *interior of A*. Additionally, the following rule is required:

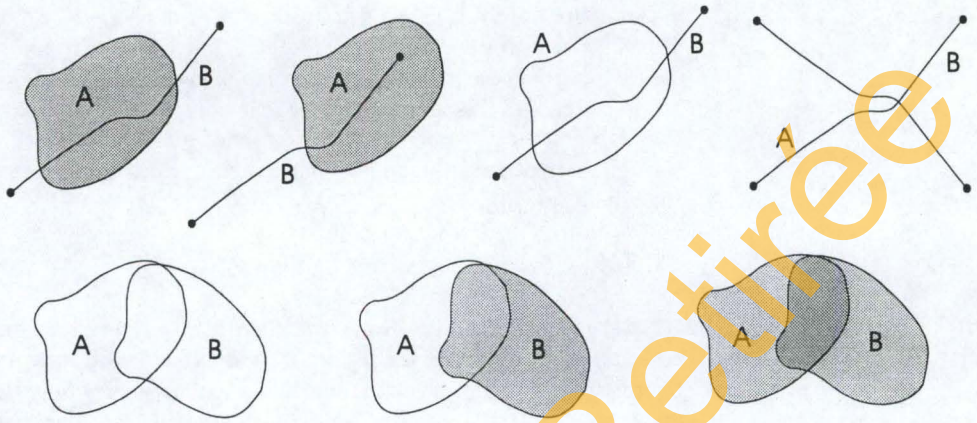
iv) - the *boundary of A* and the *boundary of B* must not intersect

A encloses B	iB	bB	eB
iA	true	-	-
bA	false	false	-
eA	false	false	-

This relationship is asymmetrical, i.e. if *A encloses B* then *B* cannot enclose *A*. Additionally, *encloses*, *equals* and *overlaps* are mutually exclusive. However,

encloses and contains are not mutually exclusive. If *A contains B* then the relationship *A encloses B* may also be valid.

Overlaps



The concept of spatial relationship *overlaps* implies the extension of one object (*A*) partially into the space occupied by a second object (*B*). This relationship is mutually exclusive from *encloses*, *equals* and *contains*. When defining the relationship *A overlaps B* the following conditions must be met:

i) - the *interior of A* and the *interior of B* must intersect,

ii) - the *interior of A* and the *exterior of B* must intersect, and

iii) - the *interior of B* and the *exterior of A* must intersect.

A overlaps B *B overlaps A*	iB	bB	eB
iA	true	-	true
bA	-	-	-
eA	true	-	-

Note that this relationship is symmetric. i.e., if A overlaps B then *B overlaps A*.

This relationship is dependent on the partial intersection of the respective interiors of the two objects. This means that a point coincident with a location on the boundary of a polygon does not overlap the polygon because there is no *interior of A / interior of B* intersection. Similarly, a point which is coincident with a location on a ring or on the interior of a line does not overlap the line or ring because there is no *interior of A / exterior of B* intersection.

Use of the named relationship *overlaps* is not applicable to points. *Overlaps* requires that the interior of B must intersect both the interior and exterior of A; additionally, the interior of A must intersect both the interior and exterior of B.

Withdrawn/Retiree

These conditions therefore require that both A and B have boundaries, which implies that they must be more that 0 dimensional.

Encircles

A portion of object A, or A itself, can serve as the boundary of a third object, C, which *contains* (or *encloses*) B, as defined under SpatialTopology. For example, the ring defining the boundary of a polygon encircles the polygon as well as any arbitrary set of points in the interior of the polygon we may also state that the ring defining the polygon encircles any set of points whose boundary intersects the boundary of the polygon but whose interior does not.. More formally we can state the following:

$\exists C \mid \{C_b \subseteq A\}$ *and* $B \subseteq C$

If the space in which the objects reside is finite (a closed set), then the definitions above lead to the result that within that space every object with a boundary *encircles* every other object to which it does not *overlap*. For example, the Arctic Circle may be considered to encircle all point sets to its north because a polygon can be defined covering the northern part of the earth with the Arctic Circle as its boundary. However, in a similar fashion the Arctic Circle encircles all point sets to its south. Consequently, *encircles* is considered as meaningful only where the space can be reasonably treated as infinite, as would be the case with true three dimensional space or projections onto a two dimensional plane.

dimensionaltiyOfIntersection

If the dimensionality of the intersection is known, intersection may take on one of the following values.

zero: the intersection is one or more discrete points.

one: the intersection is one or more arcs.

two: the intersection is one or more areas.

three: the intersection is one or more volumes.

If the intersection results in objects of different dimensionality (e.g. a point and an area), the largest value is provided."

>

Withdrawn/Retired

<SpatialTopology

subclass: **OnSide**

attributes: side Side

comments: "This relationship is designed for situations where the geometry of A is linear and that of the related objects is areal in nature, and the space in which the objects reside is two dimensional. It is possible for example to specify what is on the right or the left of the primary object. It is assumed that the side is specified with respect to travelling from the start to the end of object A."

>

<SpatialTopology

subclass: **BoundedBy**

attributes: [startOrEnd] StartOrEnd

comments: "This is a special case of topology in which typically an n dimensional object is bounded by an n-1 dimensional object. If the geometry of object A is a member of VectorLine and the geometry of object B belongs to Point, then the attribute *startOrEnd* may be completed, indicating that object B coincides with the start or end of object A."

>

<SpatialRelationship

subclass: **SpatialNeighbourhood**

subclassing: "The user may define subclasses of this class."

attributes: distance Real
[method] String
[remarks] String

comments: "If A is an object of interest, such as a shopping centre, then B is a location, such as a private residence, that is within a given travel distance of A. The method of travel and other remarks may also be given."

>

Withdrawn/Retirée

<SpatialRelationship

subclass: **Neighbour**

subclassing: "The user may define subclasses of this class."

attributes:

location	NeighbourLocation
[way]	SpatialObject

comments: "If A is *onRight* of B, then A is the primary object, B is the related object and onRight comes from NeighbourLocation. onRight or onLeft are in the context of a third object, a way (a route or line) to which A and B are adjacent or near (in the neighbourhood of). This relationship could be used with street addresses, for example, in which the way is the street. The way is specified by the object identifier of the relevant geographic object."

>

<SpatialRelationship

subclass: **DistanceFrom**

subclassing: "The user may define subclasses of this class."

attributes:

distance	Real
[metric]	String

comments: "If A is a certain distance from B, then distance is given in metres. The attribute *metric* indicates how the distance was measured, i.e., straightline distance, city block distance, etc."

>

<SpatialRelationship

subclass: **DistanceAndAngles**

subclassing: "The user may define subclasses of this class."

attributes:

location	DistanceAndAzimuth
[north]	North

defaults: north:grid

comments: "If A is a certain distance and azimuth (and declination) with respect to B, then A is the primary object and B is the related object. The attribute north specifies which concept of North is being used with respect to the azimuth measurement. If north is not specified, it is assumed to have the value *grid*."

>

Withdrawn/Retired

<SpatialRelationship

subclass: **RelativeLinearDistance**

subclassing: "The user may define subclasses of this class."

attributes: location DistanceAlong

comments: "If A is a route of some description and if B is located on A or is offset a certain distance from some point on A, then A is the primary object and B is the related object. Note that DistanceAlong and its subclasses, DistanceAndSide and Offset, allow for a variety of options for specifying a relative position for B."

>

<SpatialRelationship

subclass: **Compass**

subclassing: "The user may define subclasses of this class."

attributes: name CompassDirection

comments: "If A is north of B and C, then A is the primary object, B and C are the related objects and north comes from CompassDirection. Note that in addition to the four primary compass directions, CompassDirection also includes *above* and *below*. Thus, the relationship Compass may be used in a three-dimensional context."

>

<SpatialRelationship

subclass: **SpatialClip**

subclassing: "The user may define subclasses of this class."

attributes: [remarks] String

comments: "If the geometry of A was clipped or truncated to a boundary of another object, object B, then this relationship may be used."

>

Withdrawn/Retired

<Relationship

subclass: **TemporalRelationship**

subclassing: "The user may define subclasses of this class."

restricted: objectA:GeographicObject
objectB:GeographicObject

comments: "This is an abstract superclass under which a number of classes can be defined dealing with metric (involving measurements) and non-metric (topologic) temporal relationships. Both objectA and objectB are restricted to be a GeographicObject."

>

<TemporalRelationship

subclass: **TemporalTopology**

attributes: [temporalTopologicRelationship]TemporalTopologicRelationship

comments: "Temporal topology involves non-metric temporal relationships.

Time is fundamentally different from space in that all temporal entities can be mapped onto a one-dimensional, one-directional line. The topology along the time line is more complicated than that of points and arcs along a spatial line. With time the start and end of a duration take on great significance, as they indicate when the object in question came into existence or ceased to exist. (This work is based in part of on that of Pierre Gagnon and Yvan Bédard at Laval.)

temporallyDisjoint: No part of A is simultaneous with any part of B.

temporallyIntersect: The compliment of temporallyDisjoint, i.e., not temporally disjoint. The cases described below are the detailed ways in which two temporal objects may intersect temporally.

atStart: A occurs at a point in time simultaneous with the start of the duration of B. (A is a point; B is a duration.)

atEnd: A occurs at a point in time simultaneous with the end of the duration of B. (A is a point; B is a duration.)

follows: A begins when B ends. (A and B are both durations.)

overlapsAtStart: The start of A does not intersect B, and the end of A intersects B, but not at its start or end, and the start of B intersects A, but not at its start or end. (A and B are both durations.)

overlapsAtEnd: The end of A does not intersect B, and the start of A intersects B, but not at its start or end,

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and the end of B intersects A, but not at its start or end.
(A and B are both durations.)

during: All of A is simultaneous with some part of B, excluding the start and end of B.
(A is a point or duration, and B is a duration.)

duringFromStart: All of A is simultaneous with some part of B, excluding the end of B, and
the start of A is simultaneous with the start of B.
(A and B are both durations.)

duringToEnd: All of A is simultaneous with some part of B, excluding the start of B, and
the end of A is simultaneous with the end of B.
(A and B are both durations.)

simultaneous: A in its entirety and B in its entirety occur at exactly the same time, i.e., they occupy exactly the same portion of the time line.
(A and B are both points or both durations.)

These terms are defined rigorously using set theory constructs, based on boundary (start and end) and interior (interval) comparisons.

If object A is a temporal object mappable onto a time line, then its birth (start) and death (end) are indicated as A_s and A_e, respectively. The interval between the start and end is designated as A_i. A point in time is considered to have no boundaries, i.e., no start and no end; it does have an interval (an interior), corresponding to the situation of a point in space. These conditions are described in the following table.

time belongs to:	temporal boundary (start and end)	temporal interior (interval)
DateTime (point in time)	does not exist (i.e., no start or end)	interior of A equals A
Interval	does not exist (i.e., no start or end)	interior of A equals A
Duration	start point given explicitly; end point given implicitly (by adding interval to start point)	interval of the duration
TimeAggregate (components are disjoint)	aggregate of starts and ends of individual objects	aggregate of durations of individual objects

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To define topologic relations, a number of interior and boundary comparisons can be made. This is similar to what was done spatially; however, in this case the comparisons are simpler because the geometry of the time line is simpler. All the comparisons needed are given on the table below. (Specifically, the concepts of partial and total - the two right most columns on the corresponding spatial table - are addressed implicitly by various combinations of the nine boolean values in the temporal table.)

To handle all possible temporal topological relationships, all nine comparisons must be made. The high levels relationships (atStart, atEnd, etc.) listed earlier are defined on the table which follows.

X	Y	$X \cap Y = \varnothing$
A_s	B_s	
A_s	B_e	
A_s	B_i	
A_s	B_s	
A_s	B_e	
A_s	B_i	
A_i	B_s	
B_i	A_s	
B_i	A_i	

(Temporally disjoint implies either before or after. To distinguish one condition from the other cannot be done topologically. The temporal relationship Precedence addresses these comparisons.)

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Temporal Topologic Relationships		Condition
A and B are *temporally disjoint* B (A occurs *before* B or B occurs *before* A)		$\{A_i \cap Bi = \varnothing\}$ is true *and* $\{A_s \cap B_e = \varnothing\}$ is true *and* $\{A_e \cap Bs = \varnothing\}$ is true
A and B temporally intersect	A is atStart of B	$\{A_i \cap B_i = \varnothing\}$ is true *and* $\{A_i \cap Bs = \varnothing\}$ is false
	B is *atStart* of A	$\{A_i \cap B_i = \varnothing\}$ is true *and* $\{A_s \cap Bi = \varnothing\}$ is false
	A is atEnd of B	$\{A_i \cap B_i = \varnothing\}$ is true *and* $\{A_i \cap Be = \varnothing\}$ is false
	B is atEnd of A	$\{A_i \cap Bi = \varnothing\}$ is true *and* $\{A_e \cap Bi = \varnothing\}$ is false
	A follows B	$\{A_i \cap B_i = \varnothing\}$ is true *and* $\{A_s \cap Be = \varnothing\}$ is false
	B follows A	$\{A_i \cap B_i = \varnothing\}$ is true *and* $\{A_e \cap Bs = \varnothing\}$ is false
	A overlaps B *at start* of B	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_i \cap Bs = \varnothing\}$ is false
	A overlaps B *at end* of B	$\{A_i \cap B_i = \}$ is false *and* $\{A_i \cap B_e = \varnothing\}$ is false
	A occurs *during* B	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_s \cap B_i = \varnothing\}$ is false *and* $\{A_e \cap B_i = \varnothing\}$ is false
	B occurs *during* A	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_i \cap B_s = \varnothing\}$ is false *and* $\{A_i \cap B_e = \varnothing\}$ is false
	A occurs *during* B *from start* of B	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_s \cap B_s = \varnothing\}$ is false *and* $\{A_e \cap B_i = \varnothing\}$ is false
	B occurs *during* A *from start* of A	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_s \cap B_s = \varnothing\}$ is false *and* $\{A_i \cap B_e = \varnothing\}$ is false
	A occurs *during* B *to end* of B	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_e \cap B_e = \varnothing\}$ is false *and* $\{A_s \cap B_i = \varnothing\}$ is false
	B occurs *during* A *to end* of A	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_e \cap B_e = \varnothing\}$ is false *and* $\{A_i \cap B_s = \varnothing\}$ is false
	A and B are *simultaneous*	$\{A_i \cap B_i = \varnothing\}$ is false *and* $\{A_s \cap B_s = \varnothing\}$ is false *and* $\{A_e \cap B_e = \varnothing\}$ is false

"

>

Withdrawn/Retiree

<TemporalRelationship

subclass: **Precedence**

subclassing: "The user may define subclasses of this class."

attributes: sequence Succession

comments: "A may occur entirely before or after B, or have some degree of temporal coincidence with B. The possible values for *sequence,* as defined in the enumeration Succession, are before, after, and coincident.

before: A and B do not intersect temporally, and any temporal point (start, end or a point on the included interval) on A comes before any point on B.

after: A and B do not intersect temporally, and any temporal point on A comes before any point on B.

coincident: A and B intersect temporally. That is, there is at least one temporal point on A which is simultaneous with a point on B."

>

<TemporalRelationship

subclass: **TemporalProximity**

subclassing: "The user may define subclasses of this class."

attributes: interval Interval

comments: "If B occurred within a given time of A, then that may be specified through this relationship. The amount of time is provided by the attribute *interval.*"

>

<TemporalRelationship

subclass: **TemporalNeighbourhood**

subclassing: "The user may define subclasses of this class."

attributes:

travelTime	Interval
[method]	String
[remarks]	String

comments: "If A is an object of interest, such as a shopping centre, then B is a location, such as a private residence, that is within a given travel time of A. The method of travel and other remarks may also be given."

>

Withdrawn/Retirée

<TemporalRelationship

subclass: **TemporalOffset**

subclassing: "The user may define subclasses of this class."

attributes:

instanceA	TemporalInstance
instanceB	TemporalInstance
from	BeforeOrAfter
offset	Interval

comments: "For A and B, it is specified whether the point of time in question is a startTime (of a duration), an endTime (of a duration) or a single instance. A, or the start of A, or the end of A may occur before or after B, the start of B, or the end of B, by a given amount, the offset."

>

<Relationship

subclass: **DerivedFrom**

subclassing: "The user may define subclasses of this class."

attributes: [method] String

comments: "If A is derived from B, then A is the primary object and B is the related object. The method of derivation may be given."

>

<Relationship

subclass: **ControlledBy**

attributes: [remarks] String

comments: "If the position of A was determined partly or completely from the position of B, then A is the primary object and B is the related object. A comment may also be added."

>

Withdrawn/Retired

<Relationship

subclass: **ConnectedTo**

subclassing: "The user may define subclasses of this class."

attributes: [connectionDirection] ConnectionDirection

restricted: objectA:GeographicObject
objectB:GeographicObject

comments: "Instances of the ConnectedTo relationship define connections between pairs of geographic objects. This relationship is used in the definition of graph and network structures.

The attribute *connectionDirection* indicates whether the direction is forward, backward, alternating, etc."

>

Withdrawn/Retiree

Chapter 3, Section 6

Metadata

Withdrawn/Retirée

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Withdrawn/Retirée

3.6 Metadata Classes

<AbstractObject

subclass: **Metadata**

subclassing: "The user may define subclasses of this class."

comments: "This is an abstract superclass. Classes which are considered to define metadata are placed under Metadata or one of its subclasses.

In the SAIF standard schema only spatialReferencing and temporalReferencing are given explicitly in the definitions of SpatialObject and TemporalObject, respectively.

Other metadata in user defined subclasses may be defined through the inclusion of the appropriate attributes. These attributes may have as domains metadata classes from the SAIF standard schema, or other user defined classes, which may or may not be subclasses of those in the SAIF standard schema.

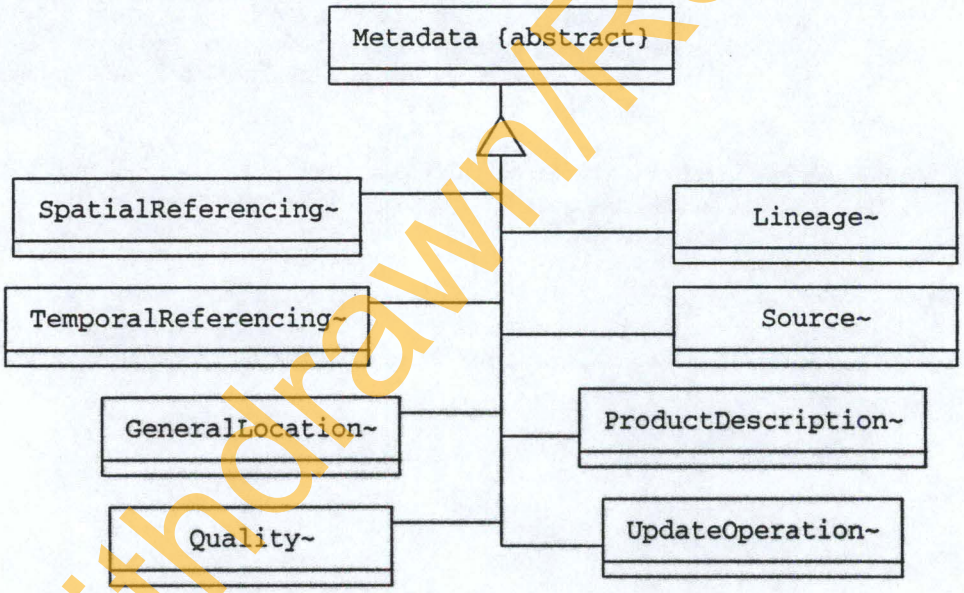


Figure 3-19 Metadata Inheritance Hierarchy

"

>

Withdrawn/Retirée

<Metadata

subclass: **SpatialReferencing**

subclassing: "The user may define subclasses of this class."

attributes:

[coordSystem]	CoordinateSystem
[hydrographic]	HydrographicReference
[control]	Control
[transform]	Transform
[positioningMethod]	PositioningMethod

comments: "The spatial referencing contains seven components.

coordSystem: concerns the way horizontal and vertical coordinates are defined.

hydrographic: includes tidal and sounding information.

control: supplies vertical and horizontal control information.

transform: gives transformation criteria necessary to generate correct coordinates, if the data has been transformed in some way; this can be used for example if the coordinates have been scaled to values between 0 and 1 or if the coordinates are relative to some starting point.

positioningMethod: a choice of methods used for determining coordinate positioning. Choices include satellite, radio, astronomic, approximation and traditional survey methods.

Note that any processing history which may have been performed on the data, such as geometric rectification for example, may be described under lineage, assuming such an attribute from the class Lineage has been specified at the geographic object level. "

>

Withdrawn/Retirée

<Metadata

subclass: **TemporalReferencing**

subclassing: "The user may define subclasses of this class."

attributes:

type	TimeType
[offset]	UTCOffset
[likelyTimeError]	Interval

comments: "type: refers to whether Greenwich (UTC), GPS, or a local reference (e.g. a system clock) is being used to define the basis of time values. Note that because of leap seconds, UTC time is not continuous. The structure of time in the context of the Global Positioning System is identical to Universal Coordinated Time (UTC), but no leap seconds are introduced (beginning in January, 1980. Consequently, time with reference to the GPS system is continuous, but at variance with UTC.

offset: provides the difference in hours and minutes from Greenwich, regardless of whether type equals utc, gps, or local.

likelyTimeError: provides a non-statistical estimate of time error. Uncertainty with respect to a date and/or time may be defined by supplying a value for likelyTimeError. True time is assumed to be time interval. "

>

<Metadata

subclass: **GeneralLocation**

subclassing: "The user may define subclasses of this class."

attributes:

[range]	BoundingBox
[tiles]	List(Tile)
[informal]	String

comments: "This subclass includes an informal, text description, a tile description related to mapsheet designation, and the bounding box (or range rectangle in 2, 3, or 4 dimensions), of the geographic object or objects in question."

