Communications Research Centre

DATA TERMINAL STANDARDS AND PROTOCOLS

BY

STAFF OF DCF SYSTEMS LIMITED

EDITED BY

R.G. FUJAROS

CRC REPORT NO. 1275

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COMMUNICATIONS RESEARCH CENTRE

DEPARTMENT OF COMMUNICATIONS
CANADA

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(Communication Systems Research and Development Directorate)

(Technology and Systems Branch)

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PREFACE

The Department of Communications (DOC) of the Government of Canada includes under its mandate a number of broad objectives. One of these is to "promote the orderly evolution and growth of efficient and effective communication systems and services for Canada". Towards this general objective the Department has in recent years carried out studies directed specifically at fostering the optimum development of the Canadian computer/communications industry — including the communications common carriers, the manufacturing industry and the service industry.

Thus the DOC Computer/Communications Task Force under Dr. H.J. von Baeyer in its report "Branching Out"*, and in subsequent studies, addressed this question and presented a number of specific recommendations. In particular the Task Force cited the proliferation of data communications terminals as posing a problem and proposed that research be conducted on the use of hardware to overcome problems of incompatibility. Furthermore, the Task Force stressed the desirability of an indigenous hardware supply role, particularly with regard to data terminal devices and computer peripherals. In addition to suggesting that component and systems research and development should be performed primarily by private industry, the Task Force indicated that government research laboratories also had a role to play in the research and development activity with the ultimate objective of appropriately transferring the results of this research activity to private industry. "Branching Out" also addressed other subsidiary but relevant points, such as the role of government in the field of standardization and the use of government procurement practices to support Canadian industry.

Responding to these objectives, recommendations and policy proposals, the Communications Research Centre (CRC) of the Department of Communications initiated a broad research and development program in the area of computer/communications. Specific projects covering many aspects of the subject were undertaken. One of these projects is the "Data Terminal Research and Development Project"**, of which the study reported herein is a part. The broad objective of this project is to explore the use of hardware development as a vehicle to support government policy with respect to computer/communications systems and services relevant to future Canadian requirements. In particular a data communications terminal is to be developed to meet existing or near-term user needs. The data terminal design is to include features which will encourage the evolution of a coherent data communications system for Canada. The area selected for study is that of interactive data terminals, on the premise that its future impact on data communications is expected to be high, both in terms of number of terminals and terminal data traffic, and that this area represents a viable opportunity for Canadian activity in the overall field of computer/communications. Though the Data Terminal Project has restricted its initial research activities to interactive data terminals, the project results are generally applicable to a wider area, for example to remote job entry systems, and to local computer peripheral devices.

The work on the Data Terminal Project during the fiscal year 1973/74 constituted a feasibility study phase, with work carried out primarily by means of industrial contracts. To establish feasibility and to define the project in greater detail for subsequent phases of the project (also to be carried out mainly by industrial contracts), a series of studies was commissioned by CRC as follows:

a) A survey and assessment of user requirements and relevant market factors;

b) A survey and assessment of research and development, manufacturing, and marketing and servicing capabilities of Canadian firms in the data terminal area;

c) A survey and assessment of the state-of-the-art of data terminal equipments;

d) A forecast and assessment to 1985 of the technologies relevant to the data terminal field; and

e) A study of standards and protocols relevant to data terminal technology and their influence on the design and use of data terminal equipments.

* *Branching Out, Report of the Canadian Computer/Communications Task Force, Department of Communications, Ottawa, May, 1972.*

** *Project Initiated in April, 1973,*

This report summarizes the work carried out with respect to topic e) under the title "Data Terminal Standards and Protocols". The first section of the report consists of the EXECUTIVE SUMMARY which highlights the major findings of the study. The remaining sections and appendices cover the details of data gathering and data analysis undertaken for the study.

DATA TERMINAL
STANDARDS AND PROTOCOLS

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ABSTRACT

Available standards and protocols applicable to the design and use of interactive data communication terminals and associated equipment are identified, classified and catalogued with respect to the operator and communication line interfaces of the terminal. The utility and influence of, and adherence to, published and unpublished standards and protocols are assessed. Major influencing factors in their development and use and the current trends in their evolution are presented. Particular emphasis is placed on those standards and protocols available worldwide which are likely to have most impact within Canada.*

1. EXECUTIVE SUMMARY

Objectives and Results

This report contains the results of a research study commissioned by the Communications Research Centre of the Department of Communications, and performed by DCF Systems Limited, to

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* Study conducted from November, 1973 to February, 1974.

investigate standards and protocols associated with data terminal technology. The study results primarily consist of a discussion and comprehensive list of published and de facto standards affecting the design and operation of data terminals. Apparent trends are also identified and presented.

Official Standards Development

The report also describes the structures and standards development activities of sources of information contacted in performing the study.

Standards Classification

The structure used to describe the study results is based on the two main interfaces of a data terminal and related equipment, namely:

a) The Operations Interface which is divided into the physical characteristics of data terminals and the operating procedures or operator protocols.

b) The Communications Line Interface, which is divided into the electrical and mechanical connection between data terminals and carrier equipment, and the data transmission procedures or protocols used to transfer data between terminals and central computers.

Some Standards for Physical Interface

Insofar as they affect data terminal design, there are few standards which relate to the physical characteristics of the operations interface. The common office typewriter keyboard arrangement ('QWERTY') has been adopted for terminal keyboards, but manufacturers use many optional key positions to incorporate special characters and control functions. There appears to be a de facto standard for the physical size, shape and spacing of keys. The 'official' standards associations, such as the International Organization for Standardization (ISO), the Canadian Standards Association (CSA) and the American National Standards Institute (ANSI), have developed various standards for peripheral devices such as paper tape and magnetic tape, but not for the prevalent cathode ray tube (CRT) displays. Hard copy printing methods have not been standardized although de facto standards exist for platen width, character spacing and pin feed dimensions.

Operator Protocols not Standardized

No formally standardized operator protocols have been identified nor are any under development despite some efforts in this direction. There are protocols to use TELEX and TWX terminals, but most operator protocols have been developed to meet the communication requirements of central computer software. These protocols have been developed by computer software designers and are normally related to the application requirements rather than the characteristics of the terminal.

Dominance of EIA RS232 Standard on the Communications Interface

The electrical characteristics of the interface between data terminals and carrier facilities have been extensively standardized by the Electronic Industries Association recommended standard number 232 (EIA RS232), which applies to medium speed data transmission. Other de facto standards are used to specify the electrical characteristics of the data communications interface for low speed and high speed data transmission.

EIA RS232 Uses Obsolete Technology

The RS232 standard has been used for about twelve years. It will likely be replaced with a standard based on solid state circuit technology. The replacement standard is under active development by a standards development committee in the EIA.

Few Other Communications Interface Conventions

Data terminals may be connected to integrated or separate data sets or modems (modulator/demodulator). When the modem is separate it is connected to the data terminal by a multiconductor cable which usually terminates with a Cannon or Cinch connector at the modem end. The terminal end of the cable may be wired directly into the terminal, or through connectors. Integrated modems meet common carrier signaling requirements.

Liberal Standards for Line Protocols Cause Confusion

There are a number of line protocols in use by the data communications industry. Some of these have been applied to interactive data terminals. However, the published standards allow many options with the result that some terminals, all built to the same basic standard, cannot necessarily communicate with each other.

Binary Synchronous Prevalence

The IBM Binary Synchronous Communication technique may be considered a de facto standard because of its wide usage. It is used in medium and high speed synchronous communications.

Line Protocol Trends

New bit-oriented line protocols are now under development by ANSI, ISO and IBM. These are generally called Advanced Data Link Control Procedures. All three proposed designs are dissimilar. IBM has announced equipment that will operate with an advanced data link control procedure. The standards associations are experiencing some difficulty in reaching a concensus in this new technological area.

Line Codes

The two most widely used code structures are the American Standard Code for Information Interchange (ASCII), as defined by ANSI Standard X3.4 and the Extended Binary Coded Decimal Interchange Code (EBCDIC) code from IBM. They appear to be equally prevalent. In addition, there are codes such as the Baudot code used with older data equipment.

Lengthy Standards Development

Standards development by the international and national standards associations is a slow process, often requiring two or more years to develop a new standard.

United States Leads

The United States appears to lead in the development of standards applicable to the data terminal industry. While Canada has active development in some terminal-related areas, such as keyboard arrangements for both the French and English languages, she generally contributes to the ISO standards development, and often adopts its recommendations.

Carriers Preserve Status Quo

The common carriers are primarily interested in standards which apply to the electrical characteristics of the interface between their equipment and a data terminal. These interface specifications have been stable for many years and are unlikely to change significantly in the next few years. The carriers are not actively participating in the EIA Committee which is developing the replacement for the RS232 standard. Except for message switching services that some carriers offer, they are not concerned with line or operator protocols.

Users Want Convenience and Low Cost

Users, on the other hand, are concerned with the compatibility of data terminals to their host computer software. They have little awareness of the standards that are used in terminal design and they do not use standards to select terminal equipment except to ensure that terminals are compatible with host computers. Large users, such as the airlines and banks, occasionally will depart from common terminal designs to design their own equipment to reduce the costs of data transmission over carrier facilities.

Manufacturers Standardize for Sales

Data terminal manufacturers have embraced standards in certain areas such as keyboard arrangements and the modem interface to eliminate operator retraining problems, and to connect to the common carrier facilities. They have also settled on a small set of communication line protocols to allow connection to the majority of computers.

Manufacturers Want Competitive Edge

In other areas, however, manufacturers appear interested in providing unique features which are offered to improve their competitive positions. This tends to discourage standardization.

Supplies Affect Standards

Data terminal design is generally standardized in those areas where an outside supply of materials such as magnetic tape, continuous forms or punched cards is needed. Standards applicable to newer interchangeable media such as magnetic tape cassettes and small magnetic disks have not yet been accepted.

De Facto Sources

Standards and protocols have been significantly influenced by two organizations. American Telephone and Telegraph (AT&T) has encouraged the widespread acceptance of the EIA RS232 standard, and has installed a large number of low-speed data terminals manufactured by the Teletype Corporation. IBM has influenced the development of medium- to high-speed terminals with its Binary Synchronous Communication technique. The majority of data terminals installed today are influenced to some degree by the de facto standards established by these two organizations.

2. INTRODUCTION

This report contains the results of a research study to investigate standards and protocols associated with data terminal technology and their influence on the design and use of data terminals.

The terms of reference of the study are to identify the utility and influence of, and adherence to, published and unpublished standards and protocols applicable to data terminal equipment. Requirements for and the effects of further standardization are to be recognized. The investigation is focussed on data terminals that communicate with computers or other terminals over common carrier communications facilities. Remote job entry terminals and modem equipment are specifically excluded from the study. In addition, the standards that are used by the carriers for interconnection and for network signaling are not considered, except as they might influence data terminal design.

Some terminals have optional peripheral equipment, such as tape drives and printers, that may be connected to the basic terminal or its controller. This study surveys the standards and protocols applicable to the interface of the sub-component with an operator and the common carrier facilities, but does not investigate any standards which may be applicable to the interconnection of terminal components.

2.1 STUDY OBJECTIVES

The objectives of the study were to:

a) Determine which standards and standardized protocols are used in the design of data terminals and associated equipment by manufacturers of such equipment for the North American marketplace.

b) Determine which standards and standardized protocols are viewed by Canadian organizations as necessary for their use of data terminals and associated equipment.

c) Classify and catalogue the available standards and standardized protocols applicable to data terminals and associated equipment.

d) Identify the influence of existing standards on data terminals and associated equipment.

e) Identify the sources of standards applicable to data terminals and associated equipment in the North American marketplace, including, but not restricted to, standards associations, industry groups, manufacturers and common carriers.

f) Determine the formal methods by which standards are developed by recognized standards-setting organizations.

g) Determine the apparent directions of evolution of recognized standards and standardized protocols applicable to data terminals and associated equipment.

h) Analyze and comment on the future requirements, potential utility, and possible influences of new or revised standards applicable to data terminal equipment.

2.2 METHODOLOGY

In conducting the study, information was drawn from standards associations, common carriers, manufacturers, manufacturer associations, users and user groups. The information was obtained by questionnaire and personal interview. In addition, documents describing the organizations were obtained during the study.

Questionnaires were prepared and sent to terminal equipment users and manufacturers. The questionnaires were designed to obtain information about the use of current standards, the influence of standards and the need for new standards.

The major carriers in Canada and the United States, and a representative sample of independent or specialized carriers in the United States, were interviewed. The Canadian Telecommunications Carriers Association was also interviewed.

User groups and manufacturer associations were initially contacted by telephone to determine which groups were active in standards development. Later, personal interviews were scheduled with the larger and more active groups such as the Electronic Industries Association (EIA), the Computer and Business Equipment Manufacturers Association (CBEMA) and the National Retail Merchants Association (NRMA).

Because of the importance of the standards associations, it was necessary to conduct personal interviews with association representatives. Accordingly, representatives of the Canadian Standards Association (CSA) and the American National Standards Institute (ANSI) were interviewed. In addition, interviews were conducted with personnel in the Automatic Data Processing (ADP) Division of the National Bureau of Standards (NBS) in the United States.

In addition to the above data collection methods, public and business libraries were consulted to obtain lists of current standards publications and information on new standards developments.

The study findings are presented in the main body of this report. A catalogue of published and de facto standards and protocols was prepared and is included as Appendix C.

The catalogue contains the majority of the published standards and many of the de facto standards that are related to data terminal equipment. Because of the large number of terminals manufactured for the North American market and the large number of terminal applications, it was not possible to identify all the variations of existing standards which may be classified as de facto standards. De facto standards which have had reasonably wide acceptance by manufacturers and users are catalogued.

Section 10 contains a list of references employed in this study. In the remainder of this report, numbers contained in parenthesis identify items listed in Section 10. Further information about the study methodology is contained in Appendix B.

3. INFORMATION SOURCES

3.1 STANDARDS ASSOCIATIONS

The development of international standards is co-ordinated by the International Organization for Standardization (ISO). The national standards assoications of most countries belong to the ISO. Canada is represented by the Standards Council of Canada, and the United States by the American National Standards Institute (ANSI). The structure of ISO, as it affects the areas of standards development within the scope of this study, is outlined in this section.

The Standards Council of Canada is responsible for co-ordinating the development of standards within Canada. ANSI performs the same function in the United States, but its approach is different. The structures of these two national standards organizations, and their procedures for developing standards are outlined below.

Within the United States, the National Bureau of Standards (NBS), is the standards co-ordinating body for the United States Federal Government. Its relationship to the U.S. Government and other national standards associations is also outlined in this section.

3.1.1 International Standards

The International Organization for Standardization (ISO) does not develop any standards of its own. Rather it assigns the standards development responsibilities to various national bodies or secretariats. Canada does not at present hold any of the secretariats for the ISO.

ISO divides its standards development among many Technical Committees. The Technical Committee of primary interest to this study is Technical Committee 97, Computers and Information Processing. The Secretariat for ISO/TC 97 is held by ANSI.