>

Withdrawn/Retirée

<Metadata

subclass: **Quality**

subclassing: "The user may define subclasses of this class."

attributes:

[structuring]	Structuring
[positional]	Set(PositionalAccuracy)
[attribute]	Set(AttributeAccuracy)
[clipping]	Boolean
[integrity]	Integrity
[remarks]	String

comments: "The quality of the data may be given through instances of this class. It contains a series of attributes which characterize different aspects of data quality.

structuring: this specifies a series of attributes related to the notion of planar enforcement in two or three dimensional space. These include ideas about shared points and boundaries, space filling (i.e., overlapping), undefined regions within the spatial extent of the data, the valid use of geometric and relationship subclasses, and the like.

positional: specifies absolute and relative accuracies pertinent to coordinate data.

attribute: specifies statistical measures associated with the thematic content of the data, i.e., content as opposed to positional accuracy.

clipping: indicates whether any geometric objects have been truncated in order to meet the data transfer request. If any geometric object in the geographic object being transferred has been truncated in any way, the value of clipping is true. If no truncation has occurred, the value for clipping is false.

integrity: provides the results from a series of data quality tests."

>

Withdrawn/Retirée

<Metadata

subclass: **Lineage**

subclassing: "The user may define subclasses of this class."

attributes:

[dataSource]	OriginalDataSource
[compilationHistory]	List(ActionHistory)
[processingHistory]	List(ActionHistory)
[remarks]	String

comments: "The lineage or history of the data may be given through the instances of this class. The data source includes any field work, imagery, positioning, etc used to create the data. Any compilation steps are given under compilation history. Software processing procedures used on the data may include interpolation, smoothing routines, filtering routines, geometric rectification (including relief displacement correction) methods, classification techniques, etc. Lastly, comments may be given."

>

<Metadata

subclass: **Source**

subclassing: "The user may define subclasses of this class."

attributes:

[terminus]	Set(Terminus)
[database]	DbInfo
[project]	Set(Project)
[releasibility]	String
[legality]	Legal
[security]	Security
[remarks]	String

comments: "An instance of Source identifies the administrative aspects of where the data comes from, where it is going, and possible restrictions on the data. The producer, distributor and receiver (which can all be provided) are typically organizations or individuals. The database provides a DBMS identification. The project contains a general description of the project associated with the source of the data. The releasibility attribute holds any designation or comment associated with the provision of the data to users. Legal and security information can be provided, as well as general remarks."

>

Withdrawn/Retirée

<Metadata

subclass: **ProductDescription**

subclassing: "The user may define subclasses of this class."

attributes:

[description]	String
[products]	Set(Product)
[remarks]	String

comments: "The product description and its subclasses provides information about the product, including price, versions, updates, shipping methods, and other information required for ordering. General comments about the product may also be included."

>

<Metadata

subclass: **UpdateOperation**

subclassing: "The user may define subclasses of this class."

attributes:

operation	UpdateType
linkName	String
[effective]	DateTime
[remarks]	String

comments: "The update operation consists of four parts.

operation: the type or choice of update operation.

linkName: the name of an attribute used as a unique identifier. This implies that the geographic object carrying the update information belongs to a subclass of GeographicObject, (or another subclass below GeographicObject), and that the subclass has an attribute used to uniquely identify the object in the addressee's (receiver's) database. The value for linkName is the name of that attribute. It is the user's responsibility to ensure that the values for the attribute ensure uniqueness.

effective: the date and time when the new data will or has taken effect can be stated.

remarks: comments may be added."

>

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3.6.1 Supporting Classes for SpatialReferencing

<AbstractObject

subclass: **CoordinateSystem**

subclassing: "The user may define subclasses of this class."

attributes: [coordinateUnits] List(UnitMeaning)

comments: "Five subclasses of CoordinateSystem are defined. They range in complexity from the simple coordinate system which defines non-earth related rectangular and polar coordinates to the standard segmented projection coordinate systems such as UTM, Universal Polar Stereographic, and the State Plane Coordinate System. Earth related coordinate systems are defined through combinations of the reference ellipsoid, horizontal adjustment system, vertical adjustment system or surface, projection and standard segmented projection system.

The examples which follow pertain to subclasses of CoordinateSystem.

Example 1 : Conventional Terrestrial Systems. In certain situations, it may be required to define coordinates using a terrestrial geocentric coordinate system. In this case, all coordinates are with reference to a right-handed cartesian system and are specified as distance from the earth's centre as defined by a particular reference ellipsoid.

This coordinate system would be defined in OSN as follows:

```
ConventionalTerrestrialSystem (
    coordinateUnits: List { metres metres metres }
    cts: CTSType (
        systemType:    grs
        systemYear:    80 ))
```

Example 2: Geodetic Coordinate Systems. If the spatial coordinates in the first example are to specified using latitude, longitude and height above the ellipsoid then the class GeodeticCoordinateSystem should be used in combination with the conventional terrestrial system:

```
GeodeticCoordinateSystem (
    coordinateUnits: List { degrees degrees metres }
    cts: ConventionalTerrestrialSystem (
        cts: CTSType (
            systemType:    grs
            systemYear:    80 )))
```

In many instances, spatial coordinates will be supplied as latitude, longitude and an elevation above some vertical datum. The following example defines a coordinate system using latitude and longitude based on the NAD27 horizontal datum adjustment system and an elevation

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from mean sea level . Note that either the conventional terrestrial system or the horizontal and vertical references can be specified but not both.

This coordinate system would be defined in OSN as follows:

```
GeodeticCoordinateSystem (
    coordinateUnits: List { degrees degrees feet }
    horizontalReference: GeodeticHorizontalReference (
        datumAdjustmentSystem:    nad27 )
    verticalReference: GeodeticVerticalReference (
        surface:      meanSeaLevel ))
```

Example 3: Projection Coordinate system. This example defines coordinates using a polyconic projection by specifying its central meridian, an offset of the origin of the projection to 45°N and a false easting of 1,000,000 metres. The coordinates use the NAD83 horizontal datum adjustment system and specifies elevations using the cvd28 vertical datum adjustment system:

```
Projection(
    coordinateUnits: List { metres metres metres }
    projectionName:          polyconic
    projectionParameters:    List { ProjectionParameter (
                                    parameterName:          centralMeridian
                                    value:                  129
                                    units:                  degrees
                                    hemisphere:             west )
                                ProjectionParameter (
                                    parameterName:          latitudeOfOrigin
                                    units:                  degrees
                                     hemisphere             north)
                                ProjectionParameter (
                                    parameterName:          falseEasting
                                    value:                  1000000
                                    units:                  metres ) }
    projectionHemisphere:   north
    geodeticReference: GeodeticCoordinateSystem (
        horizontalReference: GeodeticHorizontalReference (
            datumAdjustmentSystem:    nad83 )
        verticalReference: GeodeticVerticalReference (
            datumAdjustmentSystem:    cvd28 )))
```

Example 4 : Standard Segmented Projection Coordinate Systems. For medium scale spatial data collected in the province of British Columbia, Canada, coordinates are commonly supplied in metres using the UTM grid coordinate system, the NAD83 horizontal datum and mean sea level as the vertical datum. The UTM grid system is a standardized segmentation of a transverse mercator projection. Other segmented projections include the UPS (universal stereographic system) and the SPCS (state plane coordinate system).

This standard coordinate system would be defined in OSN as follows:

```
UTM (
    coordinateUnits: List { metres metres metres }
    projection:   Projection (
        projectionHemisphere: north
```

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```
            geodeticReference: GeodeticCoordinateSystem (
                horizontalReference: GeodeticHorizontalReference (
                    datumAdjustmentSystem:   nad83 )
                verticalReference: GeodeticVerticalReference (
                    datumAdjustmentSystem:   cvd28 )))
        zone:   10)
```

Example 5: The Simple Coordinate System. Some digital drawing and/or spatial data entry systems capture data using non-earth related coordinate systems, i.e., the coordinates are not specified as latitude, longitude, height or through some projection system. These coordinates can be specified using the Rectangular or Polar coordinate system subclasses. This example defines a cartesian coordinate system with no geodetic horizontal or vertical reference and no projection. Note also that the meaning of the coordinate values, i.e., metres, feet, degrees, etc., is not specified and the origin of the coordinate system is the default lower left corner. This is the simplest case and is specified in OSN as follows:

```
Rectangular()
```

A more specific case might specify that the x and y values of the cartesian system represent millimetres and that the origin of the system is at the upper left corner. This case is represented as follows:

```
Rectangular(
    coordinateUnits:    List { millimetres millimetres }
    origin:             nw)
```

"

>

<CoordinateSystem

subclass: **ConventionalTerrestrialSystem**

attributes:		
	cts	CTSType
	[ctsOffset]	OriginOffset
	[ctsRotation]	Rotation

comments: "A conventional terrestrial system is a terrestrial geocentric system where the origin is at or near the centre of the earth, the primary pole is aligned to the earth's axis of rotation, the primary axis is the intersection between the primary plane and the plane containing the Greenwich meridian, and the system is right-handed. The origin of the system is defined by the CTSType which is a combination of system type and system year, e.g., grs and 1980. Coordinates c1, c2 and c3 are supplied for objects using this system and represent linear distance along each respective axis. The meaning of the units of measurement is supplied by the inherited attribute *coordinateUnits*, the first entry in the list applies to c1, the second to c2, and the third to c3."

>

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<CoordinateSystem

subclass: **GeodeticCoordinateSystem**

attributes:

[cts]	CTSType
[horizontalReference]	GeodeticHorizontalReference
[verticalReference]	GeodeticVerticalReference

constraints: "If *cts* is provided then *horizontalReference* and *verticalReference* must be *nil*. If *horizontalReference*, *verticalReference*, or both is supplied then *cts* must be *nil*."

comments: "Coordinates c1, c2 and c3 supplied using this system will correspond to latitude, longitude and a measure of distance, respectively. The meaning of c3 is dependent on the attribution. If *cts* is supplied or if *horizontalReference* is supplied with no vertical reference, c3 represents the height above the ellipsoid. If both *horizontalReference* and *verticalReference* are supplied, c3 represents the elevation above the vertical datum."

>

<CoordinateSystem

subclass: **PlanarProjectionCS**

attributes:

[projectionName]	ProjectionName
[projectionParameters]	List(ProjectionParameter)
[projectionHemisphere]	Hemisphere
[geodeticReference]	GeodeticCoordinateSystem

comments: "This class is used when an earth related rectangular coordinate system is required.

projectionName - the name of the projection being used. e.g, mercator, transverse mercator, lambert conformal, polyconic, etc.

projectionParameters - a list of parameters and associated values required for the definition of the coordinate system with respect to the ellipsoid. e.g., central meridian, false easting, false northing, etc.

projectionHemisphere - the hemisphere for which the projection coordinates apply.

geodeticReference - the reference ellipsoid and vertical datum."

>

<CoordinateSystem

subclass: **SegmentedProjectionCS**

subclassing: "The user may define subclasses of this class."

attributes:

projection	ProjectionCoordinateSystem

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comments: "In some specific instances, a projection has been divided into standard segments defining width of projection, positioning of central meridian and scale factors.

projection - the projection on which the segments are based. This includes the projection name, projection parameters, and geodetic horizontal and vertical references.

Users mat define subclasses of this class. Currently SAIF supports three standard segmented projection subclasses: UTM, UPS and SPCS. Other locally standardized grid systems, e.g., 3TM, can be defined through user subclassing."

>

<SegmentedProjectionCS

subclass: **UTM**

attributes: zone Integer

restricted: zone: 1..60

comments: "The Universal transverse Mercator coordinate system. This grid system divides the area of the earth between 84°N and 80°S into north-south columns 6° of longitude wide called zones. Zones are numbered from 1 to 60 eastward beginning at the 180th meridian. The central meridian of each zone has a false easting of +500,000 metres. The equator is designated as having a northing of 0 metres for the northern hemisphere coordinates and an arbitrary value of 10,000,000 metres for the southern hemisphere. The hemisphere to be applied is inherited from the class ProjectionCoordinateSystem. The first coordinate value (c1) and the second coordinate value (c2) represent Easting and Northing respectively. "

>

<SegmentedProjectionCS

subclass: **SPCS**

attributes: stateCode String
zone String
spcsCode Integer

comments: "The State Plane Coordinate System. The plane rectangular coordinate systems defined for each of the states and territories of the United States. These systems are based on either the transverse Mercator of the Lambert conic projection.

stateCode - the two character SPC state or territory code.

zone - the one to three character SPC zone code

spcsCode - the three or four digit SPC code."

>

Withdrawn/Retirée

<SegmentedProjectionCS

subclass: **UPS**

attributes: zone String

restricted: zone: "A" | "B" | "Y" | "Z"

comments: "The Universal Polar Stereographic System. Used instead of the UTM system in the polar areas. Each circular polar zone is divided in half by the 0° - 180° meridian. In the north polar zone the west half is designated as grid zone Y, the east half as Z. In the south polar zone the west half is designated A and the east half B."

>

<CoordinateSystem

subclass: **SimpleCoordinateSystem**

subclassing: "The user may define subclasses of this class."

comments: "The class is provided for the description of coordinate systems which are NOT related to specific locations on the surface of the earth. These systems include simple rectangular systems such as the cartesian coordinate system and picture coordinates and simple angle and distance systems."

>

<SimpleCoordinateSystem

subclass: **Rectangular**

subclassing: "The user may define subclasses of this class."

attributes: [origin] OriginReference

defaults: origin: sw

restricted: origin: nw | sw

comments: "This subclass is defined for the description of coordinate systems which are rectangular in 2 dimensional space, i.e., locations can be specified on a grid for which the axes meet at right angles and the units along each axis are identical in size. Two standard types of rectangular grid can be defined by this subclass. The first has its origin in the lower left (sw) corner of the grid and commonly called a cartesian coordinate system. The second has an origin in the upper left (nw) corner of the grid. This system is typical for digital picture coordinates."

>

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<SimpleCoordinateSystem

subclass: **Polar**

constraints: "The first coordinate (c1) is the angle in degrees or radians, the second (c2) is the linear distance."

comments: "This type of simple coordinate system can be used for those location definitions that are defined by a vector in 2 dimensional space. The origin of every vector is assumed to be 0,0. Each vector is defined by an angle measured counter-clockwise from the right-hand horizontal axis and a distance from the origin. The first coordinate(c1) is the angle in degrees or radians, the second coordinate (c2) is the distance from the origin. "

>

<AbstractObject

subclass: **CTSType**

attributes:

systemType	CTSSystemType
systemYear	Integer

comments: "This class specifies the conventional terrestrial system used. The system type refers to GRS, IUGG, WGS or ITRF. When matched with system year, the reference ellipsoid is specified, e.g., GRS80, WGS72, etc."

>

<AbstractObject

subclass: **GeodeticHorizontalReference**

attributes:

datumAdjustmentSystem	GeodeticHorizontalDatumAS
[datumASRelease]	String
[ellipsoid]	GeodeticEllipsoid
[geodeticOffset]	OriginOffset
[geodeticRotation]	Rotation

comments: "The adjustment is typically sufficient, simply specifying for example NAD27 or NAD83. However, in some cases a release date or version number may be required. The name of the reference ellipsoid may also be provided, as well as any rotation or offset. "

>

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<AbstractObject

subclass: **GeodeticEllipsoid**

attributes:

ellipsoidType	GeodeticEllipsoidType
[ellipsoidYear]	Integer
[semimajorAxis]	Real
[flattening]	Real

comments: "The type of reference ellipsoid is specified for use with geodetic horizontal reference systems. Examples include grs, clarke, fisher, walbeck, wgs, etc. In addition a year may be required to differentiate different ellipsoids, for example, the wgs ellipsoid type requires an additional year designation such 60, 66 or 72. The flattening and semimajor axis values may also be specified."

>

<AbstractObject

subclass: **GeodeticVerticalReference**

attributes:

[datumAdjustmentSystem]	GeodeticVerticalDatumAS
[surface]	GeodeticSurfaceChoice

constraints: "*datumAdjustment* may only be specified if *surface* is nil and vice versa."

comments: "The geodetic vertical datum adjustment system defines basic parameters necessary to correctly understand the elevation data. Examples of vertical adjustment systems include cvd28 and navd88. If the vertical datum adjustment system cannot be supplied a surface is required. Example of surface types include mean sea level, geoid and ellipsoid."

>

<AbstractObject

subclass: **ProjectionParameter**

attributes:

parameterName	ProjectionParmName
value	Numeric
units	UnitMeaning
[hemisphere]	hemisphere

comments: "To define any projection, a number of parameters are required. These parameters vary from projection to projection. They include items such as the central meridian, latitude of tangency, zone width, etc. In addition to the specific parameter name, each parameter includes a numeric value and the type of units the value represents. In some cases, a hemisphere must also be supplied. For example, if an instance of ProjectionParameter carries the parameter name *central meridian*, the value *123* and the unitMeaning *degrees* then the hemisphere, either *east* or *west* must also be specified."

>

Withdrawn/Retired

<AbstractObject

subclass: **Tile**

subclassing: "The user may define subclasses of this class."

attributes:

[mapSheetNumber]	String
[mapNumberingSystem]	String
[publicationDate]	DateTime
[mapSeriesName]	String
[mapSheetName]	String
[inverseScale]	Integer

comments: "The map numbering system refers to the way of defining the mapsheets or tiles, for example NTS or BCGS. The number of the map (mapSheetNumber) is a unique identifier for the map in the map series. For Canadian NTS maps, an example of mapSheetNumber might be *92F/4*. The map series name may be given, and if a map name exists other than the map series name, then that may also be given. (For example, a geologic map may be used with its own name, but based on a topographic map defined by the mapSeriesNumber.) The inverse of the map scale may be provided, e.g., 20000 for 1:20,000."

>

<AbstractObject

subclass: **HydrographicReference**

subclassing: "The user may define subclasses of this class."

attributes:

[tidal]	TidalInfo
[sounding]	SoundingDatum
[remarks]	String

comments: "Hydrographic reference contains tidal and sounding data, as well as a commentary."

>

<AbstractObject

subclass: **TidalInfo**

subclassing: "The user may define subclasses of this class."

attributes:

[reference]	String
[tidalHeight]	Real
[remarks]	String

comments: "A reference for the tidal information may be given, as well as the actual tidal height and any comments."

>

Withdrawn/Retirée

<AbstractObject

subclass: **Control**

subclassing: "The user may define subclasses of this class."

attributes:

[horizontalControl]	DataControl
[verticalControl]	DataControl
[mapDerived]	Tile

comments: "Control may be defined rigorously through horizontal and vertical control criteria. Alternatively, it may specified as derived from a given, published map."

>

<AbstractObject

subclass: **DataControl**

subclassing: "The user may define subclasses of this class."

attributes:

[authority]	Agency
[adjustmentOrder]	String
[integrationStatus]	String
[collectionAgency]	Agency
[finalCollectionDate]	DateTime
[adjustmentAgency]	Agency
[finalAdjustmentDate]	DateTime

comments: "A series of attributes may be used to describe either horizontal or vertical control. The authority is the agency responsible for the control, whereas adjustmentAgency pertains to who actually carried out the adjustment work. adjustmentOrder indicates whether the survey is considered as first, second, or third order, etc. integrationStatus refers to whether the survey is tied to provincial or national networks, or whether it is isolated. collectionAgency is the agency or company responsible for the data collection associated with the survey. dates for collection and adjustment may also be provided."

>

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<AbstractObject

subclass: **Agency**

subclassing: "The user may define subclasses of this class."

attributes:

[contactPerson]	String
[agencyName]	String
[address]	String
[telephoneNumber]	String
[faxNumber]	String
[email]	String
[country]	String

comments: "Agency supplies the contact person, agency name, address, and other means of contact."

>

<AbstractObject

subclass: **Transform**

subclassing: "The user may define subclasses of this class."

attributes:

[transformMatrix]	Matrix
[spatialOffset]	Coordinate
[remarks]	String

restricted:
spatialOffset:Coord2D | Coord3D
transformMatrix.rows:2 | 3
transformMatrix.columns:2 | 3

constraints: "transformMatrix.rows equals transformMatrix.columns.
spatialOffset must be an instance of Coord2D or of Coord3D."

comments: "If a simple transformation must be applied to the coordinate data before it is spatially correct with reference to coordinateSystem (as part of spatialReferencing), then the transformation should be specified in terms of a transformMatrix and a constant (or spatialOffset). The new, correct coordinate is defined as equal to the given coordinate times the transform matrix with the result added to spatialOffset: correct = (given c1 transformMatrix) + spatialOffset. Note that a 2 by 2 matrix is appropriate if only c1 and c2 are of interest; if c1, c2, and c3 are all relevant, the matrix is 3 by 3.

Cases where this might apply include coordinates which have been scaled, coordinates associated with a raster at an angle to the c1-c2 reference system, coordinates which are relative to some starting location, and the like. The default for the transformMatrix is the identity matrix and the default for the spatialOffset is zero for all coordinate components.

If time is used within a coordinate, comments under CoordT apply."

>

Withdrawn/Retirée

3.6.2 Supporting Classes for TemporalReferencing

<AbstractObject

subclass: **UTCOffset**

attributes:

offsetHour	Integer
offsetMinute	Integer

restricted:
offsetHour:-12..13
offsetMinute:0..59

constraints: "Combination of offsetHour:offsetMinute is limited to the range -12:59 to +13:00."

comments: "This is the Universal Coordinated Time hour and minute offset (offset to seconds is always 0) that can be applied to an instance of Time. The application of this offset to the Time hour and minute attribute values provides Greenwich Mean Time. A 26 hour total interval is provided to account for the application of a 'Daylight Savings' component to some time zones.

Use of the utcOffset references the time specified by timeType to Greenwich Mean Time thereby inferring Time Zone. When the utcOffset is defaulted or equivalent to 0 then:

timeType equal to 'utc' provides actual Greenwich Mean Time.

timeType equal to 'gps' provides 24 hour clock GPS time at the Greenwich Meridian.

timeType not specified provides unreferenced 24 hour clock time."

>

Withdrawn/Retirée

3.6.3 Supporting Classes for GeneralLocation

<AbstractObject

subclass: **BoundingBox**

attributes:

[coordSystem]	CoordinateSystem
minPoint	Point
maxPoint	Point

comments: "Typically a bounding box is specified in the same coordinate and geodetic reference systems as the data contained in the transfer. In this case coordSystem is not specified. In some situations, it is of interest to be able to specify a bounding box in one coordinate system, and the spatial data in another. For example, a mapsheet boundary may be specified in latitude and longitude, whereas the data within the mapsheet map be in UTM. In such cases coordSystem is specified; it applies to the coordinates provided for minPoint and maxPoint.

Two diagonally opposed points are specified, using the same type of Coordinate to indicate position. A minimum c1 and c2 (or c1, c2, and c3; or c1, c2, and t; or c1, c2, c3, and time) define the position of the first point, and a maximum c1 and c2 (or c1, c2, and c3; or c1, c2, and t; or c1, c2, c3, and time) define the second position of the second point. The data is assumed to be within (or on the boundary) of the location and time so defined. The type of Coordinate used controls whether the boundary is two, three or four dimensional in nature.

Typically, a bounding box (range rectangle) is specified by instantiating the coordinate for each point using the subclass Coordinate, Coord2D, Coord3D, Coord2DT, or Coord3DT. "

>

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3.6.4 Supporting Classes for Quality

<AbstractObject

subclass: **Structuring**

subclassing: "The user may define subclasses of this class."

attributes:

[node]	Noding
[overlap]	Boolean
[share]	Sharing
[void]	SpaceFilling
[entity]	Boolean
[validGeometry]	Boolean
[validRelationships]	Boolean
[special]	String

comments: "Structuring concepts have been broken into a number of ideas:

node: whether or not all intersections of geometric objects occur only at explicit positions defined by other geometric objects (such as lines intersecting at explicitly defined points), overlap: whether areal or volumetric objects overlap,

overlap: indicates the possibility of overlapping areal geometry or overlapping volumetric geometry within the context of a spatial dataset.

share: whether common objects (such as arcs on polygon boundaries) are defined only once and then referenced by their object identifiers,

void: whether there are voids or holes (where nothing is defined) contained within the boundaries of the overall area or volume of interest,

entity: whether all entities are represented directly by the geometry. For example, if Lake is defined as a type of feature, and each lake is represented geometrically by a polygon, entityStatus is true. If on the other hand all the lakes are represented by a single set of arcs (defining portions of lake boundaries), with no direct means of establishing how many lakes exist or which boundaries belong to which lake, then entityStatus is false.

validGeometry: if it is expected that the instances of SAIF geometric classes in the data meet the definitions, rules, and constraints of those classes, then validGeometry is true; otherwise it is false.

validRelationships: if it is expected that the instances of SAIF relationship classes in the data meet the definitions, rules, and constraints of those classes, then validRelationships is true; otherwise it is false.

special: if special structuring rules have been followed, they may be described here."

>

Withdrawn/Retirée

<AbstractObject

subclass: **PositionalAccuracy**

subclassing: "The user may define subclasses of this class."

attributes:

[classOrCategoryName]	String
[absolute]	AbsoluteAccuracy
[relative]	List(CoordinateAccuracy)
[remarks]	String

comments: "The positional accuracy of the coordinate data is defined by its absolute accuracy and relative accuracy, as well as by remarks. Absolute means with reference to the control information given under the SpatialReferencing subclass or some other specified source. Relative accuracy means with reference to the other coordinates. (More than one instance of relative accuracy may be given. This may be used for example to state that 95% of the points are within certain bounds, that 90% are within other bounds, etc.) If the accuracy information pertains to a particular class or category of data, i.e., a component of the geographic data under consideration, then *classOrCategoryName* should be completed."

>

<AbstractObject

subclass: **AbsoluteAccuracy**

subclassing: "The user may define subclasses of this class."

attributes:

coordinateAccuracy	List(CoordinateAccuracy)
higherOrderSource	String

comments: "Horizontal, vertical and time accuracy values are defined using the CoordinateAccuracy domain. The higher order source is considered as more accurate and serves as a basis of comparison. It may be specified as 'control' to indicate the control information given under the SpatialReferencing subclass, as 'tile' for the tile data given under ContentLocation, or as some other string. (Note that more than one instance of coordinate accuracy may be given. This may be used for example to state that 95% of the points are within certain bounds, that 90% are within other bounds, etc.)"

>

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<AbstractObject

subclass: **CoordinateAccuracy**

subclassing: "The user may define subclasses of this class."

attributes:

percentile	Real
[horizontal]	Real
[vertical]	Real
[time]	Real
[timeUnits]	UnitMeaning

constraints: "If time is specified, timeUnits must also be specified."

comments: "Coordinate accuracy is expressed as a percentile, associated with a horizontal value, a vertical value and a time value. For example, 95% of the points are within 10 m horizontally and 5 m vertically. (The units for horizontal and vertical are given in the spatialReferencing attribute (under SpatialObject)."

>

<AbstractObject

subclass: **AttributeAccuracy**

subclassing: "The user may define subclasses of this class."

attributes:

attributeOrCategoryName	String
higherOrderSource	String
[statistics]	List(Parameter)
[error]	ErrorMatrixData
[remarks]	String

comments: "The name of the user attribute (or a category or class in the case of a classification) is stated, as is a description of the higher order source used for the comparison. The statistics component includes a description of individual statistics pertinent to the data set. An error (or confusion or misclassification) matrix may also be given. Class statistics associated with raster or vector overlay procedures should be given under statistics, as the error matrix does not contain marginal results. Parameters used for matrix normalization should be defined under statistics as well. Note that classification method is not provided here, since it is expected under processing history as specified under Lineage. Finally, comments may be provided."

>

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<AbstractObject

subclass: **ErrorMatrixData**

attributes:

title	String
verticalClasses	List(String)
horizontalClasses	List(String)
classificationMatrix	Matrix

constraints: "The length of the list in verticalClasses equals classificationMatrix.rows, and the length of the list in horizontalClasses equals classificationMatrix.columns."

comments: "An error (or misclassification) matrix may be given a title. The class names corresponding to the rows and typically listed down the left side of the matrix are the verticalClasses. The class names corresponding to the columns and typically listed across the top of the matrix are the horizontalClasses. The matrix may be the original matrix in which case integer values are used. The column and row for each position in the matrix indicate respectively the actual class of a number of observations and the class to which those observations were assigned by a given classification procedure. The matrix may not be square if (i) a row (usually the bottom row) is defined as values for the NULL class, or if (ii), classes are grouped or amalgamated on one dimension relative to the other. If the matrix has been normalized, it must be square and the values are defined as instances of a type of Real (in Measure)."

>

<AbstractObject

subclass: **Integrity**

subclassing: "The user may define subclasses of this class."

attributes:

[tests]	List(IntegrityTestInfo)
[remarks]	String

comments: "Integrity (or logical consistency or data quality or data health) refers to the degree to which the spatial data meets the criteria defined for geometry, non-metric relationships (e.g. Topology, ConnectedTo, etc), metric relationships (TemporalOffset, Neighbourhood, etc.), valid values. The tests may have either quantitative results, with parametric values determined, or they take the form of a checklist, with pass/fail (true/false) values. Information on specific tests may be given, as well as general remarks."

>

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<AbstractObject

subclass: **IntegrityTestInfo**

subclassing: "The user may define subclasses of this class."

attributes:

testName	String
[submissionDate]	DateTime
[completionDate]	DateTime
[submissionID]	String
[passed]	Boolean
[details]	List(Result)
[software]	String
[authority]	String
[remarks]	String

comments: *"testName:* the name of the test applied against the data.

submissionDate: the date the data were submitted for integrity or quality assurance testing.

completionDate: the date the testing completed.

submissionID: a submission identification code or number.

passed: whether the data passes or failed the overall test can be specified.

details: specific results for particular portions of the test may be specified. Note that Result has two subclasses, Parameter and Check. The former may be used to specify quantitative test results; the latter is appropriate for boolean results.

software: the software used on the test including the version number if appropriate.

authority: the name of the agency (or agency and individual) responsible for the testing."

>

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3.6.5 Supporting Classes for Lineage

<AbstractObject

subclass: **OriginalDataSource**

subclassing: "The user may define subclasses of this class."

attributes:

[fieldWork]	List(FieldWork)
[sourceMaps]	List(Tile)
[positioningSystem]	List(Positioning)
[aerialTriangulation]	List(AerialTriangulation)
[imageIdentification]	List(ImageIdentification)
[sourceAgency]	List(Agency)
[remarks]	String

comments: "The original data source has five components to describe data collection sources. A description of the field work may be given. A description of any maps used to help define the data may be provided, such as topographic, surficial geology, climate, and soils maps as input into an agricultural capability map. Information may also be given on any positioning systems or networks, aerial triangulation or remotely sensed (satellite or airborne) imagery which was used directly in the production of the current data. A list of agencies where the original data can be obtained, may also be given. General commentary may be provided."

>

<AbstractObject

subclass: **FieldWork**

subclassing: "The user may define subclasses of this class."

attributes:

[project]	Project
[agency]	Agency
[sites]	List(LocationID)
[traverse]	List(LocationID)
[startDate]	DateTime
[endDate]	DateTime
[remarks]	String

comments: "A project identification code may be specified, as well as the agency responsible for carrying out the field work. Information about specific field sites may be given sites where examinations were carried out may be listed. If data were collected along one or more traverses, they may be specified. A start date and end date may be given. Remarks on the fieldwork may also be given."

>

Withdrawn/Retirée

<AbstractObject

subclass: **LocationID**

subclassing: "The user may define subclasses of this class."

attributes:

[identification]	String
[type]	String

comments: "The identification provides a name or number for a site, traverse, or station. The type of site (or traverse or station) may also be specified."

>

<AbstractObject

subclass: **Positioning**

subclassing: "The user may define subclasses of this class."

attributes:

[project]	Project
[agency]	Agency
[systemType]	String
[instrumentType]	String
[operatingMethod]	String
[stations]	List(LocationID)
[networkClassification]	String
[remarks]	String

comments: "A project identification code may be specified, as well as the agency responsible for carrying out the work. A positioning system may have been used during the data collection phase. The type of system, the type of instrument or receiver, and the method of operation may be given. A list of stations may be specified, as well as general remarks."

>

Withdrawn/Retirée

<AbstractObject

subclass: **AerialTriangulation**

subclassing: "The user may define subclasses of this class."

attributes:

[project]	Project
[agency]	Agency
[adjustmentMethod]	String
[source]	Agency
[blockName]	String
[blockNumber]	String
[date]	DateTime
[remarks]	String

comments: "This subclass contains information on aerial triangulation adjustments. A project description may be given, as well as the agency responsible for performing the adjustment work and the adjustmentMethod used. The source agency is the agency responsible for the data. The blockName and blockNumber are used to identify the block. The date of the completion of the processing may be specified."

>

<AbstractObject

subclass: **ImageIdentification**

subclassing: "The user may define subclasses of this class."

attributes:

[analogue]	PhotoInfo
[digital]	ImageInfo
[remarks]	String

comments: *"analogue:* if conventional photography was used directly (or a digital scan of the photography), data about the photography may be provided, including photo identification.

digital: satellite or airborne digital imagery may be described here.

remarks: general remarks may also be given."

>

Withdrawn/Retirée

<AbstractObject

subclass: **PhotoInfo**

subclassing: "The user may define subclasses of this class."

attributes:

[agency]	Agency
[project]	Project
[camera]	String
[lens]	String
[calibratedFocalLength]	Real
filmSize	String
filmType	String
[correction]	String
inverseScale	Integer
[platformElevation]	Real
[photoID]	List(SceneID)
[beginningDate]	DateTime
[endDate]	DateTime
[bands]	List(ImageBand)

comments: "The agency responsible for collection of the photographic imagery may be stated, as well as the name of a specific photo collection project, if applicable. The camera and lens model and identification may be provided, as well as the calibrated focal length of the lens, if available. The film size (e.g., 9 inch by 9 inch, 6 cm by 6 cm, 24 mm by 36 mm) and film type (e.g., black and white, color infrared, natural color). must be specified. If any correction has been applied to the image, it may be given. The inverse of the scale (e.g. 70000 represents 1:70 000) must be provided, The platformElevation (i.e., flying height) in kilometres may be given. A list of photos may be provided. A beginning date (or date and time) of the photography should be stated. If endDate (or date and time) is unspecified, beginningDate is interpreted simply as a single date (and time) of photography. If the photo(s) have been converted to digital, raster images, band information may be stated."

>

Withdrawn/Retirée

<AbstractObject

subclass: **ImageInfo**

subclassing: "The user may define subclasses of this class."

attributes:

[agency]	Agency
[project]	Project
imagingSystem	String
[correction]	String
[platformElevation]	Real
[bands]	List(ImageBand)
imageID	List(SceneID)
[beginningDate]	DateTime
[endDate]	DateTime

comments: "The agency responsible for collection of the imagery may be stated, as well as the name of a specific photo collection project, if applicable. The imaging system and identification may be provided. If any correction has been applied to the image, it may be given. The elevation of the platform in kilometres may be stated. (Note that for airborne systems, height is still given in kilometres.) The band characteristics may be given next. A list of images may be provided. A beginning date (or date and time) of the acquisition of the images may be stated. If endDate (or end date and time) is unspecified, beginningDate is interpreted simply as a single date (and time) of acquisition."

>

<AbstractObject

subclass: **SceneID**

subclassing: "The user may define subclasses of this class."

attributes:

identification	String
[acquisitionTime]	DateTime
[illumination]	Illumination
[view]	ViewAngles

comments: "Some identification number or code must be given. The time of acquisition (date or date and time) may be given as well as illumination and view characteristics."

>

Withdrawn/Retirée

<AbstractObject

subclass: **ImageBand**

subclassing: "The user may define subclasses of this class."

attributes:

[bandID]	String
[wavelengthMin]	Real
[wavelengthMax]	Real
[quantization]	Integer
[pixelWidth]	Real
[pixelHeight]	Real

comments: "The band identification number may be given, as well as the minimum and maximum wavelengths. The wavelengths are specified in nanometres. The quantization gives the resolution in terms of the number of bits used to define the set of possible values, e.g., 6 implies 64, 8 implies 256, etc. The pixel width and height are given in metres."

>

<AbstractObject

subclass: **Illumination**

subclassing: "The user may define subclasses of this class."

attributes:

[sunAzimuthAngle]	Real
[sunElevation]	Real
[cloudCover]	Real

comments: "The sun azimuth angle is measured clockwise from grid North. The sun elevation is measured up from the horizon. The percent of the image covered by strong haze or clouds is provided."

>

Withdrawn/Retirée

<AbstractObject

subclass: **ViewAngles**

subclassing: "The user may define subclasses of this class."

attributes:

[centreAzimuthAngle]	Real
[centreElevationAngle]	Real
[leftRightFieldofView]	Real
[topBottomFieldofView]	Real

comments: "The centre azimuth angle is the viewing azimuth angle at the image centre, clockwise from grid North. The centre elevation angle is the viewing elevation angle from nadir at the image centre. The left-right field of view is the angular field of view from edge to edge. The top-bottom field of view is the field of view from top to bottom."

>

<AbstractObject

subclass: **ActionHistory**

subclassing: "The user may define subclasses of this class."

attributes:

[beginningTime]	DateTime
[endTime]	DateTime
[stepOrCategory]	String
[operationPerformed]	String
[methodUsed]	String
[associatedObjects]	List(Primitive)
[operator]	String
[documentationReference]	String
[remarks]	String

comments: "Action history describes basic information relevant to compilation or processing history. The time of the beginning and end of the operation are provided; if beginningTime is specified and endTime is not, then the former is interpreted to be the date (or date and time) of the action. A step number or category name may be listed. The operation performed and the method used may be given. The associatedObjects primitive provides the object identifiers of the objects in question. The individual or organization carrying out the operation can be given, as can any published reference describing the procedure. Remarks may also be provided."

>

Withdrawn/Retirée

3.6.6 Supporting Classes for Source

<AbstractObject

subclass: **Terminus**

subclassing: "The user may define subclasses of this class."

attributes: [terminusType] TerminusType
[terminusInfo] Agency

comments: "The first attribute gives the type of terminus: producer, distributor or receiver. The second attribute provides information about the terminus."

>

<AbstractObject

subclass: **DbInfo**

subclassing: "The user may define subclasses of this class."

attributes: [dbmsIdentifier] String