Of secondary interest is Technical Committee 95, Office Machines, the secretariat of which is held by Italy. Technical Committees 95 and 97 are contending for the responsibility to develop standards for data terminals. There is no technical Committee or Subcommittee specifically designated for data terminals at the present time. ISO/TC 97 has 14 active subcommittees within its scope. The subcommittees and the countries which hold the secretariats are as follows:

Subcommittee Number	Subcommittee Name	Country Holding Secretariat
SC1	Vocabulary	France
SC2	Character Sets and Coding	France
SC3	Character and Mark Recognition	Switzerland
SC4	Input/Output	disbanded
SC5	Programming Languages	United States
SC6	Data Communications	United States
SC7	Documentation of Computer Based Systems	Sweden
SC8	Numerical Control of Machines	France
SC9	Programming Languages for Numerical Control	Britain
SC10	Magnetic Disks	Germany
SC11	Computer Magnetic Tape	United States
SC12	Instrumentation Magnetic Tape	United States
SC13	Interconnection of Equipment	Germany
SC14	Representations of Data Elements	United States
SC15	Labelling and File Structure	Britain

Of the above sub committees, SC2, 6, 10, 11 and 13 are of interest to this study.

Within any one of the sub committees, there are a number of items under review at any given time. A study of the items in one of these sub committees is a good indication of the future of standards development for the next several years.(1)

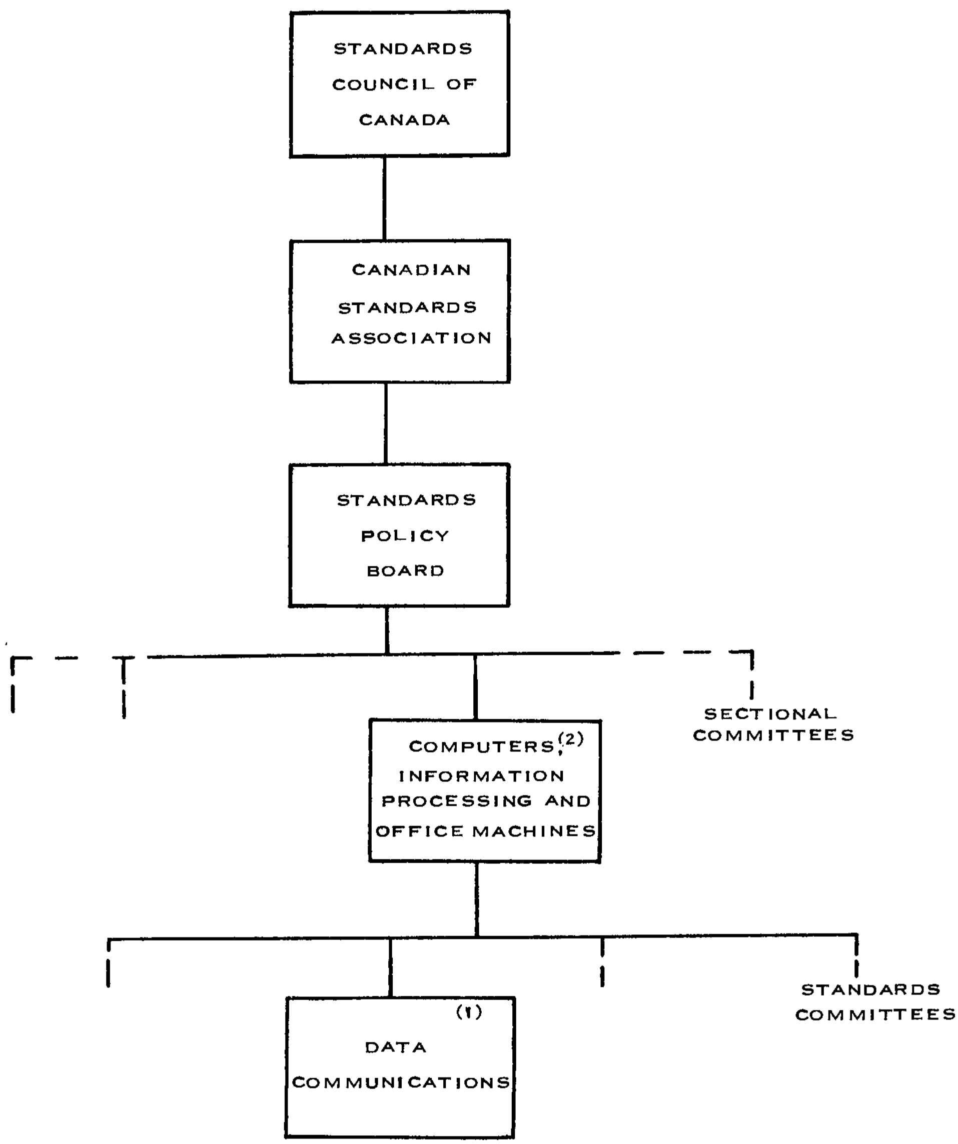
3.1.2 Standards Development in Canada

Within the Canadian standards development area, there are two structures which are closely related. These are the committees which develop Canadian standards, and the one which provides advice for international standards development.

The Standards Council of Canada is the national and international standards co-ordinating body for Canada. Within the national structure, the Canadian Standards Association (CSA) is the body responsible for the actual development of Canadian standards. A simplified organization of these groups is shown in Figure 1.

The Standards Council of Canada is an agency of the Canadian Federal Government and is funded by it. The CSA is a private agency with a government charter. It is funded primarily by the dues of members, the sale of standards publications, and the fees from certification processing. Certification is not performed for any of the standards considered in this study, although it is performed for electrical and safety standards applicable to data terminals.

Heading the Canadian Standards Association is its board of directors. Reporting to the board of directors is the Standards Policy Board, which has the responsibility of approving the standards developed within Canada. Reporting to the Standards Policy Board are a number of Sectional Committees. The Sectional Committee of interest to this study is the Sectional Committee on Computers, Information Processing, and Office



(1) FUNCTIONS AS THE CANADIAN ADVISORY GROUP ON ISO TC97 SC6
(2) FUNCTIONS AS THE CANADIAN ADVISORY COMMITTEE ON ISO TC97 AND TC95

Figure 1
CANADIAN STANDARDS DEVELOPMENT ORGANIZATION

Machines. Reporting to each of the Sectional Committees are a number of Standards Committees. Within the Sectional Committee on Computers, Information Processing, and Office Machines there are eleven Standards Committees. They are responsible for the development of standards in the following areas: (2)

Character Recognition
Character Sets and Coding
Credit Cards and Identification Cards
Representation of Data Elements
Input/Output
Keyboards
Problem Definition and Systems Analysis
Programming Languages
Publicity
Data Communications
Vocabulary.

Most of the Standards Committees have a full slate of items under active discussion.

The Standards and Sectional Committees are made up of individuals who have volunteered their services. These individuals represent various interest groups within Canada. The members of the Standards Committees represent their employers while making technical contributions to standards development. Members of the Standards and Sectional Committees are reimbursed for their expenses by their employers who also pay their salaries while tending to CSA business. The Standards Council of Canada contributes to the travel and living costs of their representatives attending international standards association meetings.

Approval of a new or revised standard at any level is by concensus and not a simple majority. More than one or two negative votes will result in the standard being returned to the responsible Standards Committee for revision.

The Canadian Standards Association (CSA) has a full time staff that provides secretarial services for its Sectional and Standards Committees.

In parallel with this structure of national standards development in Canada is the international advisory structure. At the lowest level are the Canadian Advisory Groups. These Groups correspond in scope to the ISO subcommittees and contribute to international standards development from the Canadian point-of-view. The Canadian Groups report to the Canadian Advisory Committees which also correspond in scope to technical committees within the ISO structure. The Canadian Advisory Committees advise the Standards Council of Canada on the national position which Canada should assume in relation to international standards.

The membership of the Canadian Advisory Group corresponds to the membership of a Standards Committee within the national structure. For example, the Data Communications Standards Committee in CSA is also the Canadian Advisory Group for ISO Technical Committee 97, subcommittee 6, which is the Data Communications Committee of ISO. The Sectional Committee for Computers, Information Processing and Office Machines is the Canadian Advisory Committee for ISO Technical Committees 95 and 97.

3.1.3 Standards Development in the United States

The principal function of the American National Standards Institute (ANSI) is to coordinate standards development in the private sector. ANSI is not a government agency, but is recognized as the official standards recommending body in the United States.

ANSI has structured its standards into a number of categories. The category of primary interest to this study is Category X, Information Systems, which has two divisions: X3, Computers and Information Processing and X4, Office Machines and Supplies.

The approach to the development of standards in the United States is different from the approach taken in Canada. ANSI recommends standards, but does not develop any particular standard on its own. When a need for national activity in any area of standardization is recognized, ANSI requests an appropriate user or manufacturer association to act as a secretariat. In the ANSI Information Systems category, the secretariat is the Computer and Business Equipment Manufacturers Association (CBEMA).[3]

CBEMA has organized the X3 Standards Committee on Computers and Information Processing. The X3 Committee executes its responsibilities through two standing committees: the Standards Planning and Requirements Committee (SPARC), which advises on standards requirements and performs reviews, and the International Advisory Committee (IAC) responsible for advising the X3 Committee on international activities.

CBEMA provides the administrative services for the technical committees which are developing standards. While a standard is being developed by a technical committee sponsored by CBEMA, it is controlled by rules established by ANSI. For example, it is extremely important to ANSI that it maintains a balanced representation of producers, consumers, and general interest groups. CBEMA has the responsibility of maintaining this balance among these three groups on all its committees which review standards recommendations.

ANSI is supported by the sale of standards publications, and the fees of its membership which is made up of associations and companies. CBEMA provides its secretariat services to ANSI at no cost. CBEMA is funded by the dues of its members. The working groups are comprised of voluntary members whose expenses and salaries, while engaged in standards development activities, are paid by their employers.

In order to accomplish the objectives of the X3 Committee, CBEMA has divided X3 into a number of smaller working committees. These are listed below.

Title	Section
Hardware Group	
Recognition Section	A
Physical Media Section	B
Software Group	
Languages Section	J
Documentation Section	K
Data Representation Section	L
Systems Group	
Data Communications Section	S
Systems Technology Section	T

The section of most interest to this study, Data Communications Section 'S', has three subcommittees. Presently, only one is active and it is known as the X3 S3 Subcommittee. Within that Subcommittee there are five Technical Committees. These are:

X3 S33	Message Formats
X3 S34	Transmission Procedures
X3 S35	Transmission System Performance
X3 S36	Transmission Speeds
X3 S37	Public Data Networks.

Figure 2 shows the normal X3 Committee standards development process described below.

Each of the above Technical Committees consists of voluntary members who are technical experts in the appropriate areas. They do not represent their employers while serving on the Technical Committees. (This is in contrast to the Canadian environment where members of Standards Committees represent their employers during the development of a standard). Technical Committees also keep abreast of the developments in ISO and the European Computer Manufacturers Association (ECMA).

A standard developed by a Technical Committee is reviewed by each of the Standards Steering Committee (SSC), IAC and SPARC. The voting on these committees is according to the member company position. At each of these levels, approval is by concensus and not by a simple majority vote. Failure to reach a concensus results in the proposed standard being returned to the Technical Committee for revision.

When CBEMA has drafted and approved a new standard, it forwards that standard to ANSI for approval. ANSI sends a ballot to all its members and allows them four months to study the proposed standard. The members vote on the usefulness and applicability of the standard. Any questions or negative votes are returned to CBEMA which then considers them, and reports to ANSI on the resolution of each issue. If the ballot shows concensus approval, ANSI will recommend the standard as a United States National Standard. Otherwise the standard is returned to CBEMA for revision.

ANSI also functions as the United States representative to the International Organization for Standardization, and periodically holds specific secretariats for the ISO.

X3 STANDARDIZATION PROCESS

(SIMPLIFIED)

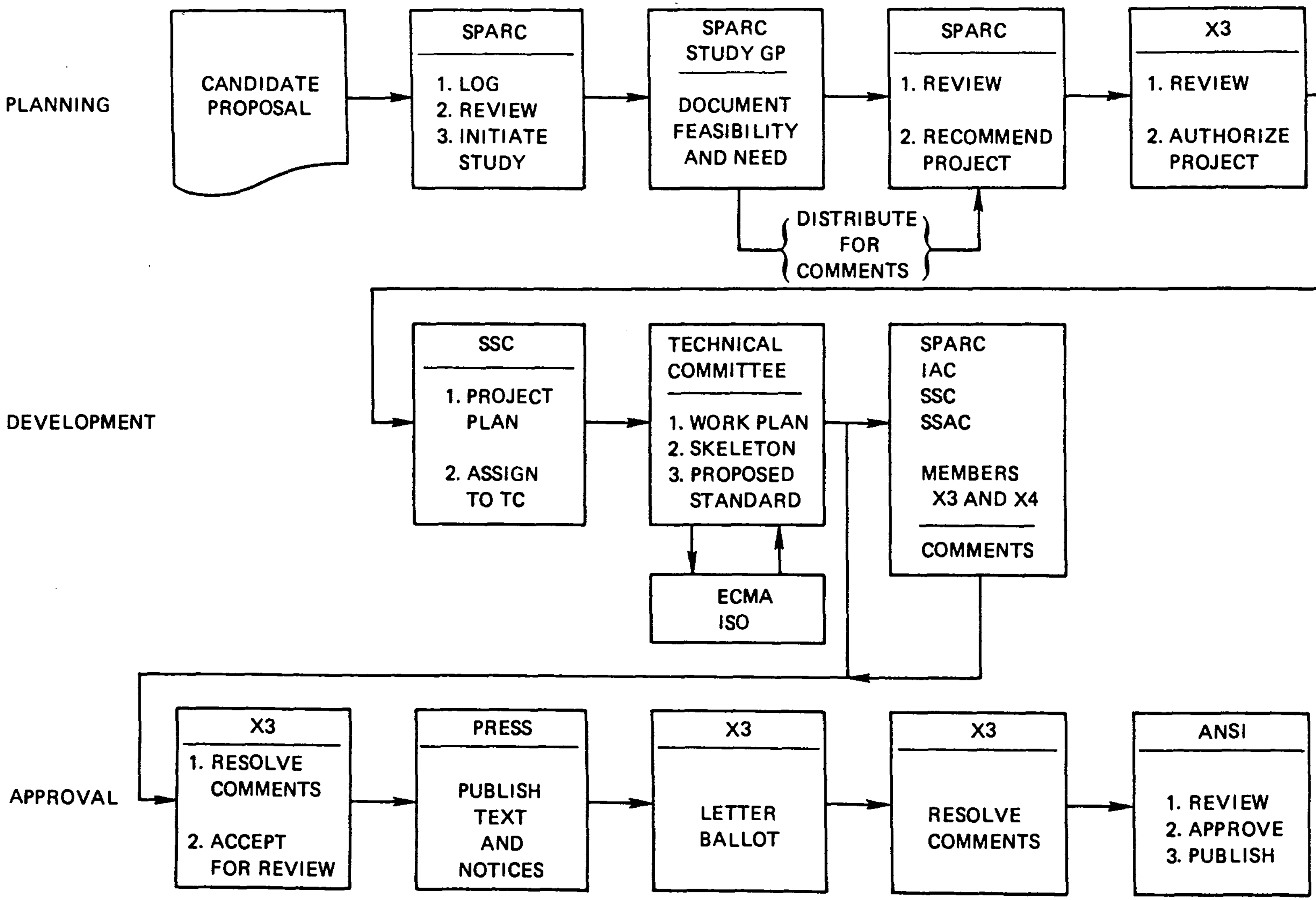


Figure 2

3.1.4 National Bureau of Standards

The National Bureau of Standards (NBS) is not a national standards setting association. Rather it is a coordinating body for the United States Federal Government. It takes the standards developed by ANSI, ISO, and other associations and adopts or revises them to become U.S. Government Standards. The Standards adopted by NBS are subsequently used in U.S. Federal Government procurement tenders.[4]

The ADP Division of NBS coordinates the setting of standards for, and works closely with, the National Communications System (NCS) which was established by the U.S. Government to coordinate the design and implementation of long-haul networks by the common carriers for U.S. Government needs. Policy direction for NCS comes from the U.S. Federal Government Office of Telecommunications Policy.