[dbIdentifier] String

comments: "The DBMS identifier is the name of the database housing the data at the sender's end. The database identifier is the name of the file, directory, etc. in the DBMS from which the data was provided."

>

<AbstractObject

subclass: **Project**

subclassing: "The user may define subclasses of this class."

attributes: [projectIdentifier] String
[remarks] String

comments: "If the data was produced from, or is associated with, a particular project, a project identification and comments may be given."

>

Withdrawn/Retirée

<AbstractObject

subclass: **Legal**

subclassing: "The user may define subclasses of this class."

attributes:

[copyrightNotice]	String
[liabilityNotice]	String
[limitsOnUse]	String
[contractTitle]	String
[contractNumber]	String

comments: "If the data is copyrighted, the first attribute should be filled with a copyright statement giving the name of the individual or organization holding the copyright. The liability notice may give restrictions on liability on the part of the data producer or distributor. The limits on use may make statements about royalties, resale and the like. If a contract is involved, the title and number of it may be given."

>

<AbstractObject

subclass: **Security**

subclassing: "The user may define subclasses of this class."

attributes:

classification	SecurityClass
[downgrading]	Boolean
[downgradingDate]	DateTime

comments: "The security classification refers to the transmittal. It is never less than that of the highest classification rating of the data. A value of true for downgrading means that the orginator's permission for downgrading is required. If no permission is required, a date of downgrading may be provided."

>

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3.6.7 Supporting Classes for ProductDescription

<AbstractObject

subclass: **Product**

subclassing: "The user may define subclasses of this class."

attributes:

[identity]	ProductID
[cycle]	Interval
[nextVersion]	Date
[price]	ProductPrice
[remarks]	String

comments: "The Product subclass provides means of identifying the data and assisting update procedures.

identity: supplies descriptive information about a set of data, including a product name and number, as well as a version number.

cycle: if the product is revised on a regular cycle, the length of the cycle is specified.

nextVersion: if the next release or version of the product is known, it can be provided here.

price: basic price information may be provided.

remarks: comments may also be given."

>

<AbstractObject

subclass: **ProductID**

subclassing: "The user may define subclasses of this class."

attributes:

[productName]	String
[productNumber]	String
[versionNumber]	String
[releaseDate]	Date
[remarks]	String

comments: "The components include the name of the product, the product number, a version number, the release date for the version and comments."

>

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<AbstractObject

subclass: **ProductPrice**

subclassing: "The user may define subclasses of this class."

attributes:

[pricingStructure]	Set(PriceComponent)
[tax]	List(Tax)
[currencyUnits]	String

comments: "The price of a product may amount to a single price in which case there is only one member of the set (in the domain of *pricingStructure,* or it may be based on several component prices. Products with or without a variable price (such as sliding scale prices) can use *pricingStructure* effectively through appropriate values for the attributes in PriceComponent."

>

<AbstractObject

subclass: **PriceComponent**

attributes:

[componentName]	String
[description]	String
unitPrice	Real
volumeDependent	Boolean

comments: "This class supplies information on the cost of delivery of the information, either in a digital or non-digital form. Examples include: connections charges, transfer charges, shipping and handling charges, sliding scale pricing (rather than fixed pricing), discount pricing, etc."

>

<AbstractObject

subclass: **Tax**

subclassing: "The user may define subclasses of this class."

attributes:

name	String
percent	Real
[remarks]	String

comments: "The name of a tax is given, followed by it percent value. A registration number or general comment may be used in the *remarks* attribute."

>

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Withdrawn/Retirée

Chapter 3, Section 7

Supporting Classes

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3.7 Supporting Classes

<AbstractObject

subclass: **Coordinate**

comments: "This is an abstract superclass under which all types of coordinate are specified.

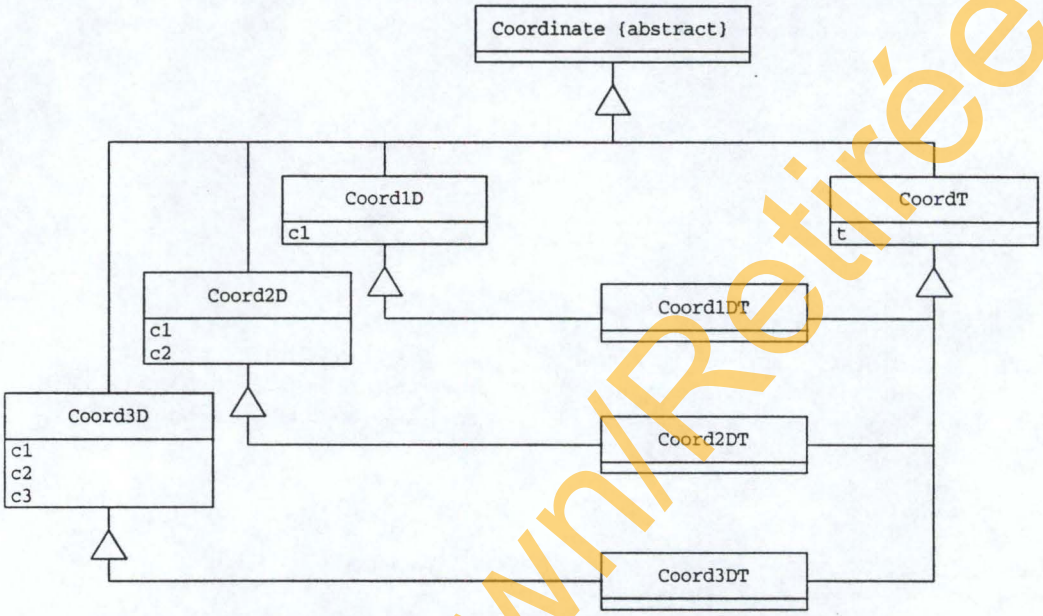


Figure 3-20 High Level Structure of Coordinate

"

>

<Coordinate

subclass: **CoordT**

attributes: t TimeObject

restricted: t: DateTime | Interval

comments: "This subclass is for the allocation of time to objects that require time as a coordinate. The high level structures of CoordT and Coordinate are as displayed below.

If t comes from the domain DateTime, then it provides a value directly from Date, Time, or TimeStamp (Date and Time). In these cases it represents an absolute value. The meaning of t may be further clarified through temporalReferencing, as used by a temporal (or spatiotemporal) object. For example, a spatiotemporal object may have coordinates defined through a subclass of CoordT. It is assumed that the value for

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temporalReferencing associated with the object applies not only to the value for time for the object (if one is given), but also to the coordinates used by the object.

If t comes from the domain Interval, then it provides a value directly from either YearMonthInterval or DayTimeInterval. In these cases it represents a relative time from some starting point. That starting point is assumed to be the value for time specified for the temporal or spatiotemporal object making use of the time-based coordinates. The starting point time must represent an instant in time, coming from Date, Time or TimeStamp. If the higher level temporal or spatiotemporal object treats time as a duration, the starting point is assumed to be the startTime for the duration."

>

<Coordinate

subclass: **Coord1D**

attributes: c1 Numeric

comments: "This subclass is for the allocation of position to objects in one dimensional space. The meaning of c1 is defined through spatialReferencing, as specified in the spatial or spatiotemporal object making use of values from Coordinate or its subclasses."

>

<Coord1D, CoordT

subclass: **Coord1DT**

comments: "This subclass of coordinate and coordT allows for the inclusion of time as part of the coordinate rather than as an attribute of the object being defined. This provides for the use of data in multi-temporal studies. Note that time is defined as the time of observation or occurrence. In studies where sampling occurs, the time of sampling is taken as the time of observation."

>

<Coordinate

subclass: **Coord2D**

attributes: c1 Numeric
c2 Numeric

comments: "This subclass is for the allocation of position to objects in two dimensional space. The meaning of c1 and c2 are defined through spatialReferencing, as specified in the spatial or spatiotemporal object making use of values from Coordinate or its subclasses."

>

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<Coord2D, CoordT

subclass: **Coord2DT**

comments: "This subclass of coord2D and coordT allows for the inclusion of time as part of the coordinate rather than as an attribute of the object being defined. This provides for the use of data in multi-temporal studies. Note that time is defined as the time of observation or occurrence. In studies where sampling occurs, the time of sampling is taken as the time of observation."

>

<Coordinate

subclass: **Coord3D**

attributes:

c1	Numeric
c2	Numeric
c3	Numeric

comments: "This subclass is for the allocation of position to objects in three dimensional space. The meaning of c1, c2 and c3 are defined through spatialReferencing, as specified in the spatial or spatiotemporal object making use of values from Coordinate or its subclasses."

>

<Coord3D, CoordT

subclass: **Coord3DT**

comments: "Coord3DT incorporates time as a coordinate for multi-temporal, three-dimensional spatial analysis."

>

Withdrawn/Retirée

<AbstractObject

subclass: **ExternalReference**

subclassing: "The user may define subclasses of this class."

attributes:

address	String
[application]	String
[comments]	String

comments: "An external file may be referenced in a SAIF data stream or file. Information about such external data is provided through instances of this class. Instances of this class may be used in the following way:

The domain of an attribute in a user defined class is specified as ExternalReference. For example, in the definition of the class *Employee* as defined by a user, an attribute called *photo* may be of interest. Assume further that the employee photographs are stored externally in TIFF (Tag Image File Format) files and that there is no interest in transforming the images to SAIF. The domain for *photo* would be given as ExternalReference.

An instance of ExternalReference may be referenced. For example, in a SAIF data stream or file, the value for the attribute *photo* for an instance of *Employee* might be specified as an object identifier with a value of *27*. In this case the value for *objectIdentifier* for an instance of ExternalReference, existing elsewhere in the SAIF data stream or file, is the integer *27*. Alternatively, it would be possible to provide the values for ExternalReference directly, i.e. to embed them, without requiring the use of object identifiers.

address: the path and file name of the external file which is being referenced.

application: the name of an application which can read the file may be specified. A spreadsheet file for example may be referenced and the name of the spreadsheet may be given under *application*.

comments: comments may be given to provide further clarification."

>

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<AbstractObject

subclass: **Matrix**

attributes:

rows	Integer
columns	Integer
matrixValues	List(Numeric)

constraints: "The product of rows and columns equals the number of elements in matrixValues."

comments: "A general structure for two-dimensional matrices consisting of numeric primitives. The structure for the matrix is standard such that the first value in the list refers to the upper left position of the matrix and the last value to the lower right position. The values are listed row by row, with each row running from left to right and starting with the top row."

>

<AbstractObject

subclass: **MatrixSymmetric**

attributes:

rows	Integer
columns	Integer
matrixValues	List(Numeric)

comments: "A structure for symmetric two-dimensional matrices consisting of primitives. Since the matrix is symmetric the values below the main diagonal need not be given. (Note that the main diagonal is situated from the upper left to the lower right location in the matrix.) The values are still given in a row by row fashion. The value for order in measure must be equal to n+(n(n-1)/2), where n is the number of rows or columns."

>

<AbstractObject

subclass: **Result**

attributes:

[name]	String
[remarks]	String

comments: "This is an abstract superclass. Through its subclasses parametric or boolean results may be specified."

>

<Result

subclass: **Parameter**

attributes:

value	Real
[units]	String

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comments: "A parameter or statistic is characterized by its name and value. The units may also be specified."

>

<Result

subclass: **Check**

attributes: value Boolean

comments: "A boolean check or evaluation is characterized by its name and value."

>

<AbstractObject

subclass: **OriginOffset**

attributes:

deltaX	Real
deltaY	Real
deltaZ	Real

comments: "Each attribute provides a value for the repositioning of the origin of a cartesian system."

>

<AbstractObject

subclass: **Rotation**

attributes:

omega	Real
phi	Real
kappa	Real

comments: "Each attribute provides a value in positive decimal degrees for the rotation of each of the axes of a coordinate system. Positive values indicate a clockwise rotation.

omega - the angle by which the *c1* and *c3*, i.e. *x* and *z*, are rotated around the *c2* (*y*) axis.

phi - the angle by which the *c1* and *c2*, i.e. *x* and *y*, are rotated around the *c3* (*z*) axis.

kappa - the angle by which the *c2* and *c3*, i.e. *y* and *z*, are rotated around the *c1* (*x*) axis."

>

Withdrawn/Retirée

<AbstractObject

subclass: **TextAlignment**

attributes:

horizontal	HorizontalText
vertical	VerticalText
[horizontalOffset]	Real
[verticalOffset]	Real

comments: "TextAlignment defines how the text string is displaced from the origin. The specific choices for the horizontal and vertical alignment are defined in the HorizontalText and VerticalText enumerations. If the continuousHorizontal or continuousVertical options are chosen, the user can provide an offset from the origin in the last two attributes. The offsets must be in the spatialReferencing coordinate system and they must be relative to the text origin at (0,0)."

>

<AbstractObject

subclass: **ArcDefinition**

attributes:

type	CurveChoice
[supportingPoints]	List(Point)

comments: "The definition of an arc requires a choice of the type of curve and and in some cases additional points as specified below. (Note that the surface on which the arc is residing is assumed to be either planar or the earth's ellipsoid, as specified in spatialReferencing; if this is not specified, it is assumed to be planar.)

line: no parameters.

nonLinear: the arc is considered as non-linear, but the kind of non-linear curve either is not known or does not match one of the options listed below. supportingPoints is not used.

circularArc: supportingPoints contains only one point, the centre of the circle.

ellipticalArc: supportingPoints contains three points:
(i) the centre of the ellipse, (ii) one of the points where the major axis intersects the ellipse, and (iii) one of the points where the minor axis intersects the ellipse.
(Note that in Arc only two points may be used in the list of points defining position if the arc is a circular or elliptical arc. The points are given in a clockwise direction. Also, if a complete circle or ellipse is intended, the same point is given twice.)

uniformBspline: supportingPoints is not used.

piecewiseBezier: supportingPoints is not used."

>

Withdrawn/Retired

<AbstractObject

subclass: **DistanceAndAzimuth**

attributes: distance Real
azimuth Real

comments: "Distance is in metres and azimuth is in degrees with 0 degrees identified as North, and clockwise considered as positive. This is used by the DistanceAndAngles relationship, where the meaning of North is also specified."

>

<DistanceAndAzimuth

subclass: **DistanceAzimuthAndDeclination**

attributes: declination Real

comments: "Declination is in degrees, with 0 degrees identified as horizontal (parallel to the ellipsoid) and positive considered as higher in elevation."

>

<AbstractObject

subclass: **DistanceAlong**

attributes: distance Real
from StartOrEnd

comments: "This is used by the relationship RelativeLinearDistance to define where one object is located with respect to another. In this case one object is located at some distance along another linear object, with respect to the second object's start or end."

>

<DistanceAlong

subclass: **DistanceAndSide**

attributes: side Side

comments: "In addition to distance from a start or end point, relative distance may include an indication as to which side one object is on relative to another. The side of a linear object is defined with respect to a traverse from the object's start to its end."

>

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<DistanceAndSide

subclass: **Offset**

attributes: offset Real

comments: "An offset in metres may be added if this subclass is used by RelativeLinearDistance. The offset is on the side indicated by the attribute *side*."

>

<AbstractObject

subclass: **GridReference**

attributes:

[ordering]	GridOrder
[originCorner]	OriginReference
[cellPositionAtCorner]	Boolean
[originCoordinates]	List(Integer)

defaults: ordering:rowOrder
cellPositionAtCorner:true

comments: *"ordering:* indicates whether row order, column order, boustrophedon by row or boustrophedon by column ordering is being used.

originCorner: refers to the corner of the grid which is assumed to be the origin. (If a value of 'centre' is given, the grid must have odd numbers for each dimension.) For example, in a typical two dimensional case, the grid origin may have grid coordinates of (1,1) or (0,0), indicating first row, first position in the row.

cellPositionAtCorner: states whether or not the origin of a given cell is positioned at the corner with respect to its corresponding grid point. The corner referred to is that specified by *originCorner*. A value of 'false' for this attribute indicates that the origin of the given cell is at the centre with respect to its corresponding grid point.

originCoordinates: gives the coordinates of the local origin for the grid. Unless the grid in question is being located with respect to a larger grid, the values for the originCoordinates consist of all ones or all zeroes."

>

Withdrawn/Retirée

<GridReference

subclass: **GridWithinGridReference**

attributes: reference GridReference

comments: "This is a recursive structure. If an n dimensional grid is decomposed into a series of subgrids (which in turn may be further subdivided), then ordering, originCorner, cellPosition and originCoordinates may be specified for each level. Each level of recursion allows for a more general reference."

>

<AbstractObject

subclass: **GridFramework**

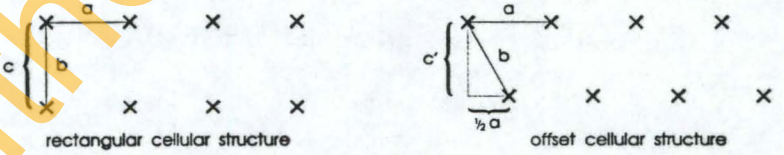
attributes:

[gridDimensions]	List(Integer)
[gridSpacing]	List(Numeric)
[offsetStructure]	OffsetStructure
[units]	List(UnitMeaning)

defaults: offsetStructure:none

comments: *"gridDimensions:* indicate the size of the grid - in terms of columns, rows, etc - first in the x direction, then the y direction, etc

gridSpacing: spacing in real world units between the grid positions, first in the x direction, then the y direction, etc.. All units are typically of the same type. However, if spatiotemporal data is being considered, the units may for example consist of a list of metres, metres, years. The spacing is given with respect to grid positions rather than grid lines. For example, a two-dimensional grid with a grid spacing of 1,1 will have equal distance between successive grid positions in both dimensions regardless of whether it is a rectangular grid or a triangular grid, the spacing between successive lines, however, will be different:



offsetStructure: an enumeration with possible values of *none*, *in* or *out* which defines the shifting of alternate grid rows with respect to the second dimension specified by gridDimensions. A rectangular grid has a offsetStructure value of *none* (default), a triangular grid structure will have a value of either *in* or *out* describing the

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relationship between alternating rows. Alternating rows are offset with respect to each other by one half the spacing specified by the second grid dimension.

Case 1- originCorner: nw
offsetStructure: out

first row of grid x x x x x x x x x
second row x x x x x x x x x
third row x x x x x x x x x

Case 2- originCorner: se
offsetStructure: out

x x x x x x x x x third row
x x x x x x x x x second row
x x x x x x x x x first row of grid

Case 3- originCorner: nw
offsetStructure: in

first row of grid x x x x x x x x x
second row x x x x x x x x x
third row x x x x x x x x x

Case 4- originCorner: se
offsetStructure: in

x x x x x x x x x third row
x x x x x x x x x second row
x x x x x x x x x first row of grid

"

>

<AbstractObject

subclass: **CellGeometry**

attributes: [cellSize] List(Numeric)
[units] List(UnitMeaning)
[cellShape] CellShape

defaults: cellShape:rectangle

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comments: "The size in real world units of a single cell is given by the first attribute, with the numbers in the list corresponding to the first dimension, then the second dimension, etc.

The corresponding measurement units for the n dimensions are given by the second attribute.

Regardless of whether the cell shape is a n dimensional rectangle or ellipse, the cell is assumed to fit exactly within the n-dimensional range rectangle defined by cellSize. If the cell shape is a point, then the cellSize is either left nil or is given as a list of zeroes."

>

<AbstractObject

subclass: **GridLocation**

comments: "This is an abstract superclass used to define arbitrary locations within a gridded structure. Clarification of the structure is only possible at the level of LocationsInGrid."

>

<GridLocation

subclass: **DirectGridReference**

attributes: gridCoordinate List(Integer)

comments: "A single location in a grid is given. The list of integers represents a coordinate in the grid. For example, the list contains two integers, if a two dimensional position is being given."

>

<GridLocation

subclass: **MortonNumber**

attributes: locationalCode Integer

comments: "A single nTree locational code is provided. The code is based on a linear quadtree (or octree, etc.), with the first level of the hierarchy referenced by the single digits1, 2, 3 and 4 (or 1 through 8, etc.). (Samet, 1989)"

>

<GridLocation

subclass: **BitMaskValues**

attributes: presenceOrAbsence BitString

Withdrawn/Retirée

comments: "This subclass represents a set of binary mask values. The presenceOrAbsence bit string carries 0s and 1s, indicating presence or absence. The structure to which the mask values are applied is provided by the subclass Grid."

>

<AbstractObject

subclass: **Category**

subclassing: "The user may define subclasses of this class."

attributes:

categoryNumber	Integer
name	String
[description]	String

comments: "The class is contained by the class CategoricalRaster and defines in detail each of the categories within a theme.

categoryNumber - the nominal designation of a category. When used with CategoricalRaster, the category number corresponds to the value associated with a cell.

name - the name of the category.

description - a textual description of the characteristics which make the category unique.

For example, a land use mapping program might define a subclass of CategoricalRaster named LandUseRaster. An instance of this type might contain a number of different categories within the land use theme. A logged area which has been recently replanted might have the category number '5', the name 'regeneration', and the description 'areas classified as a recent logging land use where there is a regenerating coniferous crop tree species present with greater than 25% cover and tree height less than 6m'. Any LandUseRaster cell with the value of '5' will be of the 'regeneration' category."

>

<AbstractObject

subclass: **Channel**

subclassing: "The user may define subclasses of this class."

attributes:

[channelNumber]	Integer
[name]	String
[description]	String
[units]	UnitMeaning
[instanceType]	PrimitiveInstanceType
[bitsPerValue]	Integer

restricted: instanceType: integer8 | integer8Unsigned | integer16 | integer16Unsigned | integer32 | integer32Unsigned | integer64 | integer64Unsigned

Withdrawn/Retirée

constraints: "The channelNumber must be greater than zero. Either instanceType or bitsPerValue must be provided."

comments: "Each channel is used to identify a layer of 2 dimensional gridded data. One or more channels make up an instance of GeneralRaster. Each instance of Channel supplies the following:

channelNumber - an integer value greater than 0 which serves to identify and distinguish this channel of the raster database from all other channels. Channel numbers need not be continuous or sequential.

name - a plain text name of the channel. Examples might include TM Band 3, PCA first component, or NDVI.

description - a textual description of the channel. Examples might include 'principal components analysis on TM bands 3 through 5 - image date May 1988', or 'slope in whole degrees generated from 20 metre gridded 1:250 000 scanned contours'.

units - this attribute takes its value from UnitMeaning. The most common application of this attribute will have the value 'digitalNumber' which means that the value is a positive whole one or two byte integer including 0. This type of value is common to most image analysis systems and can be equated to the relative intensity of a particular wavelength range.

instanceType - the values attributed to the raster may be either bit or byte aligned. If the values are byte aligned, then this attribute must be supplied. The allowable values for this attribute are identified by the restricted clause.

bitsPerValue - if the values associated with each cell of the raster are bit aligned as is the case with a bit mask this attribute must be included. The supplied value must be a whole integer. For example, a bit mask where the value for each cell of the grid is either a 1 or a 0 this attribute has a value of 1. This means that each bit of the encoded data corresponds to a cell of the raster in the order specified by the indexing scheme.

Further description of the make-up of each individual channel, band or layer may defined by incorporating the appropriate attributes under a user defined subclass of Channel. For example, a satellite image channel might be further defined by the addition of a user defined attribute of the domain ImageBand (a SAIF class which defines bandID, wavelength min and max, etc.) and other user defined attributes such as platform and sensor, or if the layer is not spectral imagery, additional user defined attributes specifying measurement minimum and maximum or, in the case of radar data, items such as band type and look angle can be included. If no user defined subclass is used, these attributes can be included as part of the *description* attribute string."

>

Withdrawn/Retirée

Chapter 3, Section 8

Enumerations

Withdrawn/Retirée

intentionally left blank

Withdrawn/Retirée

3.8 Enumerations

<Enumeration

subclass: **PrimitiveInstanceType**

values: string octetString bitString boolean integer8 integer8Unsigned integer16 integer16Unsigned integer32 integer32Unsigned integer64 integer64Unsigned real32 real64 real80

comments: "This enumeration is used to indicate the type of primitive value to be used in any specific instance. Note that numeric, integer and real are abstract superclasses, and thus are not listed."

>

<Enumeration

subclass: **NumericInstanceType**

values: integer8 integer8Unsigned integer16 integer16Unsigned integer32 integer32Unsigned integer64 integer64Unsigned real32 real64 real80

comments: "This enumeration is used to indicate the type of numeric primitive value to be used in any specific instance. Note that numeric, integer and real are abstract superclasses, and thus are not listed."

>

<Enumeration

subclass: **TagCategory**

values: universal application private

comments: "This is used by TypeDefinition, where the meanings of the values are described."

>

<Enumeration

subclass: **Optionality**

values: alwaysNil neverNil

comments: "This enumeration is used used to store restrictions on inherited optional attributes. It is used by the subclass RestrictedOptionality."

>

Withdrawn/Retirée

<Enumeration

subclass: **LocationalQualifier**

values: definite indefinite positionApproximate virtual

comments: "This enumeration is used by GeometricObject.

definite: The feature complies with positional accuracy (assuming that the spatial entity to which this refers has included an attribute from the domain Quality in its definition.).

indefinite: The feature was partially obscured on the input source material and so compliance with positional accuracy (as defined under quality of the spatial entity in question) is not ensured.

positionApproximate: The feature was not evident on the input source material; its position was estimated from alternate source material.

virtual: The feature does not exist on the ground; this feature is required to fulfill polygon closure requirements for polygonal features that intersect a data coverage boundary."

>

<Enumeration

subclass: **DEMpointChoice**

values: precise spotHeight indefinite hybrid

comments: "This enumeration is used by DEMpoint (in the creation of a Digital Elevation Model).

precise: observed or derived through survey methods,

spotHeight: photogrammetrically derived exact,

indefinite: photogrammetrically derived estimate,

hybrid: mathematically derived from other c1, c2, c3 detail."

>

<Enumeration

subclass: **BreaklineChoice**

values: sharp round hydrographic hypsographic anthropogenic

Withdrawn/Retiree

comments: "This enumeration is used by Breakline (in the creation of a Digital Elevation Model).

sharp: Identifies a marked angular change in terrain.

round: Approximates the position of a non-angular but significant change in terrain.

hydrographic: Partially or completely defines a natural hydrographic feature associated with a change in terrain.

hypsographic: Partially or completely defines a natural non-hydrographic feature associated with a change in terrain.

anthropogenic: Partially or completely defines a non-natural feature associated with a change in terrain."

>

<Enumeration

subclass: **IsolineForm**

values: normal depression

comments: "This enumeration is used by Isoline and Contour.

normal: Connects an infinite number of points of the same value. This feature may or may not enclose an area for which values inside the area are greater than the value of the isoline.

depression: Connects an infinite number of points of the same value. This feature always encloses an area for which values inside the area are less than the value of the isoline."

>

<Enumeration

subclass: **ContourGeneration**

values: stereoDigitized fromGeneratedSurface fromOtherContours

comments: "This enumeration is used by Contours.

stereoDigitized: Contours generated manually through photogrammetric methods.

fromGeneratedSurface: Contours derived automatically from a digital terrain model (such as a digital elevation model or a triangulated irregular network).

fromOtherContours: Contour derived manually or automatically from other contours."

>

Withdrawn/Retirée

<Enumeration

subclass: **GridOrder**

values: rowOrder columnOrder boustrophedonByRow boustrophedonByColumn

comments: "This provides an order choice for the listing of gridpoints. The choices indicate the difference between parallel rows of values proceeding in the same direction, parallel rows of values that alternate in direction, parallel columns of values proceeding in the same direction and parallel columns of values that alternate in direction."

>

<Enumeration

subclass: **OriginReference**

values: centre nw sw ne se
nwTop swTop neTop seTop
nwBottom swBottom neBottom seBottom
nwFirst swFirst neFirst seFirst
nwLast swLast neLast seLast
nwTopFirst swTopFirst neTopFirst seTopFirst
nwBottomFirst swBottomFirst neBottomFirst seBottomFirst
nwTopLast swTopLast neTopLast seTopLast
nwBottomLast swBottomLast neBottomLast seBottomLast

comments: "nw, sw, ne and se are northwest, southwest, northeast and southeast, respectively. Top refers to the highest elevation and bottom to the lowest. First refers to start time and last to end time.
For 2D spatial data: centre through se may be used.
For 3D spatial data: centre plus nwTop through seBottom.
For 2D spatial + 1D Time: centre, nwFirst through seLast.
For 4D space/time: centre, nwTopFirst through seBottomLast."

>

<Enumeration

subclass: **Direction**

values: forward backward bothDirections alternating across acrossLeftToRight acrossRightToLeft noDirection unknown

comments: "Choices for indicating the direction of lines belonging to the subclass ArcDirected or the subclass PathDirected, or as used in the relationship ConnectedTo. *alternating* implies alternating forward and backward. *across* implies both acrossLeftToRight and acrossRightToLeft."

>

Withdrawn/Retirée

<Enumeration

subclass: **ConnectionDirection**

values: forward backward bothDirections alternating forwardLeftSide forwardRightSide backwardLeftSide backwardRightSide unknown

comments: "Choices for indicating the direction of connections contained by the subclass Connection. *alternating* implies alternating forward and backward."

>

<Enumeration

subclass: **DirectionThrough**

values: forward backward

comments: "This is used by the subclasses OrientedArc and OrientedPath to indicate whether the constituent points are referenced, or oriented, in a forward or backward direction."

>

<Enumeration

subclass: **Side**

values: left right leftAndRight

comments: "Choices indicating the position of an object with respect to another linear object in two dimensions."

>

<Enumeration

subclass: **NeighbourLocation**

values: sameLocation onLeft onRight across

comments: "Choices indicating where an object is located relative to another. Note for example that two street addresses may be considered as at the sameLocation if they are within the same building. Across implies across a street or route. onLeft and onRight refer to the location from the perspective of being on the route looking at the objects, such as houses. It is used by the relationship neighbour."

>

Withdrawn/Retirée

<Enumeration

subclass: **CompassDirection**

values: northOf eastOf southOf westOf above below

comments: "CompassDirection is used by the Compass relationship to indicate the position of an object with respect to another object. The six primary directions in three-dimensional space are provided."

>

<Enumeration

subclass: **North**

values: geodetic grid

comments: "North is used in the relationship DistanceAndAngles to indicate which notion of North is being used with respect to azimuth measurements.

geodetic: This corresponds to the Geodetic Pole, the primary pole of the reference ellipsoid which is directed toward the Conventional International Origin (i.e., the northern pole of the averaged axis of rotation of the earth for the years 1900 - 1905).

grid: This corresponds to theoretical North as defined by the chosen map projection (ie. Universal Transverse Mercator)."

>

<Enumeration

subclass: **CellShape**

values: point rectangle ellipse hexagon triangle

comments: "rectangle includes square, rectangular solid and cube, and their four dimensional equivalents.
ellipse includes circle, ellipsoid and sphere, and their four dimensional equivalents.
hexagon and triangle are required for offset gridded structures."

>

<Enumeration

subclass: **CurveChoice**

values: line nonLinear circularArc ellipticalArc uniformBspline piecewiseBezier

Withdrawn/Retirée

comments: "Choices for the description of an arc are provided. This is used by ArcDefinition which in turn is used by Arc."

>

<Enumeration

subclass: **TemporalTopologicRelationship**

values: temporallyDisjoint temporallyIntersect atStart atEnd follows overlapsAtStart overlapsAtEnd during duringFromStart duringToEnd simultaneous

comments: "This enumeration provides the choices for a comparison of the time of occurrence or observation of one object and that of another. This enumeration is used by the temporal relationship TemporalTopology. The terms are defined there."

>

<Enumeration

subclass: **Succession**

values: before after coincident

comments: "Three possible values indicating the temporal sequence of one object with respect to another. This enumeration is used by the temporal relationship Precedence. The terms are defined there."

>

<Enumeration

subclass: **StartOrEnd**

values: start end

comments: "This enumeration is used in a relationship specifying where one object is in space relative to another, linear object."

>

<Enumeration

subclass: **BeforeOrAfter**

values: before after

comments: "This enumeration is used in a relationship specifying where one object is in time relative to another object."

>

Withdrawn/Retiree

<Enumeration

subclass: **TemporalInstance**

values: startTime endTime singleInstance

comments: "An instance of time may be either the startTime or endTime if an object has a duration. If the point in time is considered as a single instant, the value singleInstance is appropriate."

>

<Enumeration

subclass: **HorizontalText**

values: left centre right normalHorizontal continuousHorizontal

comments: "Choices for horizontal text alignment. "

>

<Enumeration

subclass: **VerticalText**

values: top cap half base bottom normalVertical continuousVertical

comments: "Choices for vertical text alignment."

>

<Enumeration

subclass: **TextPath**

values: right left up down

comments: "TextPath contains the possible choices for the placement of the characters in the string. Right and left indicate the placement of the characters along the horizontal orientation vector; up and down indicate placement along the vertical alignment vector."

>

Withdrawn/Retirée

<Enumeration

subclass: **NamedSpatialTopology**

values: intersects disjoint equals adjacent contains encloses overlaps encircles

comments: "This is used as the domain for *commonName* in the SpatialTopologyExtended relationship. See comments under SpatialTopologyExtended for a detailed explanation of each value."

>

<Enumeration

subclass: **Hemisphere**

values: north south east west

comments: "This enumeration indicates whether the hemisphere north or south of the equator or the hemisphere east or west of the prime meridian is of interest."

>

<Enumeration

subclass: **SoundingDatum**

values: mWL hHWLT hHWMT lLWMT lLWLT lNT

comments: "A list of the tidal surfaces presently used in Canadian waters is given below (Canadian Tidal Manual, 1983). Designations for U.S. and British Admiralty charts are not directly comparable.

mWL: (Mean Water Level) The average of all hourly water levels over the available period of record.

hHWLT: (Higher High Water, Large Tide) The average of the highest high waters, one from each of the 19 years of prediction.

hHWMT: (Higher High Water, Mean Tide) The average of all the higher high waters from 19 years of predictions.

lLWMT: (Lower Low Water, Mean Tide) The average of all the lowest low waters from all the 19 years of prediction.

lLWLT: (Lowest Low Water, Large Tide) The average of the lowest low waters, one from each of the 19 years of prediction.

lNT: (Lowest Normal Tide) In present usage it this is synonymous with the lLWLT, but on older charts may refer to a variety of low water chart datums."

>

Withdrawn/Retirée

<Enumeration

subclass: **PositioningMethod**

values: differentialGPS singlePositionGPS photogrammetry radioPositioning terrestrial astronomicObservation approximate fromMap other

comments: "A number of different methods may be used to determine position. They are categorized into eight basic choices.

differentialGPS: Is the position of a point with respect the GPS satellite network and a second point where the second point is taken as the origin of a local coordinate system. Several simultaneous GPS readings for the related points are determined. These multiple redundant readings are used to correct for atmospheric propagation delay, receiver error and error in satellite epherides. This is also known as relative positioning and has an associated error of 0.1 to 2.0 ppm. (Guide to GPS Positioning, 1986)

singlePositionGPS: Is the position of a single stationary or moving point or object derived through the use of a single GPS unit. This location is determined with respect to a well defined coordinate system that is itself oriented with respect to the earth. If three satellites are visible to the antenna at a point accuracy down to decimetres should be achieved. (Guide to GPS Positioning, 1986)

photogrammetry: Positioning based on generally accepted photogrammetric methodology. The position derived is based on the fact that a definite geometric relationship exist between the relative spatial positions of image points in a two dimensional photograph and their corresponding positions in 3 dimensional object space. In general the accuracy of photogrammetric positioning is related to the scale of the associated photography. (Manual of Photogrammetry, 1980)

radioPositioning: The use of radio frequencies for offshore positioning. representative systems include Syledi, Hi-Fix, Argo, Decca, Loran-C, Accufix, etc.

terrestrial: This includes traditional survey networks as well as open and closed traverses where position is derived using high quality equipment and defined procedures. Accuracy will be dependent on specific equipment and methodology.

astronomicObservation The determination of longitudes, latitudes, and azimuths by observations of the directions of stars, planets, the Moon, or other celestial bodies.

approximate: An approximate location would include field procedures such as pacing, tape and compass, compass and clinometer.

fromMap: This refers to positions that are derived from a published topographic map. Associated accuracy will depend on methods of measurement and on the scale of the map used."

>

Withdrawn/Retiree

<Enumeration

subclass: **PositioningOrigin**

values: monument fromMapsheet other

comments: "This enumeration specifies the type of reference position to which positional information is tied. Positional accuracy of subsequently derived positions is limited by the type of positioningOrigin used.

monument: This value is used if the positions supplied are referenced to a recognized survey marker.

fromMapSheet: This value is used if the positions supplied are derived from a reference position identified on a map sheet.

other: This value is used if some other method of locating a positional reference is used (ie aerial photography)."

>

<Enumeration

subclass: **GeodecticHorizontalDatumAS**

values: nad27 nad83 may76 ats77 adindan arc50 australianGeodetic bukitRimpah caa campoInchauspe chuaAstro corregoAlegre djakarta european50 gSegara gSerindung geodetic1949 ghana guam1963 heratNorth hjorsey huTzuShan indian ireland1965 kertau liberia1964 localAstro luzon merchich montjongLowe migeria oldHawaiian osgb psa1956 qornoq sierraLeone1960 tananariveObsv1925 timbalai tokyo voirol wgs60 wgs66 wgs72 wgs84 yacare hermannskogel european79 german italian other

comments: "The horizontal adjustment system is the realization of the reference ellipsoid utilizing a particular set of control networks.

nad27: This value refers to an adjustment completed in 1932 of first order triangulation done in North America prior to 1927. Associated geodetic calculations were based on the Clarke 1866 ellipsoid.

nad83: This refers to a conventional terrestrial system (geocentric) realized by modifying the US Navy Navigation Satellite System (Doppler) reference frame (NSWC 9Z-2).

Withdrawn/Retiree

Classical terrestrial network observations and space system data for North America were adjusted together in July 1986, to create the nad83 system.

may76: This is a readjustment of nad27 based on the Clarke 1866 ellipsoid completed in 1976. This adjustment is used mainly in Ontario.

ats77: Refers to the Average Terrestrial System 1977, which is used primarily in the Maritime provinces of Canada.

caa: Refers to Camp Area Astro.

wgs60: Refers to World Geodetic System 1960.

wgs66: Refers to World Geodetic System 1966.

wgs72: Refers to World Geodetic System 1972.

wgs84: Refers to World Geodetic System 1984.

osgb: Refers to Ordnance Survey of Great Britain.

psa1956: Refers to Provisional South American 1956.

other: Allows the specification of another horizontal adjustment system."

>

<Enumeration

subclass: **GeodeticEllipsoidType**

values: grs clarke airy australianNational bessel everest fisher international modifiedAiry modifiedEverest walbeck wgs clark krasovsky other

comments: "The reference ellipsoid is a method of approximating the shape of the geoid. The ellipsoid choice is typically implied by the horizontal adjustment system."

>

Withdrawn/Retirée

<Enumeration

subclass: **GeodeticVerticalDatumAS**

values: cvd28 navd88 other

comments: "The typical vertical adjustment system in Canada is cvd28.

cvd28: Refers to Canadian Vertical Datum 1928, a vertical adjustment system which uses Mean Sea Level from the 1920's.

navd88: Refers to North American Vertical Datum 1988, the vertical adjustment system using the new sea level datum from the 1980's. navd88 will redefine the heights of several hundred thousand benchmarks across North America.

other: Allows the specification of another vertical adjustment system."

>

<Enumeration

subclass: **GeodeticSurfaceChoice**

values: meanSeaLevel geoid ellipsoid other

comments: "Mean sea level is the usual value here, since the elevation is usually tied directly or indirectly to control monuments. If elevation is based strictly on GPS, then *geoid* should be given. For some work, elevation may be measured from the ellipsoid, in which case that value is provided.

meanSeaLevel: This value should be used if the reference position for the elevation is derived from a control monument or benchmark.

geoid: This value should be used if the some other equipotential surface has been used as a reference or if the value has been determined using Global Positioning technology (GPS) referenced specifically to the geoid.

ellipsoid: This value is used if the reference surface is defined by the given theoretical biaxial ellipsoid (specified by EllipsoidChoice), resulting in geometrical heights.

other: Allows the specification of an arbitrary verticalDatum."

>

Withdrawn/Retiree

<Enumeration

subclass: **UnitMeaning**

values: kilometres metres centimetres millimetres micrometres nanometres nauticalMiles miles fathoms feet inches degrees radians years months weeks days hours minutes seconds nanoseconds metresPerSecond kilometresPerSecond metresPerHour kilometresPerHour centimetresPerYear knots milesPerHour feetPerSecond degreesKelvin degreesCelcius degreesFahrenheit kilopascals digitalNumber other

comments: "Different choices of units may be specified."

>

<Enumeration

subclass: **ProjectionName**

values: albersI albersII bonne azimuthal sinusoidal mollewide parabolic hammerAiitoff boggs eckertIV lambertConformalII stereographic mercator obliqueMercator transverseMercator gnomonic azimuthalEquidistant orthographic conicI conicII polyconic perspectiveCylindrical plateCaree cartParallel miller globular aerialPerspective vanderGrinten cassini robinson other

comments: "The name of the projection used for spatial referencing of coordinates."

>

<Enumeration

subclass: **ProjectionParmName**

values: radius eccentricity latitudeOfOrigin longitudeOfOrigin firstStandardParallel secondStandardParallel standardParallelNearestEquator standardParallelFarthestFromEquator longitudeOfTangency latitudeOfTangency longitudeOfGreatCircle latitudeOfGreatCircle azimuthOfGreatCircle centralMeridian centralLongitude centralLatitude centralScaleFactor longitudeScaleFactor latitudeScaleFactor zoneWidth falseEasting falseNorthing falseLatitude falseLongitude other

comments: "The name of the parameter required when coordinates are spatially referenced using a projection."

>

<Enumeration

subclass: **UpdateType**

values: add replaceAll replacePart delete

Withdrawn/Retirée

comments: "Updating operations may be assisted through the appropriate choice of value from this enumeration. Four kinds of operations are recognized.

add: the object is to be added to the product or geographic object, (as identified in UpdateOperation.

replaceAll: the object is intended as a complete replacement for a previous copy.

replacePart: Partial modification to an existing object is required. It implies that only those parts of the object which contain values, i.e., which are specified, should replace the previous values.

delete: the geographic object should be deleted from the database. If deletion is the intention, the geographic object still must be defined, but with unspecified attributes."

>

<Enumeration

subclass: **TerminusType**

values: producer distributor receiver

comments: "These three values are meaningful in the context of the sender of the data. "

>

<Enumeration

subclass: **SecurityClass**

values: topSecret secret confidential restricted unclassified

comments: "These choices are applicable for military use, but may also be applied to other applications."

>

<Enumeration

subclass: **Noding**

values: noded nodedAtEnds notNoded

comments: "This is used by by the AbstractObject Structuring to indicate whether the intersections of geometric objects, such as lines, are explicitly indicated by other geometric objects, such as points. The first value implies that the objects defining the intersections are included within each of the intersecting objects, but not necessarily at the ends of the object. The second value implies that all such intersections form the beginning or end of the objects. The third value connotes that there is no explicit relationship between intersecting objects."

>

Withdrawn/Retirée

<Enumeration

subclass: **Sharing**

values: shared pointsNotShared notShared

comments: "The first value indicates that geometric objects common to two or more other objects, such as polygon boundaries, are first defined and then referenced by their object identifiers. The second value indicates that this is generally true, but that points (or at least some points) may be an exception. The third value implies that, for example, the same bounding arc may be explicitly defined more than once. This is used as a domain in Structuring."

>

<Enumeration

subclass: **SpaceFilling**

values: fillsSpace doesNotFillSpace

comments: "The first value indicates that voids or holes do not exist in the two or three dimensional space defined by the outer boundaries of the object in question, such as a watershed or a mapsheet which contains other spatial entities. The second value implies that the space may not be completely filled. This is used as a domain in Structuring."

>

<Enumeration

subclass: **TimeType**

values: utc gps local

comments: *"utc:* Universal Coordinated Time (previously called GMT or Greenwich Mean Time).

gps: Global Positioning Satellite time. 24 equal hour clock time that has been determined by the GPS receiver from the transmitted 29 bit Z count. Time determination is accomplished by multiplying the GPS TOW (time of week) count by 1.5 to determine the number of elapsed seconds from the most recent Saturday midnight. A UTC offset can be applied by the receiver for local time. GPS time differs slightly from UTC time in that it does not account for the leap seconds that have accumulated since the GPS start time of midnight January 5, 1980.

local: Local time is the time provided by a given computer system or watch of the person making the observation. It does not carry the accuracy associated with GPS or UTC time. It can, however, be supplied with a UTC offset which approximates the equivalent Greenwich Mean Time."

>

Withdrawn/Retiree

<Enumeration

subclass: **IndexScheme**

values: sequentialArray interleavedArray runLengthEncoded nTree

comments: "IndexScheme is an abstract superclass within which the possible schemes for referencing gridded data are defined. The inheritance hierarchy for IndexScheme is shown below.

The values sequentialArray and interleavedArray imply that no form of compression is used on structured data. The data is organized as either sequential or interleaved. For example, a non-compressed raster cover may be described by a sequentialArray. A satellite image that is delivered with seven interleaved bands would be described with the value interleavedArray.

The value runLengthEncoded provides for data compression through the grouping of locations with identical values. When applied to StructuredData, the attribute contentValues contains an integer representing the number of identically valued locations followed by the value of the location as specified by the attribute structure. This structuring scheme begins with the first location and progresses through the last location.

The value nTree allows for the spatial referencing of locations using a linear tree of n dimensions with variable length locational codes *(Samet, 1989)*. When applied to StructuredData, the attribute contentValues contains an integer representing the locational code (Morton number) of the identically valued locations followed by the value of the location as specified by the attribute structure. Only locations (or leaves) with data are specified; i.e., void areas are not explicitly listed. Also, the locational codes should be sorted hierarchically, not by numeric value. For example, the following is allowed: 1 511 521 61 62. The following list is not allowed, as it is not ordered correctly: 1 61 62 511 521."

>

<Enumeration

subclass: **OffsetStructure**

values: none in out

comments: "This type is applied to regular cellular structures only. When a structure is applied to a regular grid, it can be arranged in two distinct ways. First, it can be applied as a rectangular structure where positions in a two-dimensional grid are aligned at right angles to each other in each dimension such that minimal distance lines joining positions will form rectangles, e.g., in a vertically aligned cellular structure, any row in x will have an identical set of x values. The second structure is triangular in configuration such that minimal distance lines joining positions in the grid will form triangles. In the triangular structure, subsequent rows are offset from each other by one half the distance between consecutive positions in an alternating fashion. Consequently, the offset of alternating rows may be such that the first row starts at a position before the first position of the second row or the reverse may occur where the first row begins at a position after the start position of the second row. In the former case a choice of *out* is appropriate and for the latter case a choice of *in* is used. The value *none* is supplied for defining the offset of the rectangular case."

>

Withdrawn/Retirée

<Enumeration

subclass: **CTSSystemType**

values: wgs iugg grs itrf

comments: "The type of geodetic system required for defining geometric and physical geodetic relationships on a global scale.

wgs - World Geodetic System. A set of geodetic quantities based on a geocentric origin and a reference ellipsoid developed by the U.S. Department of Defense.

iugg - International Union of Geodesy and Geophysics

grs - Geodetic Reference System. A set of geodetic quantities approved by the International Association of Geodesy and adopted by the International Union of Geodesy and Geophysics.

itrf - International Terrestrial Reference Frame.

"

>

Withdrawn/Retired

Chapter 3, Section 9

Class Structure Definitions

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Withdrawn/Retirée

3.9 Class Structure Definitions

// This section is included for completeness only, primarily to demonstrate that any type definition
// can be defined using SAIFtalk. In practice, because the encoded SAIF file is self describing using
// both CSN and OSN, development of instances of type definitions are not required.

<AbstractObject

subclass: **TypeDefinition**

attributes:

type	TypeIdentifier
[tag]	Tag

comments: "This is an abstract superclass. It's child classes are used to define classes and enumerations which are not part of the SAIF standard.

type: the name of the class or enumeration and the schema from which it is taken are defined.

tag: the tagCategory and tagNumber are provided. Taken together they provide a unique means of distinguishing the type from all other possible types in a transfer, in encoding schemes which require the use of tags. Note that if tags are not required by the encoding scheme, it is best not to use them. (A tag value need not be entered if SAIF/ZIP is being used.)

The high level structure of TypeDefinition is diagrammed below.

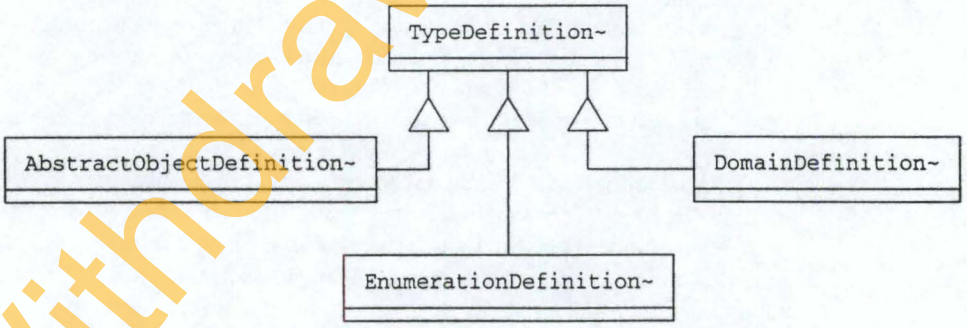


Figure 3-21 High Level Structure of TypeDefinition

"

>

Withdrawn/Retirée

<TypeDefinition

subclass: **AbstractObjectDefinition**

attributes:

[superclass]	List(TypeIdentifier)
[subclassing]	String
[attributes]	List(AttributeDefinition)
[classAttributes]	List(AttributeDefinition)
[defaults]	List(RestrictedValue)
[restricted]	List(Restricted)
[constraints]	String
[classAttributeDefaults]	List(RestrictedValue)
[classAttributeValues]	List(Restricted)
[comments]	String

defaults: superclass.typeName:"AbstractObject"

restricted: classAttributeValues{}:RestrictedValue | RestrictedValueSet | RestrictedValueRange

constraints: "classAttributes{}:RestrictedValueSet | RestrictedValueRange only if the class being defined is an abstract superclass."

comments: "With single inheritance, the list of type identifiers for *superclass* contains only one value. With multiple inheritance, the list contains two or more values.

Attributes, class attributes, and other information inherited from superclasses are not repeated in the definition of a subclass.

The defaults and restricted clauses refer specifically to attributes. The classAttributeDefaults and classAttributeValues clauses relate to classAttributes. The structures for (object) attributes and class attributes are quite analogous. However, in the latter case there are restrictions applied as to which subclasses may be used in the construction of domains for classAttributeValues (as compared to restricted) clauses.

In particular, classAttributes can never be specified as optional or as coming from complex domains. The domain for each class attribute must be either a type of primitive or an enumeration. Each class attribute must have a single primitive value specified or inherited, unless the class being defined is an abstract superclass. With an abstract superclass, particular values need not be specified at all, or alternatively, values may be defined as a set or range of values. However, each (directly instantiable) subclass of such an abstract superclass must provide a single primitive value for each classAttribute which has not been specified to that degree of detail previously."

>

Withdrawn/Retirée

<TypeDefinition

subclass: **EnumerationDefinition**

attributes:

enumerates	List(EnumerationValueDef)
[comments]	String

comments: "This subclass is used for the definition of enumerations not specified in the SAIF standard. *enumerates* consists of two attributes, *description* and *enumeratedValue*, with *enumeratedValue* being optional. Either *enumeratedValue* must be specified for every entry in the list, or it must not be specified for any of them."

>

<TypeDefinition

subclass: **DomainDefinition**

attributes:

baseType	PrimitiveInstanceType
validValues	List(Primitive)
[comments]	String

restricted: baseType:string | integer8 | integer8Unsigned | integer16 | integer16Unsigned | integer32 | integer32Unsigned | integer64 | integer64Unsigned | real32 | real64 | real80

constraints: "The members of the *validValues* list must themselves be of the type specified by *baseType*."

comments: "This subclass is used for the definition of permissible values which may be used for primitive types. The permissible values will be listed in the *validValues* attribute."

>

<AbstractObject

subclass: **TypeIdentifier**

attributes:

typeName	String
[optionalStringLength]	Integer
[schema]	SchemaIdentifier
[direct]	Boolean

defaults:
schema.schemaName:"SAIF"
schema.version:"3.2"
direct:true

comments: "Classes or enumerations can be identified by their name and the name of the schema (class or feature identification system) of which they are a part. If the type name has the value *String*, then optionally, a string length may be specified. For example, an attribute may be identified as being of type String (30). In this case the values for typeName and optionalStringLength

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are *String* and *30*, respectively. With other types, optionalStringLength should not be specified.

The default schemaName is SAIF (referring to the set of classes which are part of the SAIF specification:

Integer, Time, Point, etc.). If it is assumed that an object must be an instance of the class identified, and not one of its subclasses, direct is true. If the object may be an instance of a subclass of the class identified, then direct is false."

>

<AbstractObject

subclass: **SchemaIdentifier**

attributes:

schemaName	String
version	String

comments: "A schema is identified by its name and version number."

>

<AbstractObject

subclass: **EnumerationValueDef**

attributes:

description	String
[value]	Integer

comments: "Each entry in an enumeration is defined using a description and a value. If the value is not specified, it is assumed equal to 0 for the first entry, 1 for the second, 2 for the third, etc."

>

<AbstractObject

subclass: **AttributeDefinition**

attributes:

attributeName	String
attributeDomain	TypeIdentifier
optional	Boolean

comments: "This is an abstract superclass. Three subclasses are defined: one pertaining to a simple attribute whose domain is one of those listed under the enumeration PrimitiveInstanceType; a second appropriate for an attribute whose domain is an AbstractObject or a type of AbstractObject; and a third whose domain consists of a list or set of objects.

In the child subclasses, the name and domain of an attribute must be provided, as well as whether the attribute is considered as optional (true) or mandatory (false)."

>

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<AttributeDefinition

subclass: **SimpleAttributeDef**

attributes: [default] Primitive

comments: "This is used for a simple attribute, with a domain defined as one of those listed in PrimitiveInstanceType. The default may be given.

Note that this subclass is also used to define attributes with domains as enumerations. In this case, an enumerated value, i.e., the description (in double-quotes) in EnumerationValueDef is used for the default."

>

<AttributeDefinition

subclass: **ComplexAttributeDef**

comments: "This is used for a complex attribute, with the domain defined as a abstractObject or a type of abstractObject. Note that if the abstractObject is not defined within the SAIF standard, a class definition must be provided for it."

>

<AttributeDefinition

subclass: **CollectionAttributeDef**

attributes: membership TypeIdentifier

restricted: attributeDomain.typeName: "List" | "Set" | "Relation"

comments: "This is used for an attribute defined as a list, set or relation, with membership providing the type of object in the list, set or relation. If the object is not defined within the SAIF standard, a class definition must be provided for it."

>

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<AbstractObject

subclass: **Tag**

attributes:

tagCategory	TagCategory
tagNumber	Integer

comments: *"tagCategory:* specifies whether the type (class or enumeration) is considered as universal, *application,* or *private.*

universal: this refers to types recognized as part of the SAIF standard. It includes the basic data types (e.g. String, Integer, etc.), the constructor classes (e.g. AbstractObject, Set, etc.), and the higher-level SAIF classes (e.g. GeographicObject, Coordinate, etc.).

application: this refers to types used by the user, which are outside of the SAIF standard and which exist as part of a widely used schema, such as NTDB. The assignment of application tags is governed by a central authority.

private: this class refers to types defined by the user which are outside the SAIF standard and outside the scope of the application tagCategory as defined above.

(A fourth tagCategory is *calculated.* This is of no direct interest to the user. It is used in the binary encoding of certain geometric constructs in the SAIF schema.)

tagNumber: a unique number within a tagCategory which can be used to identify the type.

The values for universal and application tagCategory/tagNumber are unique; i.e., each universal or application tagCategory/tagNumber corresponds to exactly one subclass. Since the use of private tags is unrestricted, values for tagCategory/tagNumber are not guaranteed to be unique. Consequently, within any transfer the user must ensure that private tag numbers are unique."

>

<AbstractObject

subclass: **Restricted**

attributes:

attributePathName	String

comments: "This is an abstract superclass. Seven subclasses are recognized. If the attribute is complex, its domain may be restricted. If the attribute is simple, its value may be restricted. Where the attribute comes from the domain String, it may be restricted (in a subclass) to a maximum string length. (For example, in a class definition, an attribute may come from the domain String. In a subclass of that class, the attribute may be further restricted to String (30). If an attribute, either simple or complex, is defined as optional in a parent class, its optionality may be restricted in a user defined subclass. *attributePathName* may refer to a simple attribute name or it may include the path for that attribute using the dot, bracket, and asterisk notation defined for the restricted clause in the Class Syntax Notation."

>

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<Restricted

subclass: **RestrictedDomain**

attributes: attributeDomain TypeIdentifier

comments: "A complex attribute may come from a class with subclasses. If only a certain subclass is permitted, i.e., if the options are restricted to a single subclass, it is specified using RestrictedDomain. Similarly, if a simple attribute is specified in a class as coming from the domain String, a subclass definition may restrict the length of the character string."

>

<Restricted

subclass: **RestrictedOptionality**

attributes: attributeOptionality Optionality

comments: "An attribute defined as optional in a parent class, may be specified as not being used in a subclass, in which case *attributeOptionality* is considered as *alwaysNil*. If the attribute is always to be specified, then *attributeOptionality* is defined as *neverNil*."

>

<Restricted

subclass: **RestrictedDomainSet**

attributes: attributeDomain Set(TypeIdentifier)

comments: "A complex attribute may come from a class with subclasses. If the attribute is restricted to two or more subclasses, the allowed subclasses are provided."

>

<Restricted

subclass: **RestrictedCollectionDomain**

attributes: attributeDomain TypeIdentifier
membership TypeIdentifier

restricted: attributeDomain.typeName: "List" | "Set" | "Relation"

comments: "An attribute may be restricted to a list, set or relation of objects coming from a given domain. The choice of type of collection is provided by attributeDomain. Identification of the class permitted within the collection is given by membershipDomain."

>

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<Restricted

subclass: **RestrictedCollectionDomainSet**

attributes: attributeDomain TypeIdentifier
membership Set(TypeIdentifier)

restricted: attributeDomain.typeName: "List" | "Set" | "Relation"

comments: "An attribute may be restricted to a list or set of two or more domains. The choice of type of collection is provided by attributeDomain. Identification of the classes permitted within the collection is given by membershipDomain."

>

<Restricted

subclass: **RestrictedValue**

attributes: attributeValue Primitive

comments: "A simple attribute may have any value from a particular primitive domain. If the value is restricted to a single primitive, the allowed value is given using this subclass.

Note that this subclass is also used to define restrictions as related to the use of enumerations. In this case, the attributeName is provided in double-quotes (without explicitly stating .description or .value) and the attributeValue is the allowed description in double-quotes. For example, if the enumeration is Color and the choices are blue, green and red, a restriction may be defined by specifying attributeValue as green in double-quotes.

RestrictedDomain may be used by a restricted clause or as the means for expressing defaults and class attribute values, as indicated in *AbstractObjectDefinition*."

>

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<Restricted

subclass: **RestrictedValueSet**

attributes: attributeValues Set(Primitive)

comments: "A simple attribute may have any value from a particular primitive domain. If the value is restricted to two or more primitives, the allowed values are given using this subclass.

Note that this subclass is also used to define restrictions as related to the use of enumerations. The enumerated descriptions are given in a Set construction, with each option in double quotes and spaces between the options.

This subclass may be used by a restricted clause or as the means of expressing class attribute values, as indicated in *AbstractObjectDefinition*."

>

<Restricted

subclass: **RestrictedValueRange**

attributes: lowerAttributeValue Primitive
upperAttributeValue Primitive

comments: "A simple attribute may have a value from a particular primitive domain, from within a specified range. The range specified is inclusive; i.e., lowerAttributeValue and upperAttributeValue are considered valid, in addition to any values falling between them.

Note that this subclass is not used to define restrictions associated with the use of enumerations.

This subclass may be used by a restricted clause or as the means of expressing class attribute values, as indicated in *AbstractObjectDefinition*."

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Chapter 4

SAIFtalk

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4.0 SAIFtalk

4.1 Overview of SAIFtalk

"SAIFtalk" is a language which can represent any data or class which may described by the SAIF data model. It has two components, Class Syntax Notation (CSN) and Object Syntax Notation (OSN). CSN is the shorthand which is used to describe SAIF class definitions. It is a subset of SAIFtalk. OSN is a language which is used to construct readable representations of instances of the objects which are described by the SAIF data model. It is also a subset of SAIFtalk. It could be said the SAIFtalk = CSN + OSN, that is, SAIFtalk is the union of CSN and OSN. (The grammars of OSN and CSN are such that they may occur interspersed within a file and be able to be correctly parsed.)

SAIFtalk allows C++ style comments to be embedded within it anywhere. Such comments, which are completely optional, start with "//" and are terminated by the end-of-line. This allows users to embed English descriptions or notations within SAIFtalk definitions.

4.2 CSN rules for a class definition

The rules which follow are given in CSN. The example is intended to serve as a template. The user should be aware that, typically, commentary is not given using the // structure; instead, comments are normally given in a comments clause.