NBS is working towards the resolution of standards problems in several areas. It has not approved the EIA RS232 standard and is now assisting EIA with its replacement.[5,6] NBS has attempted to resolve typewriter keyboard standards by specifying optional 'QWERTY' or Dvorak [18] keyboard arrangements. It is also assisting the Advanced Research Projects Agency (ARPA), which is an agency of the Department of Defence, with the development of standard operator protocols. Standards accepted by the ADP Division in consultation with NCS are known as Federal Information Processing Standards (FIPS).

Representatives of NBS are members of various standards development committees. For example, it has members on the Technical Groups within CBEMA. They exert a considerable influence on the development of national standards because of the 'user' they represent.

(There is no similar department in the Canadian Federal Government. The National Research Council functions in a somewhat similar role, but with a much narrower scope, in encouraging the development of computer assisted instruction (CAI) terminals.)

3.1.5 General Information on Standards Associations

The development of standards on the national and international levels is a lengthy process because it is based on concensus at several levels. This makes the development time difficult to predict.

In all areas there is a requirement to develop timely standards which are useful to the community at large. If a national standard is developed too late, it may simply formalize a de facto situation. Or, there already may be so many existing standards that a new national or international standard only contributes further to the confusion. This is the case in optical character recognition where many de facto, national and international standards exist.

It is therefore desirable to develop anticipatory standards to avoid this confusion. This is being attempted with the advanced data link control procedures. However, anticipatory standards should not be developed too early or they may lock the standard into a technology that can soon become obsolete. Elements of this can be seen in the ASCII/EBCDIC data code conflict. Therefore, the standards associations have had, and will continue to have difficulty in developing new standards in the data processing industry, specifically with regard to data terminal equipment.

Neither CSA nor ANSI have any knowledge of the utility of the standards which they administer. They do not survey their members because it is regarded as an expensive, limited-benefit activity. However, the volume of sales of a standard provides a rough measurement of its utility.

Both CSA and ANSI have a policy of reviewing each standard every five years. This activity also provides some indication of the utility of the standard under review. The review will result in one of three actions being taken: the standard is revised, re-affirmed, or withdrawn. The review of a standard can occur sooner than five years but must not extend beyond the five year period. There is no attempt by the associations to encourage the use of their standards or to survey the degree of adherence to the standards. Particularly in the United States, enforcement of standards is avoided because it could be interpreted as an activity subject to antitrust action.

3.2 MANUFACTURER ASSOCIATIONS

Most of the manufacturer associations contacted in this study recognize the potential opportunities that they have in standardizing those areas of concern to their members. The responses to this opportunity take many forms.

Most of the Canadian associations are inactive in any standards development. They are aware of CSA activities and in many instances have representatives from their associations on subcommittees and technical committees within CSA. Most Canadian manufacturer associations are aware of the standards development activities of their United States counterparts.

In the United States, standards related to data terminal technology appear to be developed primarily in the Computer and Business Equipment Manufacturers Association (CBEMA) and the Electronic Industries Association (EIA). Both of these Associations have active standards development committees.

As has been noted previously, the Computer and Business Equipment Manufacturers Association (CBEMA) is the secretariat for the ANSI Information Systems standards category. In this capacity, CBEMA maintains balanced representation from manufacturers, consumers and general interest groups on all its committees, except on the development committees. Therefore, it goes beyond the usual role of a manufacturers association in this regard. However, CBEMA does provide other typical manufacturer association services to its members. (52) It does not publish any standards of its own. The Task Groups functioning in CBEMA have been described in the section on the United States standards development.

EIA has an engineering department concerned with the development of standards to provide better compatibility and standardization of equipment among its members. Some of its standards recommendations are forwarded to ANSI through CBEMA, while others remain as EIA standards. In some areas, EIA representatives are members of CBEMA Technical Groups which develop standards for ANSI.

EIA develops its standards in its Engineering Department to avoid the possibility of a standard, developed by one of its industry segment divisions, being too narrow or restrictive in scope. [8] There are a number of standing committees in the Engineering Department, two of which are of interest to this study. They are the Signal Quality (TR-30.1) and Digital Interface (TR-30.2) Subcommittees of the Data Transmission Systems and Equipment (TR-30) Committee. The Signal Quality Subcommittee is developing two standards which will replace the EIA RS232 standard. [5,6]

3.3 USER ASSOCIATIONS

The user associations contacted in this study, recognized the desirability of standards to resolve common problems of members. However, with the following exceptions, most are inactive in the development of any standards that will affect data terminals.

The Canadian Bankers Association (CBA) attempted unsuccessfully to have its members cooperate in the development of the function specifications of a data terminal for the Canadian banking industry. Its members refused, since each desired a competitive edge in this regard over the others. The CBA is meeting more success in its attempts to standardize magnetic stripe encoding on credit cards. It has advanced the information interchange between its members to a great degree, using Magnetic Ink Character Recognition (MICR) encoded cheques and magnetic tape standards.

The National Retail Merchants Association (NRMA) and the Grocery Product Manufacturers of Canada (GPMC) have developed, and their members have accepted, product labelling recommendations. GPMC has adopted a bar code named the Universal Product Code (UPC), while NRMA has chosen OCR over other labelling approaches. Both have adopted numbering schemes to identify their members and the commodities manufactured.[9, 45]

In the case of NRMA, it is developing the function specifications for a point-of-sale terminal for its members. This function specification will contain lists of necessary features, mandatory options, and desirable options. In this activity the Association has the active cooperation of the manufacturers involved, through a Manufacturers Liaison Committee.[10]

The drug industry has not acted yet to take advantage of its opportunity to exploit the UPC extensions available to it. In Canada the development of terminal oriented systems for the drug industry is being pursued by private companies, employing conventional data terminals.

3.4 COMMON CARRIERS AND CARRIER ASSOCIATIONS

The development of standards related to the interconnection of common carriers internationally has been performed by the

International Consultative Committee for Telephone and Telegraph (CCITT) of the International Telecommunications Union (ITU). Its recommendations are mainly applicable to the public network signalling requirements, and as such are outside the scope of this study. However, a number of its standards deal with the communications interface to data terminal equipment. (11) The ITU is recognized as an international treaty organization, and therefore representation by Canada is performed officially only by the Department of External Affairs.

Within Canada, the majority of common carriers are members of the Trans-Canada Telephone System (TCTS) with Bell Canada as the largest and most influential member. Because of the increasing importance of data communications to Bell Canada, it has established the Computer Communications Group (CCG). The CCG is responsible for the marketing, engineering and planning of data communications for Bell Canada.

The alternative to the TCTS is the Canadian National and Canadian Pacific Telecommunications Companies. They cooperate closely in the marketing and engineering of data communication services. TCTS and CN/CP Telecommunications compete in most cities across Canada.

The Canadian Overseas Telecommunications Corporation (COTC) is responsible for the interchange of information between Canada and countries outside North America.

The Canadian Telecommunications Carriers Association (CTCA) is a carrier organization formed in February, 1972 to represent the Canadian carriers in the development of telecommunications in Canada. Its members include the operating companies which make up the Trans-Canada Telephone System (TCTS), the Canadian National and Canadian Pacific Telecommunications and the COTC. One of the functions of the CTCA is to coordinate the activities of the carriers in the development of standards. All carrier representatives on CSA Committees and CCITT Committees operate as representatives of the CTCA rather than their employers.

In the United States, the Bell Systems is made up of many operating companies, including American Telephone and Telegraph (AT&T). The other major telephone system is based upon General Telephone and Electronics (GT&E). AT&T is generally in the central and eastern United States while GT&E is in the west. Several years ago AT&T sold its TWX service to Western Union which already had the TELEX network.

For historical reasons, Bell Canada, and thus the TCTS, employ many of the technical specifications (de facto standards) originally developed by AT&T. Many of their modem interface standards are specifically applicable to this study. TCTS appears to be progressing independently from AT&T in recent years.

In the United States, there is a growing group of independent carriers. These are specialized carriers established to provide data communication services. They own their own long-haul or 'backbone' facilities, and use Bell System for local lines to their customers. In 1970, MCI Communications Corporation became the first independent carrier to obtain carrier status from the Federal Communications Commission (FCC) which regulates carriers in the U.S. Its orginal plan was to offer a wider range of data transmission speeds and higher reliability than AT&T. Because there is a small market for a wider range of transmission speeds, MCI has narrowed its efforts to providing higher reliability transmission at lower cost than the equivalent AT&T service.

Datran is an independent carrier that will be offering service to its first customers in early 1974. This carrier is offering an all-digital transmission facility. It also uses AT&T local loops and provides its own long-haul facilities.

The independent carriers, such as MCI and Datran, have had no apparent influence upon the design of data terminals in the areas of signaling rates, and increased data communications reliability.

Networks such as ARPA Net and Tymnet will likely have a major influence on the future direction of data communications in the United States. These networks use a packet switching technology which allows the operators of terminals to remotely access computer resources anywhere in the network. The network is shared by many users simultaneously. Its use of store-and-forward computers to transmit units of information (packets) between terminals and host computers is a recent development. Carriers providing this type of service are known as value-added carriers.

Packet Communications Incorporated (PCI) is a value-added carrier that received carrier status from the FCC in November, 1973. It uses AT&T communications facilities to connect customer computers and data terminals. It has developed computer based switching systems to transmit information on alternate routings to customer designated destinations. The design of the system is based upon the ARPA network. Customers are charged on the basis of terminal connect time to the network, the complexity of the host computer interface, and the amount of information transmitted.

Data networks as described above give rise to the concept of a 'virtual' terminal. A 'virtual' terminal has a minimum set of common terminal characteristics, and a standard operator protocol.(12) Translation of the characteristics of the real terminal to those of the 'virtual' terminal is performed by the computers in the network. Standards development in the future may be influenced by the desirability to design a real terminal which corresponds functionally to these 'virtual' terminals for use on public data networks.

3.5 TERMINAL MANUFACTURERS

Manufacturers of many terminals and components were contacted by questionnaires. The results and opinions obtained from them contributed substantially to this study, and are integrated into the following sections.

3.6 CANADIAN USERS

Canadian companies and organizations, in all major industry groups, were contacted by questionnaire. Their comments and the statistics obtained are contained in the following sections.

4. CLASSIFICATION OF STANDARDS AND PROTOCOLS

The findings of this study have been organized into a structure which is based on the two main interfaces of a data terminal, the operations interface and the communications line interface. This structure is used in the Catalogue of Standards in Appendix C.

4.1 OPERATIONS INTERFACE

The operations interface refers to the physical features of data terminal equipment that are used by the terminal operator. It also refers to the procedures or protocols that the operator uses to send and receive formatted data to and from the computer system or other terminals.

In this report, the operations interface has therefore been divided into the operations interface - physical design and the operations interface - operator protocols.

4.2 COMMUNICATIONS LINE INTERFACE

The communications line interface refers to the electrical and mechanical connection between the data terminal and the common carrier communication facilities. It also refers to the communications procedures that are established between the terminal and a host computer and the data codes used to transmit and receive data over the carrier facilities.

The communications line interface has, therefore, been divided into two categories, the communications line interface - physical design and communications line interface - line protocols. Electrical and mechanical standards used to connect the terminal to carrier facilities are contained in the first category and line control procedures and data codes in the second category.

5. OPERATIONS INTERFACE - PHYSICAL DESIGN

5.1 CURRENT STATUS

The survey of data terminal equipment revealed that there is a variety of input and output devices capable of being attached to data terminals. In addition, manufacturers offer many options for their input and output devices which give rise to many combinations of devices and options.

The most prevalent input device identified in our survey was the alphanumeric keyboard. The basic keyboard arrangement is common but it is surrounded by a variety of optional keys and function keys.

Of the many output devices available, the hard copy printer and the cathode ray tube (CRT) are the most prevalent devices.

Including these three basic devices, the peripheral devices discussed are:

a) Input

- Alphanumeric Keyboards
- Function Keyboards
- Light Pencils
- Optical Character Recognition (OCR) Readers
- Magnetic Ink Character Recognition (MICR) Readers
- Credit Card or Badge Readers

b) Output

- Printers
- Cathode Ray Tube (CRT) Displays

c) Input/Output

- Paper Tape
- Magnetic Tape Cassettes
- Magnetic Disks
- Punched Cards
- One-Half Inch Magnetic Tape

It was found that published standards tend to relate to the older, more common devices, such as keyboards, cards, paper tape and one-half inch magnetic tape. The newer devices, such as magnetic tape cassettes, disks, CRT's and function keyboards are not standardized.

The only description that was found of a completely standardized data terminal, was published in 1970. (21) There does not appear to be any follow-up on this attempt. The NRMA point-of-sale terminal functional specification (10) is not as detailed.

In the following sections, each one of the above input, output and input/output devices is reviewed in detail.

5.1.1 Input

5.1.1.1 Alphanumeric Keyboards

The CSA Standards Committee on Keyboards has ten items on its agenda for incorporation in keyboard standards. The primary item is the Bilingual Typewriter Keyboard Arrangement (Z243.19). This standard is not yet available since it is still in a preliminary stage of development. There is no projected date for publication available. (13)

The addition of lower case accented characters for the French language has been made to the ASCII Code Structure and has been adopted as CSA Standard Z243.4. However, the typewriter keys to match these characters have not been standardized in Canada. This is the responsibility of the Standards Committee on Keyboards. A Canadian terminal manufacturer, Lektromedia, manufactures two models of terminals which have a French graphics option available in the upper case of their keyboards. (14)

Both the ISO R1092 and the ANSI X4.6 standards define the spacing and organization of the keys on 10-key adding machine keyboards, but do not address the key shapes or dimensions. The other standards applicable to typewriter keyboards do not specify the slope, the key size, the key skew, the key shapes, or the spacing between the keys for typewriter keyboards.

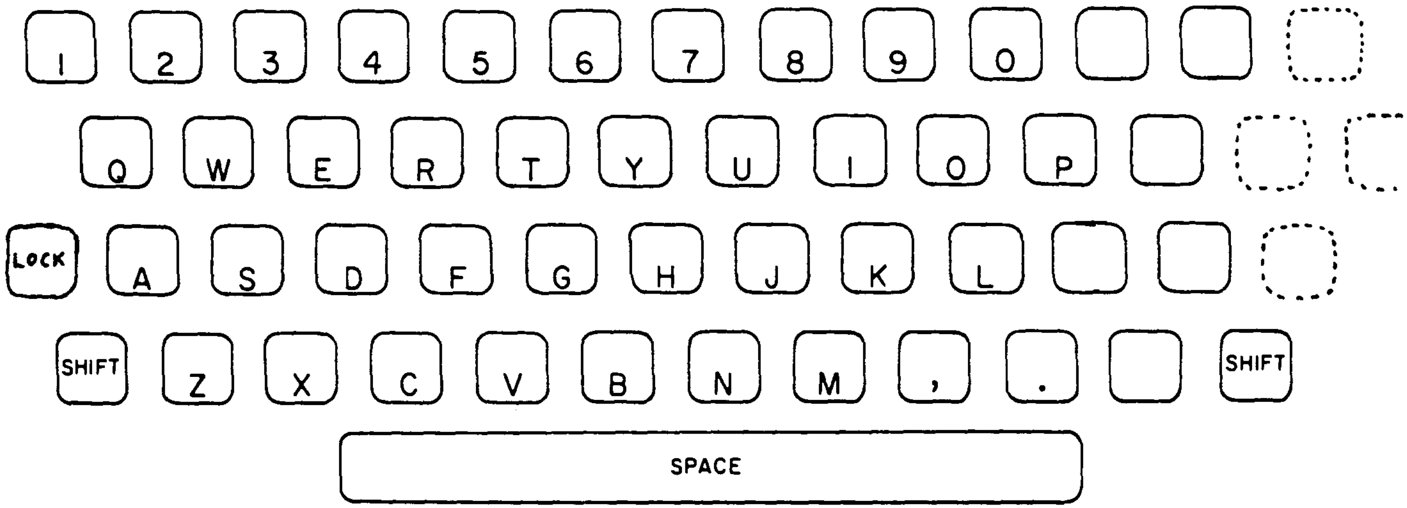
Those manufacturers offering numeric keyboards did not appear to depart from the 10-key adding machine keyboard standard. However, typewriter keyboards with an adding machine insert, such as the IBM 029 Keypunch, depart from both the adding machine and typewriter keyboard arrangement standards.

The ISO R1091 and ANSI X4.7 standards apply to a 44-key typewriter keyboard preferred arrangement. This has wide acceptance in North America on office typewriters.

The ANSI standard X4.14 contains two typewriter keyboard arrangements, to include the characters of the ASCII (ANSI X3.4) and the American Standard Character Set for OCR (ASCSOCR, ANSI X3.17) character sets. Both keyboard arrangements and the previously mentioned standards have a common 'QWERTY' layout as shown in Figure 3.

The various 'standard' keyboards have 44 to 48 keys, with the optional keys shown in dots in Figure 3. The standards assign the OCR, ASCII and other special printable graphics to the upper cases of the 1 through 0, comma, decimal and the blank keys shown in the figure. The remaining keys print upper and lower case alphabetic characters. The assignment of special graphics differs among the three standards ISO R1091, ANSI X4.7 and X4.14. The ANSI X4.14 Standard specifies which keys shall be used to produce non-printing ASCII control characters such as SOH and ETX. A standard is under development by ANSI to define the graphics for these characters.

The Baudot keyboard for 5-level Baudot transmission has a modified 'QWERTY' base. The major departure from the 'QWERTY' arrangement is that the top row of keys is missing and the numerals are produced by the upper case values of the 'QWERTY' row of keys. This standard has existed for many years. [15,16]



COMMON 'QWERTY' KEYBOARD ARRANGMENT

Figure 3

In the data gathered from the manufacturers, it was found that they all use a common 'QWERTY' base in their typewriter keyboard arrangements. However, the assignment of special characters and control characters varied among them. In some instances, the manufacturers stated that they were using "standard" or "full" ASCII keyboards. In fact, they are different from both ANSI Keyboard Standards, but do provide the basic or full set of ASCII characters. [17]

The National Bureau of Standards is the only organization that indicated any activity on the adoption of the Dvorak Simplified Keyboard as a standard. [18] NBS prefers the two basic standards, the 'QWERTY' and Dvorak. It may have success in some government departments, however, the large number of terminals with the 'QWERTY' keyboard makes it unlikely that another standard will gain broad acceptance.

5.1.1.2 Function Keyboards

There are no published standards specifically applicable to function keys. Several of the standards applicable to keyboards cover the placement of control keys for those functions defined within the ASCII Character Set. However, on many data terminals there are a number of other necessary function keys. The most prevalent use of function keys is for cursor positioning control on a CRT display. The other main use of function keys is to trigger processor activity, either in the terminal or the host computer, to perform a series of operations. This may be character or line insertion and deletion, under the control of the terminal, for example, or a complex calculation executed at the host computer on data previously entered through the terminal. [19]

The location of the function keyboard is generally to the right of, and separate from, the keyboard used for data entry. Some data terminal manufacturers place their function keys across the top of the keyboard.

There appears to be a trend towards the standardization of the functions performed by a CRT function keyboard. These are up-space, down-space, new-line, new-screen, erase-line and erase-page, in addition to the normal keyboard forward and back space functions. However, there does not appear to be a de facto physical standard evolving in this area as yet.

The functions that are initiated by a function keyboard are highly variable. Common functions such as cursor control may be the subject of standardization in the future as to the function and position of the keys. However, the number, position and function of the other keys will remain at the user's or manufacturer's discretion.

5.1.1.3 Light Pencil

This optional input device is offered by only a few of the manufacturers surveyed in our study. Few of the users indicated that they use this device.

There are no apparent standards applicable to the use or design of light pencils.

Light pencils come in two forms. Those used in conjunction with CRT displays are actually sensing devices where the position on the screen is determined by the response of the pencil to the light emitted as the electron beam scans the CRT screen.[20] The other light pencil is also termed a 'wand' and is a light source and sensor combined. It is normally associated with the reading of bar codes.

This device may become more prevalent as point-of-sale terminals become more commonplace in commercial outlets. The standardization of the bar codes read by light pencils is discussed under OCR readers.

Outside of the weight and style of the pencil, there is little opportunity for standardization in this area, since the design of the sensing electronics will continue to be left up to the manufacturer indefinitely.

5.1.1.4 Optical Character Recognition (OCR) Readers

CSA has two standards under development in the OCR area. However, as they are only preliminary, they are not available from CSA.

The ANSI Standard X3.17 recognizes the Style A Character Set for OCR. ANSI will be publishing a revised OCR standard during 1974. The ISO Standard R1073 recognizes two character sets, Style A and Style B.

The Farrington Company, which manufactures small business machines, developed an OCR font known as the Farrington 7B font. This has wide de facto acceptance in the marketplace. Both ANSI and ISO are moving towards adoption of the A, B and 7B fonts.

Moore Business Forms supplied a booklet which shows the A, B, and 7B fonts along with several other de facto character sets.[22] Figure 4 is reproduced from this booklet.

The grocery industry in Canada and the United States has recently adopted a bar code standard, known as the Universal Product Code (UPC). The bar code is machine readable by optical scanners. Below the bar code, the same data is displayed in OCR-B font for human reading. The UPC standard also defines the uses of the various fields.[9]

The NRMA has announced that it will develop OCR as the only recommended system for automated product code identification in the future.

OCR - A

The OCR - A font is the standard approved by the American National Standards Institute. This style is available in three sizes.

OCR - A Size 1:
for high speed printers and typewriters

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

ЧJH$%|&*{}_-+= —:;"',.?/‡

OCR - A Size 3
for cash registers and adding machine tapes

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789

ÜÑÄØÖÆÅ£¥'-{}%?JЧH.,:;=+/$*"&|

OCR - A Size 4
for embossed plastic credit cards

0123456789

ABCDEFGHIJKLMNOPQRSTUVWXYZ&|

ÜÑÄØÖÆÅ£¥'-{}%?JЧH.,:;=+/$*"

OCR - B

The OCR - B font is an international standard which was designed by the European Computer Manufacturers Association.

1 2 3 4 5 6 7 8 9 0

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 * " / @ £ _ & ' ( ) [ ] ¤ ↑ $

IBM 407

Available on IBM 407 accounting machines, IBM 1403 printers and IBM electric typewriters, models B and C. This style is available in two sizes.

IBM 407 - 1
for IBM electric typewriters and 1403 printers

ABCDEFGHIJKLMNOPQRSTUVWXYZ

⌑2345678901- ⌑2345678901-

IBM 407E - 1
for embossed plastic credit cards

14243444546474849404-41⌑⌑14-404948474

IBM 1428

Available on IBM 1403 printers and electric typewriters. This style is available in two sizes.

IBM 1428
for IBM electric typewriters and 1403 printers

ABCDEFGHIJKLMNOPQRSTUVWXYZ

0123456789 $*.,/-

IBM 1428E
for embossed plastic credit cards

123 456 789 0

FARRINGTON SELFCHEK®

Farrington 12L Selfchek®
for typewriters and high speed printers

ABCDEFGHIJKLMNOPQRSTUVWXYZ

1234567890#()¶&-$"+'=■Γ˥∆∇

Farrington 12F Selfcheck®
Consists of 12L numerals only

1234567890

Farrington 7B Selfchek®
for embossed plastic credit cards

123 456 789 0

IBM 1287 & 1288 HANDPRINTED CHARACTERS

Each character should be formed as illustrated and nearly fill its box.

1234567890

Figure 4

SOME OF THE OCR FONTS

Internationally, there may be some difficulty in recognizing any new OCR fonts, since Germany has a strong opposition to most of the fonts that are under discussion. Its opposition is based on the fact that the new fonts have their greatest use on credit cards, and Germany has a requirement for twenty-eight digits on its standard credit cards. This precludes its use of the common optical fonts on any standard credit card size.

5.1.1.5 Magnetic Ink Character Recognition (MICR) Readers

There are several compatible standards in effect for magnetic ink character sets. The adoption of these standards in North America is well established.

The ANSI Specification X3.3 goes beyond the definition of the geometry of the characters, since it also defines the meanings of the fields on encoded cheques in North America.

This standard was developed for ANSI by the American Bankers Association to promote the interchange of encoded cheques among its members.

5.1.1.6 Credit Card or Badge Readers

A CSA standard is still in a preliminary form and is not yet available.

The ANSI credit card or badge standard X4.13 relates to the physical size of the card and the location of the embossing. It defines the structure of a nationwide account numbering scheme as well. Appendices to the standard relate to the positioning of holes, customer signature and magnetic stripes on the cards.

The ANSI standard permits the characters on a credit card to be either OCR-A font or Farrington 7B font.

NRMA is also active in the definition of credit cards for retail store environments. This would include customer credit cards and employee identification.

The Canadian Bankers Association is involved in the standardization of credit cards for easier interchange of data among its members.

5.1.2 Output

5.1.2.1 Printers

For the physical printer, there are no published standards, but there is a de facto standard of ten characters per inch with an option of twelve characters per inch for horizontal spacing. Vertical spacing appears to be six characters per inch with options of eight characters per inch and three characters per inch. The origin of these de facto standards has not been identified, but is likely related to office typewriters.

Pin feed and friction feed platen sizes vary considerably, but lengths to allow 72, 80, 120, or 132 print positions are most common. Pin feed platens appear to have been standardized on a de facto standard of one-half inch pin spacing and a pin size of 5/32 inch.[28]

Printing fonts are not standardized in any formal manner. Several manufacturers offer a choice of fonts for their printers. Some of these are discussed under optical character recognition readers. A Programming Language (APL) requires a special print font, available from some manufacturers, to accommodate its special symbols.[7]

A few users noted the requirement for a standard concerning slashing the O (oh) or 0 (zero) characters.

There are a variety of printing techniques advanced by the manufacturers with associated claims about their advantages over the other techniques. There is no apparent standardization in this regard. Both the IBM Selectric (R) typewriter and various Teletype Corporation Teletypewriter models are the basis for a number of value-added terminal manufacturers. This tends to encourage the characteristics of these devices to be de facto standards.

There are no published standards for printers or the paper that they use. There are a series of standards by ISO related to loose-leaf standard paper sizes in the metric system.[23] However, most terminal printers use continuous forms.

There is a de facto standard, likely originating on Teletype equipment, for a roll of paper eight and one half inches wide rolled to a maximum diameter of five inches. This is used on many terminals.[28]

5.1.2.2 Cathode Ray Tube (CRT) Displays

In this area, there are no published standards applicable to the use of CRT's in data terminals. There are some standards relative to radiation hazards and electrical characteristics of cathode ray tubes, but these have not been included in this study.

A number of users indicated that they would like to see some standards for CRT displays. Their comments usually related to the number of characters per line and the number of lines on the screen. These users indicated that they would be interested in a standardization to allow them a greater choice of interchangeable data terminals for their applications.

There is some commonality among the CRT displays, probably based on the fact that many of them are imitations of other CRT displays. Common elements are the use of a 5 by 7 dot matrix for character generation, 80 characters per line and 24 lines per screen. Most have intensity control dials.

There is a considerable variety of options available with the CRT displays offered on data terminals. These include colour, rates of flashing, levels of intensity, destructive and non-destructive cursors and split-screen options. Many manufacturers view the variety of options as their opportunity for a competitive advantage.

The control functions, associated with a CRT display, are discussed in the Function Keyboard topic.

5.1.3 Input/Output

5.1.3.1 <u>Paper Tape</u>

There are a number of published standards from CSA, ISO and ANSI, related to 6- and 7-level, one inch and eleven-sixteenths inch paper tape. There are other de facto standards as well.[34]

There is a de facto standard for the five level Baudot code. This probably originated with Teletype (R) equipment. [15]

The trend to higher speed storage media appears to be reducing the use of paper tape with time.

5.1.3.2 <u>Magnetic Tape Cassettes</u>

There is a growing number of manufacturers who offer tape cassettes as input/output devices on their data terminals. These are generally used as local storage devices rather than for data interchange.

There are no published standards applicable to the physical dimensions or recording techniques for magnetic tape cassettes. There does appear, however, to be a de facto standard from Philips on the physical size of the cassettes.

There is no de facto standardization of the recording technique occurring. The cassettes are used at various speeds and densities. This means that while the cassettes are physically interchangeable, the data recorded on them by one machine cannot be read by another. (17,25)

CSA has no standard under development in this area.

ANSI has a standard under development in the Hardware/Physical Media Section which was projected for ANSI approval during 1973. However, while the industry in general appeared to be prepared to accept a standard, (24) ANSI was unable to gain a concensus on its proposal.

ISO Technical Committee 97 subcommittee 11 has two items on its agenda concerning data interchange on 3.8 mm (0.150 Inch) Magnetic Tape Cassettes. (1)

The confusion described above is detrimental to its development and should be resolved.

5.1.3.3 Removable Magnetic Disks

There is expanding interest in interchangeable disks as an I/O device for data terminals. However there are nc published standards applicable to this area.

ISO Technical Committee 97 subcommittee 10 (1) and ANSI X3B7 (3) have several items on their agendas related to single disk cartridges and front-loaded disk cartridges. The manufacturers offering disks on their data terminals did not indicate that they are standard or interchangeable.

There are several de facto standards applicable to removable disks used on other data processing equipment. There is no apparent trend towards any one of these predominating in the data terminal area.

5.1.3.4 Punched Cards

CSA has assigned the number Z243.14 to its punched card code standard, but it is not yet available. The Canadian standard is based on the ISO Standard R2021 which in turn is based on the ANSI Standard X3.26.

The ANSI card code standard is an eight level code, permitting two hundred and fifty-six hole patterns. One hundred and twenty eight of these are assigned to the 7-bit ASCII code structure.

The ANSI Standard contains an appendix which is not part of Standard X3.26, but is included for information purposes only, in which the EBCDIC structure is described. The differences in the card hole patterns are described in that appendix. The presence of this appendix is indicative of the broad usage of the EBCDIC de facto standard developed by IBM.

Most of the users and manufacturers sampled in our survey did not have card readers or punches on their terminals. The few who did differentiated between ANSI and EBCDIC punched card standards. It would appear that punched cards are not commonly used media in conjunction with interactive terminals.

There are other punched card standards in existence, such as the NCR round hole standard, and the IBM 96-column, three tiered card, that do not appear to be used with data terminals.

5.1.3.5 One Half-Inch Magnetic Tape

There are a number of standards applicable to the common one-half inch magnetic tape coding structure and the physical dimensions of a tape reel.

In this area few of the manufacturers surveyed and none of the users had half inch magnetic tape facilities on their terminals. Of those who did, none referred to the published standards in stating to which standard they adhered. Most of them referred to IBM or Honeywell recording techniques on their tapes. None of them referred to the physical dimensions of the reels. It is apparent however, that the physical dimensions correspond to the published standards, e.g. ANSI C83.43.