```
<Superclass::Schema1, Superclass2::Schema3
    subclass:                Class::Schema2

    subclassing:             "The user may define subclasses of this class."

    attributes:              attribute11      DomainForAttribute11
                             attribute12      DomainForAttribute12
                             [attribute13]    DomainForAttribute13::Schema2
                             attribute14      List(DomainForMembersOfAttribute14)

    classAttributes:         classAttribute11 DomainForClassAttribute11::Schema2
                             classAttribute12 DomainForClassAttribute12

    defaults:                attribute11: valueW

    restricted:              attribute1: RestrictedDomainForAttribute1
                             attribute2: valueX

    constraints:             "The product of the values for attribute3 and attribute4
                             must be greater than the value for attribute5."

    classAttributeDefaults: classAttribute11: valueP

    classAttributeValues:    classAttribute12: valueQ

    comments:                "This class definition serves as a template for other
                             class definitions."

>
```

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```
<Superclass::Schema1, Superclass2::Schema3
```

// The definition of a class always begins with an open, angled bracket,
// followed by the name of the superclass(es) of the class being defined.
// Note that a class may have one parent (immediate supertype or super-
// class) or two to n parents. With multiple inheritance the superclasses
// may or may not come from different schemas. Commas are used to
// separate superclasses, if more than one is listed.

// If the superclass is not part of the SAIF data model or SAIF schema,
// the name of the superclass is followed by two colons and the name of
// the external schema containing the superclass. If the superclass is
// defined in SAIF, the two colons and the schema name are omitted.

```
subclass:                Class::Schema2
```

// A meaningful name for the subclass is provided, followed by two colons and the
// name of the schema in which the class is defined, i.e., the current schema.

// The two colons and the schema name are not given in the definitions of SAIF
// classes.

// Class names and schema names begin with upper case letters and are followed
// by zero or more characters which may be upper or lower case letters , numeric
// digits or underscores (_).

```
subclassing:             "The user may define subclasses of this class."
```

// This clause is given typically only with those classes of the SAIF schema
// which may be used as superclasses for user defined classes. In a user defined
// class definition, the user may provide restrictions or commentary on subclassing,
// as may be of interest to other users.

```
attributes:              attribute11      DomainForAttribute11
                         attribute12      DomainForAttribute12
                         [attribute13]    DomainForAttribute13::Schema2
                         attribute14      List(DomainForMembersOfAttribute14)
```

// 0 to n attributes may be listed. The name of each attribute is followed
// by the domain for the attribute. If the domain is a type from an external
// schema, it is followed by ::SchemaName. If no attributes are provided, the
// clause is not given.

// If provision of a value for an attribute is considered as optional, its name is
// surrounded by opening and closing square brackets, as with attribute13 above.

// Attribute names begin with lower case letters and are followed by zero or
// more characters which may be upper or lower case letters ,numeric digits or underscores (_).

// The domain for an attribute may include a collection construction (List,
// Set, or Relation), as with attribute14 above.

// If the domain of an attribute is defined as String, it is assumed that the length of
// the string is variable. (This is identical to CHARACTER VARYING in SQL.) If
// the domain is specified as String (n), for example, String (30), then it is assumed

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// that the maximum length of the string is n. (This is equivalent to CHARACTER (n)
// in SQL.)

// The following are not allowed as attribute names or as the leading characters in attribute names.
// They may, however, be embedded in attribute names:
// *subclass* *values*
// *comments* *attributes* *subclassing*
// *classAttributes* *defaults* *constraints*
// *restricted* *primitiveType* *classAttributeValues*
// *classAttributeDefaults*
// For example, values is not allowed, valuesList is not allowed, listValues is allowed.
// All other character strings are permitted so long as the rules given above are followed.

// Where multiple inheritance is employed, the order of the attributes must
// be unambiguous. This is achieved as follows -
// All attributes inherited from the first (left most) parent are given, then
// those from the second parent, etc. Where an attribute is inherited twice
// or more from a common ancestor, the 2nd to n copies are ignored, i.e.,
// they are considered virtual. Following the inherited attributes are those
// specified in the class definition.

```
classAttributes:        classAttribute11 DomainForClassAttribute11::Schema2
                        classAttribute12 DomainForClassAttribute12
```

// Zero to n class attributes are given. The name of each class attribute is followed
// by the domain for the attribute. The domain is always either a type of primitive
// or an enumeration. If it is an enumeration from an external schema, the enumeration name
// is followed by ::SchemaName. If no class attributes are listed, the clause is not given.

// Unlike an (object) attribute, a class attribute is never considered optional; consequently,
// square brackets around a class attribute name are not allowed.

// As with (object) attributes, the word value is not allowed as a class attribute name.

```
defaults:               attribute11: valueW
```

// A defaults clause may contain one or more defaults. The example above implies
// that if a value is not provided for attribute11 in a transfer (i.e., it is left
// undefined), then it should be considered as equal to valueW, some primitive value.

```
restricted:             attribute1: RestrictedDomainForAttribute1       //  Line 1
                        attribute2: valueX                              //  Line 2
```

// If certain restrictions apply to the possible values for an attribute, beyond
// the domain given in the attribute clause, then a restricted clause is used.

// In general, an attribute may be restricted to a given domain, indicated by a type
// name, or to one or more given values. Examples of these two cases are represented
// by Lines 1 and 2 above, respectively. (In both cases in this example, the
// attribute is inherited from the superclass, hence the attributes are not listed
// in the attributes clause given earlier.)

// The restricted clause follows a formal syntax. There are a number of possible ways
// of using restricted clauses; these are discussed later in this chapter.

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```
constraints:              "The product of the values for attribute3 and attribute4
                           must be greater than the value for attribute5."

        // If certain conditions cannot be expressed effectively in a restricted clause, a
        // constraints clause is used. The constraints clause above is an example of this.
        // If - then - else constructs may be placed in a constraints clause. Also, several
        // different constraints may be placed in the same clause.

classAttributeDefaults: classAttribute11: valueP

        // A default value may be given for each class attribute. Such defaults may be overridden
        // in the definitions of subclasses. The value, valueP, must be a primitive or from an enumeration.

classAttributeValues:   classAttribute12: valueQ

        // A value for a class attribute is provided from a primitive type or enumeration. The value
        // cannot be overridden in a subclass. If the class being defined is an abstract superclass, it is not
        // required to specify a default or value for a class attribute. Also, with an abstract superclass
        // the class attribute may be assigned a range of values ( valueM .. valueN ) or a set of values
        // ( valueF | valueG | valueH ) with the classAttributeValues clause. In such cases, specific
        // values must be assigned in those subclasses which can be directly instantiated.

comments:                 "This class definition serves as a template for
                          other class definitions."