5.2 UTILITY

From the above sections it can be seen that there are a number of published standards applicable to the physical characteristics of conventional I/O devices on data terminals. Many of these standards are applicable to the outside supplier of materials used by the data terminal devices, such as magnetic tapes, continuous forms, credit cards, etc. Standards are a necessity for suppliers of these items.

There also appears to be some standardization where there are subcomponent (OEM) suppliers to terminal manufacturers. This is especially apparent in the areas of keyboards and magnetic tape, punched paper tape, and tape cassette devices.

CRT displays do not as yet appear to have settled into an identifiable pattern of de facto or established standards.

Many of the users of data terminals are taking advantage of the de facto or published standards that exist for older devices to provide them with a high measure of interchangeability on their recorded media. This option will likely be demanded by them soon on the newer media devices, such as tape cassettes and removable disks.

Most of the users surveyed are not concerned with standards, however, they are interested in compatibility with previously installed equipment as being one of the key criteria for their selection of a terminal. They require that the terminals communicate with computers or other data terminals without modification.

5.3 TRENDS

There is an obvious requirement for standards to be developed which define a minimum set of features and desirable options for CRT displays. Many users and a number of manufacturers suggested that standards related to the number of characters on the screen would be welcomed by them. Along with the CRT display standards is the requirement for minimum function keyboard standards to control the cursor positioning. Some of the function keyboards available today, and possibly to be standardized in the future, have potentially powerful editing capabilities for line, word and character insertion and deletion. At the present time, however, most manufacturers view the variety of CRT's, and the function key facilities supplied as being options that they can offer for competitive advantage in the marketplace.

As the input and output components of a data terminal become more modular in nature, it is likely that many manufacturers will continue to offer customized terminals to their customers. A number of large users today have customized terminals. This trend will no doubt continue into the future. The variety of terminal offerings and the potential for customizing data terminals will probably give rise to some degree of difficulty in standardizing terminal offerings.

It can be expected in the future that various user associations will continue to advance the functional requirements of their members. The success of NRMA and the Grocery Product Manufacturers Association in getting the active participation of the manufacturers indicates that manufacturers are willing to cooperate with users in this way. This approach speeds up the development of standards, but bypasses the concensus approval. The effect may be that large incompatible data terminal systems arise, each catering to a specific industry group.

Standardization of interchangeable storage media will undoubtedly be a future trend. As has been noted earlier, tape cassettes and credit cards and badges are candidates today for standardization, primarily in their recording techniques. The resolution of some of these problems is now in the control of user and manufacturer groups. This may indicate that the problems will be resolved by the de facto standards established by large associations rather than by the national standards organizations.

6. OPERATIONS INTERFACE - OPERATOR PROTOCOLS

6.1 CURRENT STATUS

Operator protocols are required for all data terminals which communicate with computers. They include procedures for signing-on to the computer system and for terminating communications. They are also used to identify the operator, identify the terminal, identify the location and to enter date information.

Almost without exception, operator protocols are dependent upon the computer terminal support software in the host computer. In these cases the operator protocol is designed to operate interactively with the computer software. For example, during sign-on, the computer software will ask the operator to enter his location, his name, possibly a password and information required to access the application programs in the computer system.

With some terminals, for example Lektromedia [14], a special function button has been provided for the sign-on function. When the operator presses the sign-on button the terminal generates the data characters required to sign the terminal on to the computer system. This is accomplished by programming in the terminal system.

Very few standardized operator protocols exist. Published standards are related to the entry of date information, geographical location and operator identification. A small percentage of the users indicated that the geographical location and date standards were used by them.

6.2 UTILITY

Because of the wide variety and changing nature of operator protocols, little standardization has taken place. There are as many sign-on procedures as there are software systems to support terminals.

Two years ago a meeting was convened to discuss the standardization of operator protocols. There was no agreement other than to acknowledge that standardization would be desirable. The existing operator protocols are changing so rapidly that there is little opportunity to develop a standard for future use. In addition, there do not appear to be any de facto standards. Although a large number of users may use the APL protocol, for example, it is not used for other computer applications or functions.

6.3 TRENDS

Some users have indicated that a standardized sign-on protocol is desirable. This contrasts to the present situation where every interactive system has a different sign-on procedure established for the computer application software. This desire is beginning to influence data terminal design as in the Lektromedia design. Also, with the increased use of data terminals with packet switching network systems, the need for a standardized sign-on procedure is greater. With these systems the user must not only identify his terminal to the network but must also identify himself and his terminal to the selected host computer system. Programmable logic contained in the data terminal would simplify the sign-on procedure to the network and the host computer.

There is little prospect for the development of standardized operator protocols in the next few years. No activity is taking place within the standards associations. Except for the protocols that are used with TWX, TELEX and store-and-forward systems, the common carriers have not identified a need for standardized protocols. Although some users have expressed an interest in developing these standards, the data terminal industry does not seem willing to cooperate in this task.

7. COMMUNICATIONS LINE INTERFACE - PHYSICAL DESIGN

7.1 CURRENT STATUS

The EIA RS232 C [26] is the most widely used standard for the electrical interface between data terminal equipment and common carrier facilities. It has undergone two revisions, and references to the previous versions, denoted by the suffixes A or B, still exist. This is a 25-pin interface standard developed about twelve years ago. It was designed for vacuum tube technology and is obsolete for today's solid state technology. This standard has not been accepted by the National Bureau of Standards as a U.S. Federal Government standard. The voltages specified in the standard are too high to be acceptable to the U.S. military with the result that considerable effort is under way to replace the standard. RS232 is an electrical standard and is not related to the physical characteristic of the interface between data terminal equipment and carrier facilities.

The MIL 188 standard is used by the U.S. military. It is similar to the RS232 standard but has a wider scope. In addition to this, the CCITT V.24 [11] standard is similar to the RS232. Common carriers specify either the EIA RS232 or the CCITT V.24 standard for the attachment of data terminal equipment to their facilities.

For data transmission on wide-band data circuits, a standard has been developed by AT&T. This is used on Western Electric 300 and 400 series data sets. [27] It provides a variation of the pin definitions of the EIA RS232 B standard and should be recognized as a de facto standard since other carriers are insisting upon its use. AT&T also uses the CCITT V.35 [11] standard for transmission over wide-band circuits. [29]

For transmission of asynchronous data at 75 and 110 baud, two de facto standards exist. The first is a 20 ma current loop which is used for Teletype Corporation compatible terminals transmitting at 110 baud. It generally applies to the Teletype Model 33 and Model 35 terminals which have widespread use in North America.[28] For data transmission at 75 baud with the Teletype Model 28 terminal, a 60 ma current loop is generally used. The usage of this interface is gradually being reduced because the Model 28 Teletype is no longer in production.

Some terminals have built-in modems and non-standard interfaces to these modems. Terminals using built-in modems operate on leased lines which usually require conditioning. Conditioning is performed by the carriers on leased lines to improve the characteristics of the circuit. The terminal user is responsible for providing compatibility between the terminal's modem and the modem attached to the host computer. No signalling standards other than compatibility with Western Electric 100, 200 or 300 series modems exist.[27] This de facto standardization appears to be unchanging.

Built-in acoustic couplers must accomodate a standard hand receiver, and must receive and produce audible signals compatible with the modem at the host computer, which is usually series 100 compatible. Separate acoustic couplers attach to a data terminal normally through an RS232 interface.[30]

In the case of synchronous transmission, the timing of data transmission is provided by electronic clocking in the data set.

For synchronous data transmission the EIA RS334 standard entitled 'Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission' is used. It specifies the distortion tolerance for synchronous transmission. This standard is referenced by the RS232 standard. The ANSI designation of the identical standard is X3.24.

Data transmission speeds are influenced by the electrical characteristics, especially the bandwidth of the data channels. In the United States a four kilohertz voice channel is normally used. Transmission of synchronous signals occurs at 2,400, 4,800 or 9,600 bits per second. In Canada, two grades of analogue transmission facilities are offered. The sub-voice grade supports transmission of asynchronous data up to 300 baud. Transmission above this speed takes place on voice grade circuits. Above 9,600 bps several voice channels in parallel are used. This is made available through the Telpak service. The Canadian carriers offer services in speeds ranging from 75 to 50,000 bits per second. Carriers will provide higher speeds on a custom basis if desired.

The signalling rate for synchronous transmission is specified by EIA RS269 A. This standard is widely accepted by carriers in the United States. It specifies that the standard serial signalling rate shall be a multiple of 600 bits per second. The preferred signalling rates are 600, 1,200, 2,400, 4,800, 7,200 and 9,600 bits per second. The rate of 2,000 bits per second is recognized as an interim standard. For operation below 600 bits per second the standard rates are 75, 150 and 300 bits per second.

The two largest carriers in Canada offer all-digital services, called Dataroute and Infodat from TCTS and CN/CP Telecommunications respectively. These services allow attachment of terminals which use the 20 ma current loop, EIA RS232 and modified RS232 B interfaces. They will support transmission speeds from 110 to 50,000 bps. The transmission facility is code sensitive and, at present, only the ASCII and EBCDIC codes are supported. [29]

For those data terminals which make use of automatic calling equipment, the EIA RS366 standard applies. This interface is used where a data terminal supplies the automatic calling unit with dialing information.

In the experience of one carrier, about seventy five percent of the types of data terminals that are evaluated for connection to the network do not meet the EIA RS232 standard. About 10 percent of these terminals are rejected as being unsuitable on the network. The others will operate without interference to the data set or carrier facility. These deviations from the standard occur because the terminal manufacturers can lower the cost of manufacturing the terminals by deviating slightly from the standard.

The physical interface to data sets is standardized by a de facto cable standard. This is the Cannon or Cinch DB 19604-432/3 cable connector.

There is no physical or pin placement standard for connection between the cable and the data terminal. Each manufacturer provides his own interface.

7.2 UTILITY

Because of the widespread use and acceptance of the EIA RS232 standard, it is extremely important. Almost all terminal manufacturers for the commercial data communications market follow this standard for their communications line interface, although there are minor deviations.

Terminals which are manufactured as plug replacements for the Teletype Corporation Model 33 and 35 terminals use the current loop standard.

Signal quality characteristics and signal speeds adhere to EIA standards. ANSI and CCITT have comparable standards, but manufacturers consistently cited the EIA standards.

7.3 TRENDS

The EIA RS232 standard will likely be replaced in the next few years. At the present time, the TR30 Committee of EIA has developed draft standards to make use of new solid state technology.(5,6) The balanced and unbalanced interface standards, now under development, are considerable departures from the RS232 standard. They will operate at between 0 and 5 volts and at standardized speeds up to 10 million bits per second. The development of this standard is anticipatory, and as yet there is no equipment that makes use of it. There is still disagreement among the developers of this standard causing progress to be slow. Proposals are received on an average of one every six months for changes to the standard. Because of these problems it is not known when the standards will be published.

CCITT is also attempting to develop new interface standards and is encountering similar problems.

There is little pressure from data terminals for standardization of signaling speeds beyond 9600 bps. There are de facto standards of 14400, 19200, 40800 and 50000 bps widely used in data transmission today. The evolution of data terminals to employ these higher speeds is not likely to occur.

8. COMMUNICATIONS LINE INTERFACE - LINE PROTOCOLS

8.1 CURRENT STATUS

Line protocols employed in data terminals involve several areas of standardization. The two main categories are code structures used by the data terminal, and the actual line discipline or protocol used to maintain logical synchronization between the data terminal and the host computer or another terminal. There are a number of published standards applicable to both of these areas.

8.1.1 Data Codes

In the area of data codes there is the published ISO Standard R646, which establishes the international version of ASCII. The CSA Standard Z243.4 takes advantage of permitted extensions to the ISO Standard, by defining the extra characters necessary to incorporate the French language in the Canadian Standard. The Canadian Standard actually consists of two sets of character codes. The ANSI Standard X3.4 (ASCII) corresponds to the ISO R646 Standard.

All of these standards permit the manufacturer to use certain codes to accomplish user-specified device control functions on his data terminal. Therefore, in some cases, it is difficult to determine the degree of adherence to the ASCII code structure when a manufacturer invokes some of these options.

In addition to the ASCII code structure, there are a number of other code structures available to data terminal users, such as:

- 5-level Baudot Code [15]
- EBCDIC [31]
- BCD Code [55]
- Transcode [31]

While the 5-level Baudot Code is prevalent because of the quantity of installed equipment, ASCII and EBCDIC are the most common on newly designed equipment.

In all of these codes, certain characters or sequences of characters are reserved for control functions. At the terminal the control functions are usually interpreted by hardware or software as opposed to the operator.

As noted above, a number of terminal manufacturers take advantage of unassigned bit patterns, especially in the ASCII structure, to accomplish unique functions within their data terminals, such as activating peripheral devices or controlling CRT displays.

Most host computers are capable of handling several different data codes through translation facilities in the host computer. However, the data terminal and the host computer telecommunications control unit are usually code-sensitive.

All of the data codes transmitted on common carrier facilities are serial-by-bit. The ASCII structure transmits the bits from the low order, that is the rightmost, bit first as specified in standards CSA Z243.11, ISO R1177 and ANSI X3.16. However, EBCDIC is transmitted with the high order, or leftmost, bit first.[31]

Many of the interactive data terminals which are the subject of this study are start/stop or asynchronous data transmission terminals in which the timing of the signal is re-established with each character. The published standards allow for the transmission of ASCII codes in a start/stop transmission mode having one start bit, zero or one parity bit, and one or two stop bits. The parity bit may establish even or odd parity, or may always be set to one.[28] The published standards, CSA Z243.11, ISO R1177, ANSI X3.15 and X3.16, specify the criteria for determining the number of stop bits and the sense of the parity bit, but in practice these guidelines are interpreted loosely. Therefore, the recognized standards permit a variety of combinations among the data terminal manufacturers and users.

Of the other codes, the 5-level Baudot code is transmitted with one start bit, 1, 1.42 or 1.5 stop bits and without parity. [15] EBCDIC, BCD and Correspondence codes are transmitted with one start, one stop and a parity bit.

The EBCDIC, ASCII, and 6-level Transcode are used for synchronous transmission. This transmission technique establishes synchronization for the transmission of a block of characters. Therefore, there are no stop or start bits on each character. It requires that all the data in the block be transmitted continuously. Consequently, the data terminal must have a buffer large enough to contain at least one block of data.

Most of the coding structures accommodate a block check character. The standard for this, CSA Z243.19, specifies a longitudinal redundancy check (LRC) character. The LRC is a parity balancing character at the end of a string of characters comprising a message, normally terminating with an 'end' control character. There is a de facto standard from IBM called the Cyclic Redundancy Check (CRC) method. With this method, a check character of twelve or sixteen bits is calculated using an algebraic algorithm. [31]

8.1.2 Line Protocols

Line protocols tend to be associated with a particular code structure, but this is not a necessary condition.

The CSA Standard Z243.13 is the same as the ISO Standard R1745 entitled Basic Mode Control Procedures. This standard differs in detail from the ANSI X3.28 Standard. In addition to these published standards there are a number of de facto standards, primarily from the Bell System and IBM. [31,32,33]

Of the de facto and published standards, the most common are the IBM Binary Synchronous Communications Conventions and the Teletypewriter protocols used by the Bell System.

The IBM Binary Synchronous Communication (BSC) Convention is an evolving standard. It was originally defined in 1967 [32] and has had a number of changes made to it since. Binary Synchronous Communication can use the EBCDIC, ASCII or the Transcode code structures. [31]

From the user survey, it appears that larger users tend to design customized protocols for their particular applications. They have discovered that they can make operating efficiency improvements and also can realize considerable savings in the cost of their data communication facilities by developing their own line protocols. For example, most of the line protocols are oriented towards data flow in one direction at a time with only acknowledgement messages in the opposite direction. The line must be logically 'turned around' for each reversal in data flow. In a normal man-machine environment this turn-around is sufficiently rapid to not be noticed. However, for the user with heavy data traffic in both directions, the time lost in turn-arounds can be substantial. By modifying the line protocol to accommodate simultaneous data traffic in each direction, performance improvements can be realized, and a smaller capacity line will accommodate greater volume.

These modifications sometimes require hardware changes in the terminal for the revised protocol. Usually the protocol revisions are accomplished through software in the host computer.

8.2 UTILITY

Protocols available in published standards appear to be a base which most manufacturers and a number of users adapt to meet their specialized needs. Features of the codes and protocols are exploited to provide device addressing and component selection features unique to one manufacturer's equipment. Only in those cases where a manufacturer is making a terminal intentionally compatible with some other terminal or system are the protocols adhered to rigorously, and then it may be the modified protocol of the subject terminal being copied.

Most of the published standards appear to be a minimum set of agreed upon functions for the protocol or definitions of a data code. It is apparent that the concensus process has given rise to a least-common-denominator standard permitting a number of variations. Many of the users and manufacturers take advantage of these options so that the degree of commonality is reduced. While these variations are annoying to those wanting compatibility of equipment, the extra features provided are beneficial to users. There may be some standardization of special functions possible, but it will be restricted by the shortage of unassigned codes in the present 7-bit ASCII code structure.

The most common protocols are the IBM Binary Synchronous Communication and those from the Bell System, [33] which are used with Teletypewriter equipment.

Few users stated that line protocols were of importance to them except for compatibility with their host computers.

Most manufacturers stated that their data terminals were compatible with some other device, [36] that their terminals would operate under a certain host computer software package, [37] or that they would supply the necessary software package. [35]

8.3 TRENDS

Both CSA and ISO are developing high-level data link control (HDLC) standards. Also, ANSI has an active committee in this area.[38] It should be noted that these standards may evolve considerably before they are approved.

IBM is developing a Synchronous Data Link Control (SDLC) procedure. It has not yet released any technical information about it. IBM has stated that its new grocery store and retail point-of-sale recording systems are compatible with its Synchronous Data Link Control procedure.

Other manufacturers, when queried in this particular area, were reasonably confident that they could adapt the logic of their terminals to any new protocols. The manufacturers of intelligent terminals stated that they can accommodate any new protocol by software or firmware logic in their data terminals.

The future development of value-added networks may result in a 'virtual' terminal protocol. A 'virtual' terminal has a minimum set of features plus a number of possible options. The current 'virtual' terminal definitions appear to be based upon the most common features of the real terminals that may be attached to the network.[12,39] There is the possibility of standardizing the 'virtual' terminal and this could subsequently result in a real terminal which has precisely those features in the standard.

It is difficult at this time to state whether the advanced data link control procedures being developed in the industry and by the standards associations will accommodate a 'virtual' terminal protocol.

9. FINDINGS

9.1 ROLE AND INFLUENCE OF STANDARDS ASSOCIATIONS

The standards associations potentially play an extremely important role in the development of standards applicable to data terminals. However, they are in some instances unable to act effectively because of the concensus approach that they must take. This has given rise to the development of ineffective standards which provide too much scope to be true standards. The standards associations are in a difficult position in the development of their standards. If they develop them too late, the de facto standard may be firmly in place, and the standards association simply adds one more standard to the number already available. If the standards association is too early with its anticipatory standard, it may encourage an obsolete technology or, possibly, a narrow application of the standard.

The utility of the standards developed by a standard association is also diminished by the fact that there is no formal influence exerted by the national standards associations.

Most manufacturers and users contacted are aware of standards organizations but do not consult them for guidance in using the standards already available, or under development.

The standards associations are generally aware of the limitations of their development approach. Nevertheless, they are moving ahead in new standards areas, and in some instances such as advanced data link control procedures, seem to be in the forefront, ahead of industry.

In the international standards area, European development appears to have little influence on data terminal standards development in North America. This is due to the fact that Europe is lagging behind North America in the development of interactive data terminals, higher speeds of transmission, better reliability of transmission, and newer input/output devices available on data terminals.

9.2 STANDARDS AND COMMON CARRIERS

Standards are used by common carriers for two major reasons:

a) To protect the common carrier facilities from misuse.

b) To provide a standard basis for interconnection and access by customers.

Most standards in use today were developed by Bell Laboratories for the American Telephone and Telegraph Company. Because of the influence of AT&T, these interconnection standards have subsequently been adopted by every carrier in North America. In the United States, most carriers use AT&T - provided loops to connect their facilities to customer premises. In Canada, CN/CP Telecommunications uses the local loops provided by the TCTS members. For these reasons, the data communication interface standards that are applicable to data terminals are widely accepted.

The North American carriers recognize that the standards used by AT&T reflect good engineering practice. However, they are not necessarily suitable to today's solid state technology. Also the standards that are commonly used were developed for analogue transmission and are not adequate for the new developments that are taking place with all-digital data transmission systems.

9.2.1 Line Interface Standards

The main standards requirement imposed by the carriers on data terminals concerns the electrical and mechanical interface. In the United States, the carriers have designed their data communications facilities to be independent of the line protocols and operator protocols used for data terminals. There are procedures that are used to connect data terminal equipment to carrier facilities and to access the receiving computer, through the data set, independent of the data terminal.

An exception to this is the service offered by Packet Communications Incorporated. Special operator and line protocols have been specified to allow the terminal to access the host computer through the PCI network.

In Canada, the carrier facilities are also normally independent of line and operator protocols. However, the carriers offer specialized data communication services such as Dataroute,[29] Infodat and Telenet which impose some restrictions on the characteristics of the data terminals using the facility. For example, the Dataroute will support terminals using only the ASCII or EBCDIC codes. In addition, terminals using the Dataroute must transmit information at specific speeds. Store-and-forward systems such as CN/CP's Telenet require special line protocols and operator protocols to communicate through the systems.

Technical information on the Bank Net system announced by TCTS is not yet available.

9.2.2 Data Terminal Evaluation

In Canada and the United States the major carriers have terminal evaluation groups. These groups are formed on an ad hoc basis from engineering staff who are familiar with data transmission equipment and who are knowledgeable about standards. Each make of terminal that is to be connected to carrier facilities, either by manufacturers, customers, or the carriers themselves, is evaluated. The evaluation procedure is based on a list of engineering hints and practices together with applicable standards. No carrier has published these procedures.

The independent carriers in the United States do not have active terminal evaluation groups. They rely upon the knowledge of which terminals are acceptable to the AT&T facilities. Because of the widespread use of the EIA RS232 standard they have found little reason to evaluate the terminals. Evaluation is done on an exception basis if the terminals are not able to communicate through carrier facilities.

The carriers, through the CTCA, are actively involved in forward-looking standards development. Bell Canada has at least ten participants in CSA activities. In the United States, Bell Laboratories are active in the ANSI Committees. All other carriers are interested in standards and often observe committee activities.

9.2.3 The Influence of Carriers

The influence of the carriers on data terminal standards began with the introduction of the Teletype Corporation terminals. The Model 28 Teletype uses a five-level Baudot code with a 60 ma current loop interface. Later, the Models 33 and 35 were introduced by the Teletype Corporation employing the eight-level ASCII code and a 20 ma current loop interface. These current loop interfaces became de facto standards when other terminal manufacturers began to make Teletype replacement terminals. Indeed, the 20 ma current loop interface is a standard offering with the Dataroute system.[29]

With the widespread acceptance of the RS232 C interface standard and the modifications to the RS232 B standard for high-speed data transmission, there has been no effort by the carriers to introduce new or changed standards. They are not taking an active part in the development of the replacement standard for RS232 being developed in the EIA TR30 Committee. Data terminal industry representatives on the Committee, especially IBM, are most interested in developing a simplified and up-to-date standard. This Committee has active participation from NBS to replace the EIA RS232 standard.

With the exception of TWX and TELEX terminals, the major U.S. carriers do not market data terminals to their customers. Even the independent carriers do not provide a terminal marketing service. They will advise customers as to which terminals to acquire but will not offer the terminals as standard products.

In Canada, on the other hand, the carriers provide data terminals as product offerings. However, these terminals are chosen by the carriers with careful consideration to compatibility with their equipment and the requirements of their customers. There is no direct influence on the design of data terminals other than to ensure that the EIA RS232 C, or current loop standards are met.

There is little or no influence by European and other foreign carriers on the design or use of data terminals in Canada. For this reason, there is a tendency to rely on the standards originally introduced by AT&T in the data communication area.

9.2.4 New Carrier Developments

Among the independent carriers in the United States, one is of the opinion that the dominant influence in the development of data transmission and interface standards will be IBM. The independent carriers are very conscious of user requirements and are continually holding discussions with customers. Because IBM predominates among data transmission users, and IBM is interested in simplifying and updating the electrical interface to the carrier facilities, they believe that IBM will eventually become more dominant than AT&T in this area.

The strongest evidence of this trend is in the line protocols used by data terminal equipment. Ten years ago, IBM provided software support for line protocols established by AT&T and Western Union. (40, 41) Now the most widely used of the newer line protocols are those developed by IBM for its terminal equipment. This equipment meets no line protocol standards imposed by the carriers.

The newest carrier offering is the value-added service. Until recently, users were required to lease expensive private circuits to transmit information at high speed, and multiplex many users in a single channel. This approach has been used by the airlines. However, if a customer wishes to pay for transmission services based upon the resources actually used, his only alternative today is to use the public dial-up facility. However, because of the inability to condition the public network, data transmission at medium- and high-speeds is not possible. Two new technologies have been developed to respond to this problem:

a) The Dataroute and Infodat systems in Canada.

b) The packet switched or value-added networks in the United States.

In Canada, the carriers have developed time division multiplexing systems to distribute the cost of high-speed data transmission facilities among several users. The multiplexing function is independent of the use that the customer makes of the communications circuits. However, the time division multiplexing approach imposes speed and code constraints on the terminals. Dataroute, for example, was designed to offer service to 95 percent of the data terminals in Canada. This was met by offering speed ranges between 110 and 50,000 bits per second. In addition, the system accepts only ASCII and EBCDIC codes for both asynchronous (to a maximum of 1200 bps) and synchronous transmission. Although the customer does not pay for data transmission on the basis of his own data traffic volume, usage of the carrier facilities is shared and price reductions of up to 90 percent can be achieved for the slower speeds.

9.2.5 Value-added Carrier Requirements

In the United States, no similar digital transmission offering exists. The technology represented by the ARPA Network [12] has been adopted by Packet Communications Incorporated, Telenet Incorporated and others to provide value-added service. With these systems, the customer is charged on the basis of the amount of information he transmits through the network.

In an attempt to standardize the transmission of information through the value-added network, two developments are currently under way which have broad implications:

a) A standard error detection and correction technique for packet transmission.

b) A standardized terminal to be used with the packet transmission systems.

ARPA has specified a 'virtual' terminal that satisfies the second requirement. PCI and Telenet have also specified 'virtual' terminals based upon the ARPA standard. At present, these terminals exist as software translations from the characteristics of real terminals that are physically connected to the network. In the future, it appears likely that there will be some development effort by manufacturers to produce a physical version of the 'virtual' terminal. This will depend to a large degree upon the extent of the growth of these networks in the future.

The value-added carriers will influence terminal development in the areas of line and operator protocols. Currently, a terminal operator using these carriers must identify his terminal to the network and the host computer separately. It is the opinion of one carrier that a possible improvement will be to develop a programmable terminal which will translate a simplified operator sign-on procedure into a sign-on to the network and host computer, and identification of the protocol required by the value-added network.

For all of these new service offerings, there is little standards development taking place by the independent carriers. New offerings marketed by the major carriers are compatible with existing standards and the same compatibility exists for the independent carriers, but where their service offerings differ markedly from the major carriers, no standards are being developed. They are interested in eventually developing standards but it is a costly process, and they have given it a low priority so they can focus attention on making their services profitable.

9.3 STANDARDS AND TERMINAL MANUFACTURERS

The underlying aim of terminal manufacturers is to be economically viable. Therefore, most manufacturers are committed to producing data terminals for the broadest possible customer base at the least possible cost. These objectives are balanced with reliability, serviceability and other factors which would tend to increase the cost of terminals. In order to ensure a broad customer base, the manufacturers of data terminals have adopted some published and de facto standards, where necessary, for compatibility. The key areas of applicability of standards are in the electrical and mechanical interface to the data communications circuits, the adoption of some data communications protocols, a certain uniformity of keyboard layouts and support of the interchangeability of recording media. Where standards do not exist, or the compatability is less important, the manufacturers appear to ignore the existing standards in order to provide a marketing edge for themselves, or a cost saving to their customers. For example, the CRT display stations have no published standards applicable to them, and there is little trend towards the adoption of de facto standards in this area. There is some movement towards a de facto standard of a 5 x 7 dot matrix and 24 lines of 80 characters, but cursor controls and other CRT features are highly variable.

Designers of new data terminals take into account the compatibility of their terminals with common carrier facilities, and the software and application programs of the host computers with which their terminals will communicate. Beyond this most terminal manufacturers exercise some degree of imagination in providing input/output devices and other options with their data terminals.

9.3.1 Compatible Terminals

There is a growing number of data terminal manufacturers who build data terminals solely for compatibility and substitutability with other terminals. Most of these manufacturers attempt to incorporate some competitive advantages into their terminals, through reduced price, or additional features, that the original terminals do not possess. Key examples of terminals being substituted are Teletype Models 33, 35 and 37, and IBM 2260 and 3270 CRT terminals. The substitute terminals are normally marketed as 'plug compatible' terminals. 'Plug compatible' means that the terminal functions under the same basic line protocol as the original terminal, although there may be some improvements or extensions to the protocol. Compatibility also means that substitute terminals will physically plug into existing control units and modems without modification to these devices.

9.3.2 Intelligent Terminals

A number of manufacturers now offer 'intelligent' terminals. This gives the manufacturer a much broader marketing potential for his terminal, although the terminal cost may be higher because of its added features. Also, a broader marketing potential exists since the terminal may be adapted to accommodate a wide range of line protocols and it often has greater versatility in the number and type of input/output devices that can be attached to it. The potential of 'intelligent' terminals to perform various operator protocols, such as sign-on procedures or text editing functions through function keys, is attractive as well. If in the future additional operator protocols are standardized they can readily be incorporated through function keys.

9.3.3 Manufacturer Standardization Activities

Some of the user associations are resolving the problems of manufacturing specialized terminals for a particular industry group. It appears that the manufacturers are willing to co-operate fully with the user groups since they represent large potential markets for the industry-oriented terminals.

Manufacturers individually, and through their associations, have actively supported standardization for improved interchangeability of components and sub-assemblies in other areas. Unfortunately, manufacturer associations in the United States tend to have reservations about enforcing standardization because of possible anti-trust problems. Therefore, they tend to go only so far in the standardization process and avoid the follow-through activities such as identifying the utility of the standard, or enforcing the standard.

According to the study findings, IBM provides a large umbrella for the data terminal industry. It has developed de facto standards for codes, operations interfaces, and line protocols. Also, its large installed computer base influences the selection of data terminals for many users who require compatibility.

with their host computers. The other influential manufacturer is the Teletype Corporation. Of the common carrier offerings that use Teletype equipment, it was suggested by the AT&T respondent that approximately sixty-five to seventy percent of the message switching systems still use Teletype Model 28's. Also used are Teletype Models 33, 35 and 37. The number of installed Teletype terminals forces newer terminals to be compatible with them in order to have an immediate customer base among Bell System customers.