        // Comments may contain text, tables, or graphics. (The use of non-ASCII characters and graphics is at
        // variance with what is specified in the BNF later in this chapter. As discussed below, these would be
        // removed prior to parsing with a computer program. The user need not be concerned about this when
        // defining types in CSN.)

>

// The definition of a class ends with a closing, angled bracket, as shown above.
```

Typical examples of class definitions are shown in Chapter 2 as well as later in this chapter.

(As mentioned above under comments, certain changes must be made to a file containing CSN definitions before it can be parsed by a computer program. Typically, indents and tabs are replaced globally by spaces, and it is advisable to replace globally each carriage return (hard return) with: space carriage return. When the file is exported to a generic text file, diagrams should be removed.)

4.3 CSN for the restricted clause in a class definition

A restricted clause consists of one or more statements. Each statement has three phrases: (i) the attribute phrase, including the attribute's name and possibly its path (as explained below), (ii) a colon, and (iii) a domain phrase, defined by types or values.

The attribute phrase, containing the attribute name, can take several different forms.

1 the simple case for specifying an attribute
The attribute may be referenced simply by providing its name, e.g., attribute1.

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2 using dot notation to specify an attribute's path
The name of an attribute may include its path, using dot notation, as in attribute1.attributeX. This implies that attribute1 comes from a domain which contains attributeX, and that the restriction applies to that particular attribute. A path statement includes an attribute name for each level of the containment hierarchy until the particular attribute of interest is reached.

3 using brace notation to reference objects inside a collection
An attribute may have a collection in its domain statement, e.g., the domain of attributeA may be defined as List(DomainA). Assume that a restriction is intended to apply to any members of the list. In order to specify a restriction on that attribute, it is required to be able to reference objects within the list. This is accomplished by the following: attributeA{}. The opening and closing braces signify that the objects within the collection are being referenced. This notation applies to any kind of collection. Assume now that DomainA includes attributeX and that it is desired to place a restriction on attributeX. The first part of the statement would be attributeA{}.attributeX. Assume next that DomainA also includes attributeY which comes from Set(DomainY). The members of this set may be referenced with attributeA{}.attributeY{}.

4 using wildcard notation when the path is uncertain or very long
We may wish to place a restriction on a lower level attribute when the path to that attribute is not known. For example, it may be desired to place a restriction on the type of coordinate used to describe geometric locations, regardless of which subclass of GeometricObject is actually used. A restricted phrase would reference the type of coordinate used by the geometry, with the actual geometry unknown, by the following phrase: geometry*Coordinate . The name of the high level attribute is followed by an asterisk and then the name of the domain of the lower level attribute.
If we wished to place a restriction specifically on t (the time coordinate) as used in Coord2DT or any of its subclasses, we would reference t by: geometry*Coord2DT.t . Here we have the name of the high level attribute, an asterisk, the name of the domain of the lower level attribute, a dot, and the name of the specific attribute referenced in that domain.
Even if the exact attribute path is known, it may be so long that the wildcard syntax is more straightforward and easier to understand.

The different kinds of notation described above may be mixed as required in order to specify a given attribute. Regardless of how simple or complicated the reference to the attribute, it is always followed by a colon (the set to or assignment character), and then by a domain phrase. The domain phrase may take several different forms.

1 the domain as a primitive value or enumerate
The right side of the restricted statement may be a single primitive value, such as 2.5 (a numeric value) or "passed" (a string value) or false (a boolean value). It may also be a single description from an enumeration. If an enumeration had been defined for primary color, the domain phrase may read blue for example.

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2 the domain as a set of primitive values or a set of enumerates
This is similar to the above case but more than one value is given. The attribute takes a value from the discrete set of options provided. Adjacent values are separated by vertical lines, (|), indicating an or construct. An attribute with an integer domain may be further restricted to be either 1 or 2 or 4; the domain phrase in the restricted statement becomes: 1 | 2 | 4. Character string values may be provided similarly: "Carr" | "Friesen" | "Kucera" | "Sondheim". With the primary color enumeration, the options may be restricted to green or blue: green | blue, without double quotes around each description.

3 the domain as a range of primitives
The value for pH may be restricted to the range between 0.0 and 14.0, by stating the lower value, two adjacent dots, and then the upper value: 0.0 .. 14.0. In order to limit a name to the first half of the alphabet (names beginning with A through M), we could define the restricted domain as "A" .. "Mzzz".

4 the domain as a type
The domain for an attribute inherited from a superclass may be further restricted as to the type of domain. There are three different situations under which a domain may be restricted to a type. (i) In the first case, a particular type of primitive is specified in a restricted statement in the subclass. For example, in the superclass the domain for an attribute may be defined as Integer. In the subclass definition we may further specify that it is Integer32. (ii) In the second case, a domain previously specified as a collection of objects of some type, is restricted further to be a set or list or other specific kind of collection. To accomplish this the domain phrase may be given as List, for example. (iii) In the third case an attribute may be restricted to come from a subclass of the original domain. This is essentially the same as the first case, but here we are talking about classes as opposed to primitive types. If the class appearing in the domain phrase is from an external schema, the name of the class must be followed by two colons and the schema name. The relationships associated with a type of geographic object may be limited in a given set of data to topologic ones only. That is, the class SpatialTopology can be considered a more restricted form of SpatialRelationship, and the restricted domain phrase would be stated as SpatialTopology.

5 the domain as a class, without any of its subclasses
We may want to specify that an object must be a direct instance of a class; that is, it does not come from any of the subclasses which the class may have. The class SpatialTopology has subclasses. If the relationships are intended to come from SpatialTopology directly (and not from SpatialTopologyExtended, etc.), then a carat precedes the name of the domain, i.e., ^SpatialTopology. This notation cannot be used of course with an abstract superclass; similarly if a class has no subclasses, the carat should not be given. Otherwise, wherever a class appears as part of a restricted domain, it is also legal to use the carat notation.

6 the domain as a set of classes
Different subclasses of a superclass may be given in a restricted domain. This is logical

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when an attribute has been inherited and it is desired to restrict its domain further. Thus the geometry of a type of geographic object may be restricted to be from the class Point or Polygon with the following phrase: Point | Polygon. If we wanted to exclude subclasses of both classes, we can write: ^Point | ^Polygon.

7 excluding particular values or subclasses from a domain

Occasionally it may be of interest to exclude a value or subclass from consideration as part of the domain. For example, for some we can exclude the number 5 from a integer domain by using the character ~ as follows: ~5. Similarly, a string value may be excluded as a possible value with the domain phrase: ~"Fraser Basin". A subclass can be excluded in the same way: ~Real80 or ~GeometricAggregate. However, unless the set of possible types is very long, it is considered better form to state what options are available, as opposed to what options are not allowed.

8 using nil and notNil in a restricted domain phrase

For an inherited optional attribute, it may be desired to state that it will never be specified or that it must always be specified. These two cases can be handled by stating the attribute in a restricted statement and defining its domain as nil or notNil, respectively.

Some examples of restricted statements in a restricted clause may be useful to examine. Spaces may be placed between parts of a statement to improve readability, as has been done here.

```
restricted:          attribute0: descriptionFromAnEnumeration

        // attribute0 takes a specific value from an enumeration.

                     attribute1: RestrictedDomainForAttribute1::Schema1
                     attribute1.attributeA: "string value1"  |
                                            "string value2"  |
                                            "string value3"

        // attribute1, inherited from a superclass, is restricted to a particular domain from an
        // external schema. On the following line attributeA, which is part of attribute1, is
        // restricted to one of three string values.

                     attribute2.attributeB.attributeX: ^SpecificDomainForX
                     attribute2.attributeB.attributeX: notNil

        // Both of the above statements indicate that attributeX is included in attributeB, which
        // in turn is contained in attribute2. The first statement says that attributeX must come
        // directly from a specific domain and not one of its subclasses. The second statement
        // specifies that a value for attributeX must always be given.

                     attribute3: List
                     attribute3{}: lowerNumericValue .. upperNumericValue

        // The domain for attribute3 was stated in a superclass as a collection (i.e. a list) of numbers.
        // The firstline above specifies that the aggregate consists of a list. The second line indicates
        // that the the numbers in the list must come from a range, defined by a lower bound and an
        // upper bound.

                     attribute4: nil
```

Withdrawn/Retiree

```
// The assignment of attribute4 to nil, as shown above, indicates that the attribute is never
// specified.

                attribute5.attributeC*ClassM: Subclass1ofClassM  |
                                              Subclass2ofClassM

// In the above statement, attributeC is contained by attribute5. It is known that at some
// lower level in the containment hierarchy, there exists an attribute whose domain is specified
// as ClassM. The restricted statement asserts that the attribute may come specifically from one
// of two subclass of ClassM.
```

Other examples, dealing with real data, are provided in Chapter 2 and later in this chapter.

4.4 CSN rules for an enumeration definition

The rules defining an enumeration are similar to those for a class. As before, the explanation below is in CSN and is intended to serve as a template.

```
<Enumeration

    // The definition of an enumeration always begins with an open, angled bracket,
    // followed by the word Enumeration.

    subclass:               EnumerationName::Schema2

        // A meaningful name for the enumeration is provided. With a user defined enumeration
        // that is followed by two colons and the name of the external schema to which the
        // enumeration belongs. As in the class definition, the enumeration name and
        // schema name begin with upper case letters and are followed by zero or more
        // characters which may be upper or lower case letters ,numeric digits or underscores (_).

    values:                 descriptionA  descriptionB  descriptionN

        // Any finite number of descriptions may be listed. Internally, SAIF assigns an integer
        // to each description, beginning with with 0 and incrementing by one. The integers then
        // for the above example are 0, 1 and 2. Normally these are not visible to the user and are
        // of no interest.

        // Enumeration values must begin with either a lower case letter or a pound sign (#). An enumeration
        // may not begin with a capital letter, number or any other symbol. The remainder of the
        // value may be a lower case letter, an upper case letter, a number, an underscore (_) or a dash (-).

        // In special cases, it may happen that a user wishes to assign his or her own integer values
        // to the descriptions in order to match some pre-existing specification. In this case after each
        // description a numerical value is given in parenthesis. The values clause in this situation is
        // as follows:
        // values:          descriptionA (integerA)  descriptionB (integerB)  descriptionN (integerN)
        // A real example of this is shown later in this chapter

    comments:               "Comments may be given explaining the values in
                            the enumeration."
```

Withdrawn/Retiree

```
        // Comments in an enumeration typically provide textual definitions of the values in
        // the enumeration. However, tables and graphics may also be included. (See also the discussion
        // on comments in the earlier section on class definitions.)

>

    // The definition of an enumeration ends with a closing, angled bracket.
```

4.5 CSN rules for a domain definition

Where an attribute has a primitive type as its domain, the user may wish to limit the possible values for the attribute to a set of finite values. This may be done with a restricted clause in the new class definition. Typically the restricted clause lists the valid values for an attribute, with the values separated by vertical lines, as has been previously discussed.

An alternative involves a domain definition which is very similar to an enumeration in style. Where there are a large number of options or where it is desired to make the overall structure more modular (as with an enumeration), many users may prefer to use a domain definition.

Consider the following restricted clause dealing with two attributes defined in a class or superclass. Their domains as originally given are String and Integer, respectively. Here the possible values are further restricted.

restricted: *attributeA: "stringA" | "stringB" | "stringN"*
attributeB: 10 | 11 | 12

Another way of handling this would be with the following clause:

restricted: *attributeA: DomainA::Schema1*
attributeB: DomainB::Schema1

In this case the permitted values would be included in the definitions of DomainA and DomainB. If attributeA and attributeB are defined in the current class definition and not inherited from a superclass, then a third alternative would be to avoid the restricted clause and instead to include the two user defined domains directly in the attributes clause:

attributes: *attributeA* *DomainA::Schema1*
attributeB *DomainB::Schema1*

The discussion below is in CSN and is intended to serve as a template for defining such domains. It will be followed by the definition of DomainA and DomainB, as discussed above.

```
<Domain

    // A domain definition always begins with an open, angled bracket, followed by the word Domain.

    subclass:               DomainName::Schema1
```

Withdrawn/Retired

```
        // A meaningful name for the domain is provided, along with the name of the external
        // schema to which it belongs. These names must follow the same naming conventions as
        // discussed earlier under class and enumeration definitions.

    baseType:               String

        // The type of primitive is given for baseType. String is used here, as this is the most
        // common situation, but other possible values include any of the types of Integer or Real
        // supported by SAIF.

    validValues:            "stringA"  "stringB"  "stringN"

        // Any finite number of string values may be listed, provided the baseType is String. If the
        // baseType were some type of Integer or Real, the possible numeric values would be given,
        // without double quotes around each value.

    comments:               "Comments may be given explaining the values or
                            providing other useful information."

        // Comments typically provide textual definitions of the values. However, tables and graphics
        // may also be included, as with classes and enumerations. (Similarly, the discussion on comments
        // in the earlier section on class definitions also applies here.)

>

    // The definition of a domain ends with a closing, angled bracket.
```

DomainA and DomainB, as described at the beginning of this section, are defined below.

```
<Domain
    subclass:               DomainA::Schema1
    baseType:               String
    values:                 "StringA"  "StringB"  "StringN"
    comments:               "StringA means ...
                             StringB means ...
                             StringN means ..."
>

<Domain
    subclass:               DomainB::Schema1
    baseType:               Integer8
    values:                 10  11  12
    comments:               "10 implies ...
                             11 implies ...
                             12 implies ..."
>
```

4.6 The structure of OSN

Two concepts are important here. The first is that all classes defined in the SAIF schema or external schemas are types of AbstractObjects, either directly or through their lineage; therefore all objects encoded in SAIF are instances of AbstractObjects. The second is that all objects are ultimately defined in terms of primitives and/or descriptions from enumerations. The ramifications of these statements are explained as follows. The Object Syntax Notation must be able to display data pertaining to one or more AbstractObjects. The internal structure of the

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AbstractObjects must provide data for the attributes. Each attribute is described by its domain. If the domain is an enumeration or primitive, the value is provided directly. If the domain is complex, the component parts must be described recursively until finally all values are given as primitives or descriptions from enumerations. A generic example is given below with appropriate commentary.

```
Class1     (
            attribute1 : "text string value"
            attribute2 : description1FromEnumeration
           )

    // The class to which the object belongs is stated and is followed by an open parenthesis.
    // Next each of the attributes are given, along with its value. The attributes are given in
    // a specific order. Attributes are ordered by seniority, i.e., inherited attributes appear first
    // and are followed by those defined in the parent class. All attributes, whether they were
    // defined by the parent class or inherited from an ancestor, will be ordered as provided by
    // their respective CSN definitions. The first attribute is assigned a value from the String domain,
    // with the value given in double quotes. The second attribute comes from an enumeration
    // with the description provided without quotes.

    // Note that if an object is to be shared or referenced by other objects, the first attribute
    // would be objectIdentifier followed by its particular value. The value would be preceded
    // by an asterisk ( * ), and the value itself would be either an integer or a string value. For
    // example, the first attribute might be either:
    //
    //       objectIdentifier: *47
    //             or
    //       objectIdentifier: *"A23_z"

Class1     (
            attribute1 : "another string value"
            attribute2 : description2FromEnumeration
           )

    // Above is another object from the same class. The attributes are the same, but the values are different.

    // The object below, from Class2, contains five attributes.

Class2     (
            attribute1 : integerValue1
            attribute2 : Class10   (
                                     attributeA : true
                                     attributeB : realValue1
                                    )

                // The first attribute is assigned a value from an integer domain; it might be equal to 1280
                // for example. The second attribute, attribute2, comes from the domain Class10, where two
                // attributes are specified; attributeA takes the boolean value true and attributeB is a real
                // number, such as 0.314.

            attribute3 : Class11   (
                                     attributeC: *144
                                     attributeD: Class12       (
                                                   attributeX : integerValue2
```

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```
                                        attributeY : integerValue3
                                                    )
                                )

        // The third attribute comes from the domain Class11 and contains two attributes, the first of
        // which, attributeC, is assigned the value 144, the objectIdentifier of some other object.
        // (The value is preceded by the asterisk to indicate that it is an objectIdentifier.) The
        // second attribute, attributeD comes from Class12 and consists of attributeX and attributeY,
        // both of which have integer values.

    attribute4 : List {
                                integerValue11 integerValue12 integerValue13
                            }

        // The fourth attribute has a domain consisting of a list of integers, here instantiated as an
        // list consisting of three integer values, e.g., List(17 23 14) . Note that with sets and lists,
        // braces are used to enclose the values, instead of parentheses.

    attribute5 : Set {
                            Class3    (
                                       attributeE : realValue2
                                       attributeF : "string ...."
                                      )
                            Class3    (
                                       attributeE : realValue3
                                       attributeF : "string ---"
                                      )
                            }

        // The fifth attribute comes from a set of objects in Class3. Two instances of Class3 are given,
        // each listing a real value for attributeE and a string value for attributeF.

)

// The OSN statement of the object finishes with a closing parenthesis.
```

4.7 Examples of CSN and OSN

The examples concern geographic objects belonging to three classes: StreamSection, ForestStand, and Swamp. These classes are assumed part of a schema designated as MS (my schema).

```
<GeographicObject
    subclass:               ForestStand::MS
    attributes:             majorSpecies      String(20)
                            minorSpecies      String(20)
    restricted:             position.geometry:Polygon
    comments:               "This is a simple definition suitable as an example."
>

<GeographicObject
    subclass:               StreamSection::MS
    attributes:             substrate         Composition::MS
                            bankFullWidth     Real32
    restricted:             position.geometry:ArcDirected
```

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```
    comments:               "bankFullWidth is in metres."
>

<GeographicObject
    subclass:               Swamp::MS
    restricted:             position.geometry:Polygon
    comments:               "Typically a user defined class includes new attributes,
                            but there is no requirement that new attributes be
                            supplied."
>

<Enumeration
    subclass:               Composition::MS
    values:                 gravelly sandy fineGrained
    comments:               "Three options for the composition of the bottom of a
                            stream are available."
>
```

// Here is the OSN for a stream section. Assume that the stream is represented by a single arc and that it was
// digitized in a downstream direction (from North to South for the purposes of the example). Here and
// throughout these examples, all arcs are treated as straight lines between specified points.



Figure 4-1 Geometry of a stream section

```
StreamSection::MS   (
    position:   SpatialObject   (
                    geometry:   ArcDirected     (
                                pointList:      List {
                                                Point       (
                                                  coords: Coord3D     (
                                                    c1:     497560
                                                    c2:     5431050
                                                    c3      132
                                                                    )
                                                            )
                                                Point       (
                                                  coords: Coord3D     (
                                                    c1:     497575
                                                    c2:     5431042
                                                    c3:     123
                                                                    )
                                                            )
                                                Point       (
                                                  coords: Coord3D     (
                                                    c1:     497561
                                                    c2:     5431034
                                                    c3:     115
                                                                    )
                                                            )
                                                Point       (
```

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```
                                                    coords: Coord3D     (
                                                      c1:       497578
                                                      c2:       5431028
                                                      c3:       102
                                                                        )
                                                              )
                                                    }
                                              )
                                  flowDirection:  forward
                                )
                        substrate:   gravelly
                        bankFullWidth: 7.3
                    )
```

// If the stream positional data are provided in a downstream direction, then flowDirection need not be given, as // its default value is forward. Next is the OSN for the same stream section, but this time an object identifier is //used and flowDirection is not stated. Also, this time spatial referencing is provided.

```
ArcDirected          (
    objectIdentifier: *13
    pointList:        List {
                       Point (
                           coords: Coord3D  (
                              c1: 497560
                              c2: 5431050
                              c3: 132
                                          )
                           )
                       Point (
                           coords: Coord3D  (
                              c1: 497575
                              c2: 5431042
                              c3: 123
                                          )
                           )
                       Point (
                           coords: Coord3D  (
                              c1: 497561
                              c2: 5431034
                              c3: 115
                                          )
                           )
                       Point (
                           coords: Coord3D  (
                              c1: 497578
                              c2: 5431028
                              c3: 102
                                          )
                           }
                          )
                    )

SpatialReferencing  (
    objectIdentifier: *7
    coordSystem:    UTM     (
          coordinateUnits: List { metres metres metres }
          projection: Projection (
                projectionHemisphere: north
                geodeticReference: GeodeticCoordinateSystem    (
```

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```
                    horizontalReference:  GeodeticHorizontalReference    (
                        datumAdjustmentSystem:  nad83
                                                                         )
                    verticalReference:    GeodeticVerticalReference      (
                        datumAdjustmentSystem:  cvd28
                                                                         )
                                                                  )
                                )
        zone:  10
                            )
                    )

StreamSection::MS    (
    position:    SpatialObject    (
                  geometry:              *13
                  spatialReferencing:    *7
                                )
    substrate:   gravelly
    bankFullWidth: 7.3
                  )
```

// Next we introduce two forest stands, one on the left of the stream and the other on the right of the stream.

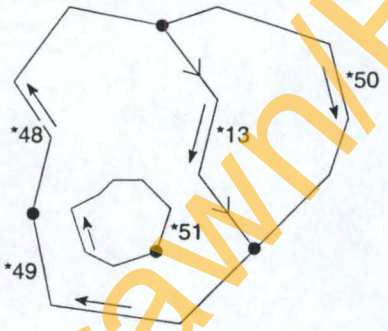


Figure 4-2 Boundaries as Oriented Arcs with OIDs

// The forest stand on the left is defined first. We'll assume that two other arcs have been defined, with object
// identifiers (sometimes referred to as oids) specified as *48 and *49. For the moment, ignore the inner
// boundary of the area on the left.

// Notice that this time oriented arcs are used. Both oriented arcs and oriented paths include a traversal direction,
// which by default is assumed to be forward unless otherwise stated. In Figure 4.2 the arrows indicate the
// direction of compilation of the points for each arc. For the stand on the left, the three arcs were all captured
// such that the area of interest is on the right. SAIF dictates that the arcs on the boundary of a polygon must be
// traversed in a right hand fashion; thus, there is no need to change the traversal direction for these arcs when
// specifying the forest stand on the left.

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```
ForestStand::MS  (
    position: SpatialObject (
          geometry: Polygon     (
                boundary: OrientedPath    (
                   path: Ring                    (
                         arcList: List               {
                               OrientedArc           (
                                    arc:       *48
                                                     )
                               OrientedArc           (
                                    arc:       *13
                                                     )
                               OrientedArc           (
                                    arc:       *49
                                                     )
                                                   }
                                                 )
                                           )
                                     )
          spatialReferencing:    *7
                                 )
    majorSpecies:     "Douglas Fir"
    minorSpecies:     "Grand Fir"
                )
```

// Now we'll look at the forest stand on the right. Assume that an arc with object identifier *50 has been
// previously specified. Note that the traversal direction of the arc with an object identifier of *13 is now in the
// opposite direction.

```
ForestStand::MS  (
    position: SpatialObject (
          geometry: Polygon     (
                boundary: OrientedPath    (
                   path: Ring                    (
                         arcList: List               {
                               OrientedArc           (
                               arc:                        *13
                               traversalDirection:         backward
                                                     )
                               OrientedArc           (
                               arc:                        *50
                                                     )
                                                   }
                                                 )
                                           )
                                     )
          spatialReferencing:    *7
                                 )
    majorSpecies:     "Grand Fir"
    minorSpecies:     "Douglas Fir"
                )
```

// We'll continue the example by assuming that the forest stand on the left has a hole in the middle of it,
// occupied by a swamp. We'll also assign object identifiers to the forest stands and the swamp. Another arc,
// with an object identifier equal to *51, is an inner boundary of the forest stand on the left and the (outer)
// boundary of the swamp.