9.4 STANDARDS AND USERS

The most common selection criteria uncovered in the survey for selecting data terminals were the following: compatibility with the control program and application software at the host computer, price performance of the terminal and compatibility with existing or previously installed equipment. No user respondent stated that published standards are foremost in choosing a data terminal.

Some larger, more sophisticated users customize their terminals and line protocols in order to produce a terminal system suitable to their particular application. This provides them the benefits of operational convenience and more importantly, reduced line charges.

Few users appear to be concerned with standards. However, they do consider interchangeability of components to be important and expressed concern that uniform operator procedures may not be easy to develop.

A number of suggestions for new standards were derived from the User Questionnaire. These include the following:

a) Many users would like a standardized sign-on protocol which would allow their operating staff to work interchangeably with software packages on various host computers.

b) Some users requested that there be standards to allow multiple sets of graphics for output devices, both printers and CRT's. The examples given are the APL character set and normal graphic character sets.

c) A number of users requested CRT standardization with respect to the number of characters per line and number of lines per screen. Also, they want standardization of the function keys which control cursor and other screen functions for CRT displays.

9.5 DE FACTO STANDARDS

It is apparent from this study that no manufacturer has intentionally established de facto standards. Any major manufacturer or supplier of data communications equipment or services is potentially the originator of a de facto standard. Major manufacturers or suppliers, because of their sizes, become the target for equipment replacement by other manufacturers. This gives rise to the adoption of these suppliers' standards as de facto standards for the industry. The obvious examples in the area of data terminals are the Bell System (AT&T) and IBM. While the Bell System today is primarily a supplier of data communications services, it has been a major supplier of data terminals through its close relationship with the Teletype Corporation.

The large base of installed equipment tends to inhibit the development of new standards because the large company, with its investment in customer equipment, tends to make its new offerings evolutionary in nature rather than revolutionary. This means that it may not support the adoption of new standards which would render its currently installed equipment obsolete. IBM, as an historical source of de facto standards, does not seem as reluctant as the Bell System to adopt new standards when the needs arise, but still protects its installed revenue base to a large degree.

One advantage of a de facto standard is that the developer of the standard does not keep it static, but tends to treat it as a guideline, and will revise and adapt it to varying requirements as the need arises. This can be seen in the case of IBM's Binary Synchronous Communications Conventions. This was first available in 1967.[32] However, today, it has been expanded and has many new features that were not included in the original design.[31] It is also now being expanded into a Synchronous Data Link Communications system with appropriately designed terminals being offered. Because of this evolution, even within the product lines of IBM, some binary synchronous communication based devices are incapable of communicating with each other.

Outside of these sources of de facto standards, it is difficult to identify any other major source. A number of common features have been adopted by manufacturers and users of data terminals with no apparent key originator. This would appear to correspond to a selective evolutionary process where the "best" standard rises to pre-eminence. An example of this is the adoption of the Farrington 7B Optical Character Recognition Font over the many other fonts available to data terminal manufacturers and users of OCR, especially for credit cards.

The pressure for compatibility with other equipment should not be overlooked in any discussion of de facto standards. This applies both to the large companies not wanting to disturb their installed customer bases, and to smaller companies wishing to sell equipment to the customers of the larger companies.

10. REFERENCES

1. 'Draft Annual Report ISO/TC 97 for 1973'
Daniel W. Smith, American National Standards Institute, Secretariat ISO/TC 97,
1430 Broadway,
New York, New York

2. 'Canadian Standards Association Sectional Committee on Computers, Information Processing and Office Machines, Annual Report 1972'
Dr. D. Baxter, Chairman, Canadian Standards Association, 178 Rexdale Boulevard, Rexdale, Ontario

3. American National Standards Committee, X3-Computers & Information Processing, MASTER PLAN, X3/SD-2 May 1973;
CBEMA,
1828 'L' Street N.W.
Washington, D.C.

4. Objectives and Requirements of the Federal Information Processing Standards Program,
FIPS PUB 23, February 1973, SD Catalogue No. C 13.52.23;
U.S. Government Printing Office
Washington, D.C.

5. Draft, Electrical Characteristics of the Balanced Voltage Digital Interface Circuit, TR-30.1/40,
Electronics Industries Association,
2001 Eye Street N.W.
Washington, D.C.

6. Draft, Electrical Characteristics of the Unbalanced Voltage Digital Interface Circuit, TR-30.1/41,
Electronic Industries Association,
2001 Eye Street N.W.
Washington, D.C.

7. MCM/APL Language Specification, Micro Computer Machines Inc.,
4 Lansing Square
Willowdale, Ontario

8. Manual Organization and Procedure, Engineering Publication EP-1-F, August 1970, Engineering Department, Electronic Industries Association,
2001 Eye Street N.W.
Washington D.C.

9. Canadian Grocery Product Code Symbol Specification, Canadian Grocery Product Code Guidelines, Canadian Grocery Product Code Vendor Code List, Grocery Product Manufacturers of Canada, Suite 504
797 Don Mills Road,
Don Mills, Ontario

10. Terminal Systems Functional Requirements, September 1973, National Retail Merchants Association,
100 West 31st Street,
New York, New York 10001

11. Fifth Plenary Assembly, Green Book, Volume VIII, Data Transmission, The International Telegraph and Telephone Consultative Committee of the International Telecommunication Union,
Geneva

12. TELNET Protocol Specification, NIC #15372, Advanced Research Project Agency, Network Information Centre,
Stanford, California

13. CSA Section Committee on Information Processing and Office Machines, Report on Items under Study, Committee on Keyboards, November, 1973, Canadian Standards Association, 178 Rexdale Boulevard, Rexdale, Ontario

14. LEK 100 Series CRT Computer Terminal, Lektromedia
88 Ashgrove, Pointe Claire, Quebec

15. Teletype Equipment for 5-Level Data Communication,
Teletype Corporation,
5555 Touhy Avenue,
Skokie, Illinois 60076.

16. The abc's of Teletype Equipment, Teletype Corporation
5555 Touhy Avenue
Skokie, Illinois 60076

17. Silent 700 Electronic Data Terminals, form TI-334A-10M-7/73,
Texas Instruments Inc., Digital Systems Division,
P.O. Box 1444,
Houston, Texas 77001

18. The Dvorak Simplified Keyboard: Forty Years of
Frustration, Computers and Automation, Nov. 1972,
Vol. 21, No. 11

19. Sycor Inc. Model 250 Intelligent Display System,
Component Description Manual, Sycor Inc,
100 Phoenix Drive, Ann Arbor, Michigan.

20 Vectorgraphics 11, Direct Writing Interactive Graphics
System, Vector General, 8399 Topanga Canyon Blvd.
Canoga Park, California.

21 Functional Specification for Typewriter - Like Time
Sharing Terminals by T.A. Dolotta, Computing Surveys,
March 1970, Volume 2, No.1.

22. The World of Optical Character Recognition,
G91E(7-71), Moore Business Forms, 7 Goddard Ave.,
Toronto

23. Metric Business Letter Sizes for North America,
Moore Business Forms,
7 Goddard Ave., Toronto,

24. The New Cassette Standard, William W. Otterson, Datamation, September, 1972.

25. Datapoint Equipment Catalog, 0973, Datapoint Corporation, Computer Terminal Corporation,
9725 Datapoint Drive,
San Antonio, Texas 78284

26. EIA Standard, Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange, RS-232-C, Electronic Industries Association, 2001 Eye Street, N.W. Washington, D.C. 20006.

27. Data Set 103A Interface Specification, Feb. 1967, PUB41101:
Data Set 103F Interface Specification, May 1964, PUB41103:
Data Sets 201A & 201B, August 1969, PUB 41201:
Data Sets 202C & 202D Interface Specification, May 1964, PUB 41202:
Data Set 202E Series, Sept. 1971, PUB 41203:
Data Set 403D,403E Interface Specification, Nov. 1967, PUB 41406:

Bell System Technical Reference, American Telephone and Telegraph,
195 Broadway, New York, New York 10007

28. Catalog,
Teletype Model 33 Data Terminals, April 1973 Edition:
Teletype Model 35 Data Terminals, April 1973, Edition:
Teletype Model 37 Data Terminals, May 1973 Edition:
Teletype Model 38 Data Terminals, April 1973, Edition:
Teletype Model 40 Data Terminals, October 1973, Edition:
Teletype Corporation,
5555 Touhy Avenue,
Skokie, Illinois 60076

29. Customer Reference Manual, The Dataroute, Computer Communications Group, Trans-Canada Telephone System member company.

30. Acoustic and Inductive Coupling for Data and Voice Transmission, October 1972, PUB 41803, Bell System Technical Reference, American Telephone and Telegraph 195 Broadway, New York, New York 10007

31. General Information - Binary Synchronous Communication, form GA27-3004, International Business Machines Ltd.

32. Conventions for Digital Data Communication Link Design by J.L. Eisenbies, IBM Systems Journal, Vol. 6. No. 4, 1967

33. 83B3 Teletypewriter Selective Calling System, Sept. 1967:
85A1 & 85A2 Data Selective Calling Service Stations, Oct. 1971, PUB41702:
86A1 & 86A2 Data Selective Calling Service Stations, June 1969, PUB41703:
86B-Types Data Selective Calling Stations, Nov. 1968:
Bell System Technical References, American Telephone and Telegraph Company,
195 Broadway, New York, New York 10007

34. Catalog, Teletype 4100 Paper Tape Equipment, December, 1972 Edition, Teletype Corporation,
5555 Touhy Avenue, Skokie, Illinois 60076

35. Model 401-III Adaptive CRT Terminal, form 11/73/5M DP, Conrac Data Products,
600 North Rimsdale Avenue, Covina, California 91722

36. Model 73 Interactive Terminal, General Description, Data 100 Corporation,
40 Wynford Drive, Don Mills, Ontario

37. Sycor Model 340, Intelligent Communications Terminal, System Reference Manual, Sycor Inc.,
100 Phoenix Drive, Ann Arbor, Michigan 48104

38. Proposed American National Standard on Advanced Data Communication Control Procedure (ADCCP), X3S34/475 DR7, Committee X3 on Computers and Information Processing, CBEMA, 1828 'L' Street N.W., Washington, D.C. 20036

39. The Emerging Computer Networks January 1973: Distributed Intelligence in Data Communications February 1973: Developments in Data Transmission March 1973: EDP Analyzer, 925 Anza Avenue, Vista, California 92083

40. IBM System /360 Operating System, Basic Telecommunication Access Method, form GC30-2004, International Business Machines Limited.

41. IBM System /360 Introduction to Teleprocessing, form GC 30-2007, International Business Machines Limited.

42. Various articles from Datamation July 1973, October 1973

43. The Impact of Standards, by Gibert Jones, Computers and Automation May 1969

44. Branching Out, Report of the Canadian Computer/Communications Task Force, Department of Communications, 171 Slater Street, Ottawa

45. Data Universal Numbering Systems, Dun and Bradstreet, Marketing Services Division, 99 Church Street, New York, New York 10007

46. A Guide for Developing Questionnaire Items, O. Jacobs, Human Resources Research Organization, Alexandria, Virginia, January 1970

47. The Role of the American National Standards Institute, ANSI, 1430 Broadway, New York, New York 10018

48. I Say ISO's So-So, Dec. 18 1973:
And I Say ISO's Super, Jan. 24, 1974
But You Say ISO's Unsound, Feb. 21, 1974:
Engineering, published by Canadian Technical Publications Ltd., P.O. Box 887, Station F, Toronto.

49. IBM Service for Consultants, IBM Canada Ltd.

50. Datapro 70, the EDP Buyer's Bible, Datapro Research Corporation, 1805 Underwood Boulevard, Delran, New Jersey 08075

51. Various issues of Telecommunications International published by Horizon House, 610 Washington Street, Dedham, Massachusetts 02026.
especially November 1973, September 1973 and May 1973

52. CBEMA Where the Action Is, Computer and Business Equipment Manufacturers Association, 1828 L Street N.W., Washington D.C. 20036

53. Display Terminals - Status and Standards C. Machover, Data and Communications, September-October 1973.

54. The Role of International Standardization in Telecommunication Network Development, W.T. Jones, Telecommunication Journal, Vol 40-lV 1973.

55. System/370 Reference Summary, form GX20-1850, International Business Machines Limited.

A P P E N D I X   A

COMPOSITION OF STUDY TEAM

This study was carried out by the following staff members of the consultant firm of DCF Systems Limited * :

B.E. Pitts	Project Leader
Dr. W.B. Foss	Senior Consultant

The study was monitored by the following members from the Communications Research Centre:

R.G. Fujaros	Project Officer
A.A. Mosher	Consultant - The Canada Systems Group Limited **

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APPENDIX B

METHODOLOGY AND RESPONSE

In conducting the study, information was drawn from users, user groups, terminal manufacturers, manufacturer associations, common carriers and standards associations. The information was obtained by questionnaire and personal interview. In addition, documents describing the organizations were obtained during the study.

Questionnaires were prepared and sent to terminal equipment users and manufacturers. The questionnaires were designed to obtain information about the use of current standards, the influence of standards and the need for new standards. They were sent to all known manufacturers of terminal equipment in Canada and the United States. User questionnaires were sent to a sample of Canadian organizations which were believed to use data terminal equipment.

Following the mailing of questionnaires, manufacturers and users were contacted by telephone and encouraged to respond. The aim of the study team was to obtain a twenty percent response to the user and manufacturer questionnaires. All known Canadian manufacturers were contacted by telephone to increase the percentage of Canadian responses.

Because of the relatively small number of carriers in Canada and in the United States, a representative sample was chosen by the study team for direct personal interviews. Representatives of the Canadian Telecommunications Carrier Association were also interviewed.

User groups and manufacturer associations were initially contacted by telephone to determine which groups were active in standards development. Later, personal interviews were scheduled with the larger and more active groups such as the Electronic Industries Association (EIA), the Computer and Business Equipment Manufacturers Association (CBEMA) and the

National Retail Merchants Association (NRMA).

Because of the importance of the standards associations, it was necessary to conduct personal interviews with association representatives. Accordingly, the Data Communications Committee chairman in the Canadian Standards Association (CSA) and the Information Systems Standards Coordinator of the American National Standards Institute (ANSI) were interviewed. In addition, interviews were conducted with personnel in the ADP Division of the National Bureau of Standards (NBS) in the United States.

In addition to the above data collection methods, public and business libraries were consulted to obtain information about current standards and information on new standards development.

Copies of standards and equipment descriptions were obtained wherever possible.

As of March 19, 1974, the results of the user questionnaire are:

188 questionnaires sent

63 responses (33.5%)

42 useful

21 did not have terminals or did not provide a meaningful response

1 interviewed.

As of March 19, 1974, the results of the manufacturer questionnaire are:

174 questionnaires sent

10 returned as undeliverable

52 responses (31% of potential)

34 useful

18 not useable

2 interviewed.

Included in the above are:

13 Canadian firms contacted by mail and telephone

3 Canadian firms either not manufacturing terminals, or unwilling to respond

6 responses received.

APPENDIX C
CATALOGUE OF STANDARDS

1. STRUCTURE

The structure of this catalogue corresponds to the structure of the body of the report. There are four major sections, and sub-sections as follows:

Operations Interface - Physical Design

- Input
  - Alphanumeric Keyboards
  - Function Keyboards
  - Light Pencil
  - Optical Character Recognition (OCR) Readers
  - Magnetic Ink Character Recognition (MICR) Readers
  - Credit Card or Badge Readers
- Output
  - CRT Displays
  - Printers
- Input/Output
  - Paper Tape
  - Magnetic Tape Cassettes
  - Magnetic Disks
  - Punched Cards
  - One-Half Inch Magnetic Tape

Operations Interface - Operator Protocols

Communication Line Interface - Physical Design

Communication Line Interface - Line Protocols

2. SOURCES OF STANDARDS

CSA Standards may be ordered from:

Canadian Standards Association
178 Rexdale Boulevard
Rexdale, Ontario

ANSI Standards may be ordered from:
American National Standards Institute
1430 Broadway
New York, New York 10018.

ISO Standards may be ordered from:
CSA or ANSI.

EIA Standards may be ordered from:
EIA of Canada
Commonwealth Building, Suite 809
77 Metcalfe Street
Ottawa.

CCITT Standards are contained in:
Fifth Plenary Assembly
Green Book Volume VIII
Data Transmission
International Telecommunications Union
Geneva.

Numbers in brackets beside the standards in the following list refer to Section 10, References.

3 OPERATIONS INTERFACE - PHYSICAL DESIGN

3.1 Alphanumeric Keyboards

CSA Z243.19	Bilingual Typewriter Keyboard Arrangement (under development, not available from CSA).
ISO R1091-1969	Layout of Printing and Function Keys on Typewriters.
ISO R1092-1969	Numeric Section of Ten-Key Keyboards for Adding Machines and Calculating Machines.
ISO R2257-1972	Widths of Fabric Printing Ribbons on Spools for Office Machines and Printing Machines Used for Information Processing.
ISO DR2530	Keyboard Using the ISO 7-Bit Coded Character Set - Alphanumeric Area.
ANSI X4.6-1966	10-Key Keyboard for Adding and Calculating Machines.
ANSI X4.7-1966	Typewriter Keyboards.
ANSI X4.14-1971	Alphanumeric Keyboard Arrangements Accommodating the Character Sets of American National Standard Code for Information Interchange and American National Standard Character Set for Optical Character Recognition.

'QWERTY' Keyboard Arrangement - see Figure 3 of this report.

Dvorak Simplified Keyboard. (18)

Baudot Keyboard. (15,16,17)

APL Keyboard. (7)

IBM 029 Keypunch Keyboard

Other Examples - (14, 17, 19, 37)

3.2 Function Keyboards

Examples - (14, 19, 35, 37)

3.3 Light Pencil

Example - (2)

3.4 Optical Character Recognition

CSA Z243.22	Style A Character Set for OCR (under development, not available from CSA).
CSA Z243.23	Paper Form Sizes for OCR (under development, not available from CSA).
ISO R1073-1969	Alphanumeric Character Sets for Optical Character Recognition.
ISO R1831-1971	Printing Specifications for Optical Character Recognition.
ISO R2033-1972	Coding of Character Sets MICR and OCR.
ANSI X3.17-1966	Character Set for Optical Character Recognition.

OCR-A, OCR-B, IBM 407, IBM 407E, IBM 1428, Farrington Self-chek (R), Farrington 7B, IBM 1287 - (23, 48).
Universal Product Code - (9).

3.5 Magnetic Ink Character Recognition

ISO R1004-1969	Print Specifications for Magnetic Ink Character Recognition.
ISO R2033-1972	Coding of Character Sets MICR and OCR.
ANSI X3.2-1970	Print Specifications for Magnetic Ink Character Recognition.
ANSI X3.3-1970	Bank Check Specifications for Magnetic Ink Character Recognition.

3.6 Credit Cards or Badges

CSA Z243.17	"Credit Card" Specifications and "Credit Card" Account Numbering System (under development, not available from CSA).
ANSI X4.13-1971	Specifications for Credit Cards

3.7 Printers

ISO DR2047	Graphical Representations for the Control Characters of the ISO 7-bit Coded Character Set.

APL Print Font - (7)

OCR Fonts - (22)

Paper Sizes, ISO Recommendations - (23,48)

Teletype requirements - (28)

3.8 Cathode Ray Tube (CRT) Displays

Examples - (14,19,20,25,35,37)

3.9 Paper

CSA	Z243.3-1970	Unpunched Paper Perforator Tape
CSA	Z243.8	Representation of 6- and 7-Bit Coded Character Sets on Punched Tape.
ISO	R1113-1969	Representation of 6- and 7-Bit Coded Character Sets on Punched Tape.
ISO	R1154-1969	Dimensions for Punched Paper Tape for Data Interchange.
ISO	R1729-1971	Properties of Unpunched Paper Tape for Information Processing.
ANSI	X3.6-1965	Perforated Tape Code for Information Interchange.
ANSI	X3.18-1967	One-Inch Perforated Paper Tape for Information Interchange.
ANSI	X3.19-1967	Eleven-Sixteenths Inch Perforated Paper Tape Information Interchange.
ANSI	X3.20-1967	Take-up Reels for One-Inch Perforated Tape for Information Interchange.
ANSI	X3.29-1971	Specifications for Properties of Unpunched Paper Perforator Tape.

5-level Baudot paper tape code - (15)

Other Paper Tape conventions (16,34)

3.10 Magnetic Tape Cassettes

Draft Standard - (24)

Examples - (17,25)

3.11 Magnetic Disks

3.12 Punched Cards

CSA Z243.14	Representation of 8-Bit Patterns on 12-Row Punched Cards (under development, not available from CSA).
ISO R1679-1970	Representation of ISO 7-Bit Coded Character Set on 12-Row Punched Cards.
ISO R1681-1970	Specifications for Unpunched Paper Cards.
ISO R1682-1971	Dimensions & Location of Rectangular Punched Holes in 80 Column Punched Paper Cards.
ISO R2021-1971	Representation of ISO 8-Bit Coded Character Set on 12-Row Punched Cards.
ANSI X3.11-1969	Specifications for General Purpose Paper Cards for Information Interchange.
ANSI X3.21-1967	Rectangular Holes in Twelve-Row Punched Cards.
ANSI X3.26-1970	Hollerith Punched Card Code

NCR Card Code

IBM 96-column card

Example - (25)

3.13 One-Half Inch Magnetic Tape

CSA Z243.5-1971	Implementation of the 7-Bit Coded Character Set on 9-Track 12.7 mm (1/2 inch) Magnetic Tape.
CSA Z243.7-1971	Magnetic Tape Labelling and File Structure for Information Interchange.

ISO R962-1969	Implementation of the 7-Bit Coded Character Set on 9-Track 12.7 mm (1/2 inch) Magnetic Tape
ISO R1001-1969	Magnetic Tape Labelling and File Structure for Information Interchange
ISO R1861-1971	7-Track 8 RPmm (200RPI) Magnetic Tape for Information Interchange
ISO R1862-1971	9-Track 8 RPmm (200RPI) Magnetic Tape for Information Interchange
ISO R1863-1971	9-Track 32 RPmm (800RPI) Magnetic Tape for Information Interchange
ISO R1864-1971	Unrecorded Magnetic Tape for Information Interchange - 8 and 32 RPmm (200 and 800RPI), NRZI and 63 RPmm (1600RPI), Phase-Encoded.
ANSI C83.43-1968	1/2 Inch (12.7mm) Magnetic Tape Reel for Computer Use (Requirements for Interchange)
ANSI X3.22-1967	Recorded Magnetic Tape for Information Interchange (800 CPI, NRZI).
ANSI X3.27-1969	Magnetic Tape Labels for Information Interchange.
EIA RS352-1968	One-half Inch (12.7mm) Magnetic Tape Reel for Computer Use (Requirements for Interchange)

Example - (25)

4 OPERATIONS INTERFACE - OPERATOR PROTOCOLS

CSA Z243.9	Identification of Individuals for Machine-to-Machine Information Interchange (under development, not available from CSA).
CSA Z243.20-1973	Writing of Calendar Dates in all Numeric Form.
ISO R2014-1971	Writing of Calendar Dates in all Numeric Form.
ISO R2015-1971	Numbering of Weeks
ANSI X3.30-1971	Representation for Calendar Date and Ordinal Date for Information Interchange.
ANSI X3.38-1972	Identification of States of the United States (including the District of Columbia) for Information Interchange.

Canadian Grocery Product Code Vendor Code List - (9)

Data Universal Numbers System - (45)

5 COMMUNICATIONS LINE INTERFACE - PHYSICAL DESIGN

CSA Z243.12	Functions, Pin Connections and Electrical Characteristics of Circuits at the Interface Between Data Terminal Equipment and Data Communication Equipment (under development, not available from CSA).
ISO R2110-1972	Assignment of Connector Pin Numbers.
ANSI X3.1-1969	Synchronous Signaling Rates for Data Transmission.
ANSI X3.24-1968	Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission.
EIA RS-232-C	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.
EIA RS-269-A	Synchronous Signaling Rates for Data Transmission.
EIA RS-334	Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission.
EIA RS-366	Interface Between Data Terminal Equipment and Automatic Calling Equipment for Data Communication.

CCITT V.1-1972	Equivalence Between Binary Notation Symbols and the Significant Conditions of a Two-Condition Code.
CCITT V.4-1968	General Structure of Signals of International Alphabet No. 5 Code.
CCITT V.10-1968	Use of the Telex Network for Data Transmission at the Modulation Rate of 50 Bauds.
CCITT V.11-1968	Automatic Calling and/Or Answering on the Telex Network.
CCITT V.15-1972	Use of Acoustic Coupling for Data Transmission.
CCITT V.21-1972	200-Baud Modem Standardized for Use in the General Switched Telephone Network.
CCITT V.22-1972	Standardization of Data-Signaling Rates for Synchronous Data Transmission in the General Switched Telephone Network.
CCITT V.23-1972	600/1200-Baud Modem Standardized for Use in the General Switched Telephone Network.
CCITT V.24-1972	List of Definitions for Interchange Circuits between Data Terminal Equipment and Data Circuit-Terminating Equipment.
CCITT V.25-1972	Automatic Calling And/Or Answering Equipment on the General Switched Telephone Network, Including Disabling of Echo Suppressors on Manually Established Calls.
CCITT V.26-1972	2400 Bits per Second Modem Standardized for Use on Four-Wire Leased Circuits.
CCITT V.27-1972	4800 Bits per Second Modem Standardized for Use on Leased Circuits.

CCITT V.35-1972 Data Transmission at 48 Kilobits per Second Using 60 to 108 kHz Group Band Circuits.

CCITT V.50-1968 Standard Limits for Transmission Quality of Data Transmission.

CCITT V.56-1972 Comparative Tests of Modems for Use over Telephone-Type Circuit.

CCITT V.57-1972 Comprehensive Data Test Set for High Data Signaling Rates.

CCITT X.1-1972 User Classes of Service for Public Data Networks.

CCITT X.2-1972 Recommended User Facilities Available in Public Data Networks.

CCITT X.20-1972 Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment for Start-Stop Services in User Classes 1 and 2 on Public Data Networks.

CCITT X.21-1972 Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment for Synchronous Operation on Public Data Networks.

EIA Preliminary - Electrical Characteristics of the Balanced Voltage Digital Interface Circuit - (5)

EIA Preliminary - Electrical Characteristics of the Unbalanced Voltage Digital Interface Circuit - (6)

Acoustic Couplers - (30)

Data Sets - (25,26)

Dataroute - (29)

6 COMMUNICATIONS LINE INTERFACE - LINE PROTOCOLS

CSA Z243.4-1973	7-Bit Coded Character Sets for Information Processing Interchange.
CSA Z243.6-1971	Guide for the Definition of 4-Bit Character Sets Derived from the ISO 7-Bit Coded Character Sets for Information Processing Interchange.
CSA Z243.10-1972	Use of Longitudinal Parity to Detect Errors in Information Messages.
CSA Z243.11-1972	Character Structure for Start/Stop and Synchronous Transmission.
CSA Z243.13-1972	Basic Mode Control Procedures for Data Communication Systems.
ISO R646-1967	6- and 7-Bit Coded Character Sets for Information Processing Interchange.
ISO R963-1969	Guide for the Definition of 4-Bit Character Sets Derived from the ISO 7-Bit Coded Character Sets for Information Processing Interchange.
ISO R1155-1969	Use of Longitudinal Parity to Detect Errors in Information Messages.
ISO R1177-1970	Character Structure for Start/Stop and Synchronous Transmission.
ISO R1745-1971	Basic Mode Control Procedures for Data Communication Systems.
ISO R2022	Code Extension Procedures for ISO 7-Bit Code.

ISO R2111-1972	Code Independent Transmission Procedures
ISO DR2375	Procedures for the Registration of Escape Sequences in Data Processing.
ANSI X3.4-1968	Code for Information Interchange.
ANSI X3.15-1966	Code for Information Interchange in Serial-by-Bit Data Transmission.
ANSI X3.16-1966	Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in the American National Standard Code for Information Interchange.
ANSI X3.25-1968	Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in the American National Standard Code for Information Interchange.
ANSI X3.28-1971	Procedures for the Use of the Communication Control Characters of American National Standard Code for Information Interchange in Specified Data Communications Links.
CCITT V.3-1972	International Alphabet No.5.
CCITT V.40-1968	Error Indication with Electromechanical Equipment.
CCITT V.41-1972	Code-Independent Error Control System

EBCDIC Code Structure - (31,41,55)

Transcode Code Structure - (31,41)

Baudot Code - (15,17)

BCD Code - (55)

CRC-12,CRC-16 Calculation - (31)

Binary Synchronous Communication - (31,32)

Teletypewriter Selective Calling Systems,
83B3, 85A, 86A, 86B - (33)

Public Data Network - (12, 38, 39)

Examples (19,37)

CRC DOCUMENT CONTROL DATA

1. ORIGINATOR: Department of Communications/Communications Research Centre

2. DOCUMENT NO: CRC Report No. 1275

3. DOCUMENT DATE: April 1975

4. DOCUMENT TITLE: Data Terminal Standards and Protocols

5. AUTHOR(s): by Staff of DCF Systems Limited
Edited by R.G. Fujaros

6. KEYWORDS: (1) Data Terminal
(2) Standards
(3) Protocols

7. SUBJECT CATEGORY (FIELD & GROUP: COSATI)

14		Methods and Equipment
14	06	Research

8. ABSTRACT: Available standards and protocols applicable to the design and use of interactive data communication terminals and associated equipment are identified, classified and catalogued with respect to the operator and communication line interfaces of the terminal. The utility and influence of, and adherence to, published and unpublished standards and protocols are assessed. Major influencing factors in their development and use and the current trends in their evolution are presented. Particular emphasis is placed on those standards and protocols available worldwide which are likely to have most impact within Canada.*

* *Study conducted from November, 1973 to February, 1974.*

SOMMAIRE: Les normes et les règles d'exploitation disponibles qui s'appliquent à la conception et à l'utilisation des terminaux interactifs de transmission de données et du matériel connexe sont recensées, classées et cataloguées par rapport à l'opérateur et aux interfaces des lignes de communication du terminal. L'utilité, l'influence et le respect des normes et des règles d'exploitation publiées ou non sont évalués. On présente les principaux facteurs qui influencent leur développement et leur utilisation et la tendance actuelle de leur évolution. On met l'accent, en particulier, sur les normes et les règles d'exploitation qui existent à travers le monde et qui auront vraisemblablement le plus d'influence au Canada.*

* *Étude effectuée de novembre 1973 à février 1974.*

9. CITATION:

Government of Canada Gouvernement du Canada