Withdrawn/Retirée

// First we redefine the forest stand on the left.

```
ForestStand::MS  (
    objectIdentifier: *1
    position: SpatialObject (
          geometry: PolygonComplex  (
                boundary: OrientedPath    (
                   path: Ring                    (
                         arcList: List              {
                               OrientedArc           (
                                    arc:       *48
                                                     )
                               OrientedArc           (
                                    arc:        *13
                                                     )
                               OrientedArc           (
                                    arc:        *49
                                                     )
                                                   }
                                                 )
                                              )
                innerBoundaries: Set       (
                   OrientedPath:                    (
                         path: Ring                 (
                               arcList: List        {
                                    OrientedArc                (
                                         arc:                  *51
                                         traversalDirection: backward
                                                               )
                                                             }
                                                           )
                                                        )
                                                     )
          spatialReferencing: *7
                                )
    majorSpecies:   "Douglas Fir"
    minorSpecies:   "Grand Fir"
               )

Swamp::MS        (
    objectIdentifier: *3
    position: SpatialObject      (
          geometry: Polygon         (
               boundary: OrientedPath    (
                    path: Ring                    (
                          arcList: List              {
                               OrientedArc           (
                                    arc:       *51
                                                     )
                                                   }
                                                 )
                                              )
                                           )
          spatialReferencing: *7
                              )
               )
```

Withdrawn/Retirée

```
// In the cases described above, sharing of arcs is demonstrated. It is also practical to share the rings, which may
// at times be more efficient. Examining the stand on the left and the swamp, two oriented paths can be defined,
// each with an object identifier.
```

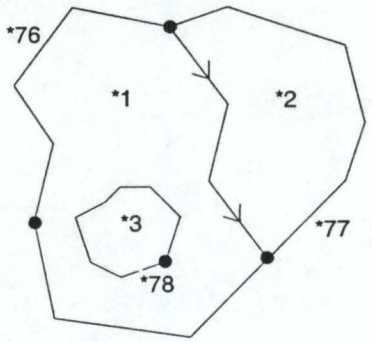


Figure 4-3 Boundaries as Rings with OIDs

```
Ring      (
    objectIdentifier: *76
          arcList: List   {
                OrientedArc     (
                     arc:  *48
                                )
                OrientedArc     (
                     arc:  *13
                                )
                OrientedArc     (
                     arc:  *49
                                )
                          }
          )

Ring      (
    objectIdentifier: *78
          arcList: List   {
                OrientedArc     (
                     arc:  *51
                                )
                          }
          )

ForestStand::MS  (
    objectIdentifier: *1
    position: SpatialObject (
          geometry: PolygonComplex  (
                boundary: OrientedPath    (
                     path: *76
                                          )
                innerBoundaries: Set      {
                     OrientedPath                 (
                          path:                   *78
                          traversalDirection:     backward
                                                  )
                                          }
                                     )
          spatialReferencing: *7
                                )
```

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```
    majorSpecies:   "Douglas Fir"
    minorSpecies:   "Grand Fir"
                )

Swamp::MS       (
    objectIdentifier: *3
    position: SpatialObject     (
          geometry: Polygon         (
                boundary: OrientedPath    (
                     path:      *78
                                          )
                                     )
          spatialReferencing: *7
                               )
               )
```

// As demonstrated above, there are several ways of representing the same data. Making use of extensive
// referencing and sharing, as in the last examples, has two advantages: brevity and more explicit information.
// This must be balanced against the overhead of tracking references.

4.8 The relationship between CSN and OSN

This example is included for completeness only, primarily to demonstrate that any type definition can be defined using SAIFtalk. In practice, because the encoded SAIF file is self describing using both CSN and OSN, development of instances of type definitions are not required.

The best way to illustrate the relationship between CSN and OSN is through examples. Below are two type definitions, expressed in CSN, pertaining to towers, as defined in the National Topographic Database, 1:50 000 program. TowerFunctionType is an enumeration used as the domain for an attribute in Tower. Tower is defined as a subclass of Entity (in the NTDB50K schema), which itself is identified as a subclass of GeographicObject.

```
<Enumeration
   subclass:            TowerFunctionType::NTDB50k

   values:              clearance (1) communication (2) control (3)
                        fire (4) lookout (5)

   comments:            "A choice of tower functions."
>

<Entity::NTDB50k
   subclass:            Tower::NTDB50k

   attributes:          [towerFunction]  TowerFunctionType::NTDB50k
                        towerIdentifier  Integer16
                        [heightOfTheTower]Integer16

   defaults:            heightOfTheTower:-1

   restricted:          position.geometry:^Point
                        position.geometry*Coordinate:^Coordinate
                        position.geometry:notNil
                        position.spatialReferencing:notNil
```

Withdrawn/Retirée

```
    constraints:            "Height only applies if higher than 30 metres.
                            A height lower than 30 metres is represented by a
                            value of zero. An unspecified height is indicated
                            by a value of -1."

    comments:               "A high structure built to provide clearance above
                            the surrounding objects."

>
```

A particular instance of class Tower would be expressed in OSN as follows:

```
Tower     (
    position:     SpatialObject     (
                      geometry:     Point     (
                                coords:   Coord3D       (
                                                c1:     477377
                                                c2:     5360468
                                                c3:     150
                                                )
                                )


                      // Note that the spatialReferencing should be specified in this example, as it is restricted
                      // above to be notNil; however, in the interests of brevity, it is not provided here.

                                )
    towerFunction: control
    towerIdentifier: 40
          )
```

The type definitions given earlier can themselves be described in OSN as instances of the SAIF classes AbstractObjectDefinition and EnumerationDefinition (both of which are subclasses of TypeDefinition). The definitions of TowerType and Tower are expressed in OSN below.

```
EnumerationDefinition (
    class: TypeIdentifier     (
                typeName:  "TowerFunctionType"
                    schema:  SchemaIdentifier       (
                                schemaName:         "NTDB"
                                version:            "v.2.0"
                                )
                    )
    enumerates:  List {
                        EnumerationValueDef     (
                            description:        "clearance"
                            value:              1
                            )
                        EnumerationValueDef     (
                            description:        "communication"
                            value:      2
                            )
                         EnumerationValueDef    (
                            description:        "control"
                            value:              3
                            )
                         EnumerationValueDef    (
```

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```
                        description:    "fire"
                        value:          4
                                        )
                    EnumerationValueDef (
                        description:    "lookout"
                        value:          5
                                        )
                    }
    comments:   "A choice of tower functions"
   )

AbstractObjectDefinition   (
   type:  TypeIdentifier     (
                typeName: "Tower"
                   schema:  SchemaIdentifier      (
                                schemaName:       "NTDB"
                                version:          "v.2.0"
                                                  )
                            )
    superclass:  TypeIdentifier   (
                typeName: "GeographicObject"
                            )
    attributes:  List {
                    SimpleAttributeDef
                        (
                         attributeName: "towerFunction"
                         attributeDomain: TypeIdentifier
                                 (
                                  typeName:    "TowerFunctionType"
                                  schema:      SchemaIdentifier
                                                (
                                                 schemaName:          "NTDB"
                                                 version:             "v.2.0"
                                                )
                                 )
                         optional: true
                        )
                    SimpleAttributeDef
                        (
                         attributeName: "towerIdentifier"
                         attributeDomain: TypeIdentifier
                                 (
                                  typeName:    "Integer16"
                                 )
                          optional: false
                        )
                    SimpleAttributeDef
                        (
                         attributeName: "heightOfTheTower"
                         attributeDomain: TypeIdentifier
                                 (
                                  typeName:    "Integer16"
                                 )
                          optional: true
                        )
        }
    defaults:       List
        {
                     RestrictedValue
                        (
```

Withdrawn/Retirée

```
                        attributeName: "heightOfTheTower"
                        attributeValue: -1
                       )
        }
    restricted: List
        {
                RestrictedDomain
                        (
                        attributePathName: "position.geometry"
                        attributeDomain: TypeIdentifier
                                (
                                 typeName:    "Point"
                                )
                        )
                RestrictedDomain
                        (
                        attributePathName: "position.geometry*Coordinate"
                        attributeDomain: TypeIdentifier
                                (
                                 typeName:    "Coordinate"
                                )
                        )
                RestrictedOptionality
                        (
                        attributePathName: "position.geometry"
                        attributeOptionality: neverNil
                        )
                RestrictedOptionality
                        (
                        attributePathName: "position.spatialReferencing"
                        attributeOptionality: neverNil
                        )
        }
    constraints:    "Height only applies if higher than 30 metres.   A height
                    lower than 30 metres is represented by a value of zero.
                    An unspecified height is indicated by a value of -1."

    comments:       "A high structure built to provide clearance above the
                    surrounding objects."
)
```

As one can see, the OSN notation is much more verbose for class definitions than the equivalent CSN notation. The conversion between the two notations is mechanical, and could be done by appropriate software. For the purpose of encoding class definitions for archive or interchange, class definitions in CSN may be converted to TypeDefinition objects, if required by the encoding scheme. When decoded, these would be in OSN, and could be converted to CSN by software.

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4.9 BNF Notation

The Extended Backus-Naur Formalism (BNF) notation makes use of several special symbols. These are listed below, together with their meanings:

Symbol	Usage
<>	Enclose term names
|	Separates alternatives (exclusive OR)
[]	Term enclosed is optional (not used or used once)
{}	Term enclosed is used zero or more times
()	Enclose groups of alternative terms

Note that in SAIFtalk end-of-line characters are insignificant and are ignored, with the following exception. In either CSN or OSN a comment line may be given starting with a "//" pair, followed by any number of characters, and ending with an end-of-line character. Note that characters and text are assumed to be ANSI X3.4.

Token definitions

```
<openDefinition>        ::=  "<"
<closeDefinition>       ::=  ">"
<openBracket>           ::=  "["
<closeBracket>          ::=  "]"
<openParen>             ::=  "("
<closeParen>            ::=  ")"
<openBrace>             ::=  "{"
<closeBrace>            ::=  "}"
<doubleQuote>           ::=  """
<setTo>                 ::=  ":"
<selector>              ::=  "."
<comma>                 ::=  ","
<chooser>               ::=  "|"
<excludedType>          ::=  "~"
<forceType>             ::=  "^"
<wildCard>              ::=  "*"
<poundSign>             ::=  "#"
<dash>                  ::=  "-"
<lowerCaseLetter>       ::=  "a"|"b"|"c"|"d"|"e"|"f"|"g"|"h"|"i"|"j"|"k"|"l"|"m"|
                             "n"|"o"|"p"|"q"|"r"|"s"|"t"|"u"|"v"|"w"|"x"|"y"|"z"
<upperCaseLetter>       ::=  "A"|"B"|"C"|"D"|"E"|"F"|"G"|"H"|"I"|"J"|"K"|"L"|"M"|
                             "N"|"O"|"P"|"Q"|"R"|"S"|"T"|"U"|"V"|"W"|"X"|"Y"|"Z"
<sym>                   ::=  "_"
<digit>                 ::=  "0"|"1"|"2"|"3"|"4"|"5"|"6"|"7"|"8"|"9"
<bit>                   ::=  "0"|"1"
<hexDigit>              ::=  "A"|"B"|"C"|"D"|"E"|"F"|
                             "0"|"1"|"2"|"3"|"4"|"5"|"6"|"7"|"8"|"9"
<hexValue>              ::=  <hexDigit> <hexDigit>
<otherSym>              ::=  "!"|"#"|"$"|"%"|"&"|"'"|"("|")"|"*"|"+"|","|"-"|"."|
                             "/"|":"|";"|"="|"?"|"@"|"["|"\"|"]"|"^"|"_"|"`"|
                             "{"|"|"|"}"|"~"
<whitespace>            ::=  " "
<letter>                ::=  <upperCaseLetter> | <lowerCaseLetter>
<character>             ::=  <letter> | <digit> | <sym>
<textString>            ::=  <doubleQuote> <text> <doubleQuote>
<bitString>             ::=  <doubleQuote> <bit> { <bit> } <doubleQuote>
<octetString>           ::=  <doubleQuote> <hexValue> { <hexValue> } <doubleQuote>
<text>                  ::=  <character> | <whitespace> | <otherSym>
```

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```
                                    {   { <character> }  { whitespace }
                                        { <otherSym> }   }
<lowerName>                 ::=  <lowerCaseLetter> {<character>}
<upperName                  ::=  <upperCaseLetter> {<character>}
<unsignedInteger>           ::=  <digit>  {<digit>}
<integer>                   ::=  ["+"|"-"]  <unsignedInteger>
<exponent>                  ::=  "E"  <integer>
<float>                     ::=  (["+"|"-"]{<digit>}"."<digit>
                                 {<digit>}[<exponent>]) |
                                 (["+"|"-"]<digit>{<digit>}"."
                                 {<digit>}[<exponent> )
```

4.10 CSN BNF

Below is a BNF of the CSN. In preparing this BNF, the goal was not only to provide strictly the syntax of CSN, but also to provide hints as to the meaning of the constructions through the use of descriptive (and sometimes extra) terminal and non-terminal names.

```
<schemaDefinition>          ::=  <definition> |
                                     <definition> <schemaDefinition>
<definition>                ::=  <openDefinition> <definitionBody> <closeDefinition>
<definitionBody>            ::=  <abstractObjectDefinition> | <enumerationDefintion> |
                                     <domainDefinition>
<abstractObjectDefinition>  ::=  <parentName> <subclass>
                                         [<tag>]
                                         [<subclassing>]
                                         [<attributes>]
                                         [<classAttributes>]
                                         [<defaults>]
                                         [<restricted>]
                                         [<constraints>]
                                         [<classAttributeDefaults>]
                                         [<classAttributeValues>]
                                         [<comments>]
<parentName>                ::=  <className> {<comma> [<whitespace>] <className>}
<className>                 ::=  <upperName> [<schemaID>]
<schemaID>                  ::=  "::" <upperName>
<subclass>                  ::=  "subclass:" <className>
<tag>                       ::=  "tag:" <tagCategory> <tagNumber>
<tagCategory>               ::=  "universal" | "application" | "private"
<tagNumber>                 ::=  <unsignedInteger>
<attributes>                ::=  "attributes:" <attributeDef> {<attributeDef>}
<attributeDef>              ::=  <attribNameSpec> [<forceType>] <attributeType>
<attributeType>             ::=  <className> | <stringType> |
                                     ( <collection> "(" [<forcetype>] <className>
                                     | <stringType> ")" )
<stringType>                ::=  "String" [ "("  <unsignedInteger> ")" ]
<collection>                ::=  "List" | "Set" | "Relation"
<stringType>                ::=  "String" ["(" <unsignedInteger> ")"]
<attribNameSpec>            ::=  <attributeName> | <optionalAttrib>
<attributeName              ::=  <lowerName>
<openValueSpec>             ::=  <openParen>
<closeValueSpec>            ::=  <closeParen>
<openOptional>              ::=  <openBracket>
<closeOptional>             ::=  <closeBracket>
<optionalAttrib>            ::=  <openOptional> <attributeName> <closeOptional>
<subclassing>               ::=  "subclassing:" <textString>
```

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```
<defaults>                  ::=  "defaults:" <defaultSpec> {<defaultSpec>}
<defaultSpec>               ::=  <attributeName> <setTo> <value>
<value>                     ::=  <textString> | <number> | <enumtag>
<number>                    ::=  <float> | <integer>
<enumTag>                   ::=  <lowerCaseLetter> | <poundSign>
                                     { <character> | <dash> }
<restricted>                ::=  "restricted:" <restrictionSpec> {<restrictionSpec>}
<restrictionSpec>           ::=  <valueRestriction> | <typeRestriction>
<valueRestriction>          ::=  <attribPathName> <setTo> <valueChoice>
<valueChoice>               ::=  <valueSpec> {<chooser> <valueChoice>}
<valueSpec>                 ::=  <value> | <range>
<range>                     ::=  <lowerBound> ".." <upperBound>
<lowerBound>                ::=  <integer>
<upperBound>                ::=  <integer>
<attribPathName>            ::=  { <attributeNameSpec> [<collectionMember>] <selector> }
                                     <attributeNameSpec>
<collectionMember>          ::=  "{}"
<typeRestriction>           ::=  <typePathName> <setTo> <typeChoice>
<typeChoice>                ::=  <typeSpec> {<chooser> <typeChoice> }
<typeSpec>                  ::=  [ <excludeType> | <forceType> ] <className>
<typePathName>              ::=  [<attributePathName>] (<wildcard> |<selector>  )
                                     <className>
<constraints>               ::=  "constraints:" <textString>
<comments>                  ::=  "comments:" <textString>
<classAttributeValue>       ::=  { <attributeName> <setTo> <value> }
<classAttributeValues>      ::=  "classAttributeValues:" <classAttributeValue>
                                     {<classAttributeValue>}
<classAttributeDefaults>    ::=  "classAttributeDefaults:" <classAttributeValue>
                                     {<classAttributeValue>}
<enumerationDef>            ::=  "Enumeration"
                                         <subclass>
                                         [<tag>]
                                         <enumTags>
                                         [<comments>]
<enumTags>                  ::=  "values:" <tagSpec> {<tagSpec>}
<tagSpec>                   ::=  <enumTag> [<numericRep>]
<numericRep>                ::=  <openValueSpec> <unsignedInteger> <closeValueSpec>
<domainDefinition>          ::=  "Domain"
                                         <subclass>
                                         [<tag>]
                                         <primitiveType
                                         <domainValues>
                                         [<comments>]
<primitiveType>             ::=  "primitiveType:" <className>
<domainValues>              ::=  "values:" ( <strings> | <integers | <floats> )
<strings>                   ::=  <textString> {<textString> }
<floats>                    ::=  <float> {<float> }
<integers>                  ::=  <integer> {<integer> }
```

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4.11 OSN BNF

The BNF of OSN follows.

```
<instances>                 ::=  <abstractObject> {<abstractObject>}
<expression>                ::=  <integer> |
                                      <float> |
                                      <textString> |
                                      <bitString> |
                                      <octetString> |
                                      <enumTag> |
                                      "true" |
                                      "false" |
                                      "nil" |
                                      <abstractObject> |
                                      <list> |
                                      <set> |
                                      <relation> |
                                      <identifier>
<attribute>                 ::=  <lowerName> <setTo> <expression>
<attributeList>             ::=  <attribute> {<attribute>}
<expressionList>            ::=  <expression> {<expression>}
<abstractObjectList>        ::=  <abstractObject> {<abstractObject>}
<openAbstractObject>        ::=  <openParen>
<closeAbstractObject>       ::=  <closeParen>
<openList>                  ::=  "List" <openBrace>
<closeList>                 ::=  <closeBrace>
<openSet                    ::=  "Set" <openBrace>
<closeSet>                  ::=  <closeBrace>
<openRelation>              ::=  "Relation" <openBrace>
<closeReation>              ::=  <closeBrace>
<abstractObject>            ::=  <upperName> <openAbstractObject> <attributeList>
                                      <closeAbstractObject>
<list>                      ::=  <openList> <expressionList> <closeList>
<set>                       ::=  <openSet> <expressionList> <closeSet>
<relation>                  ::=  <openRelation> <abstractObjectList> <closeRelation>
<identifier>                ::=  "*" (<integer> | <textString> )
```

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