Copy No. _____

Defence Research and Development Canada
Recherche et développement pour la défense Canada

DEFENCE R&D DÉFENSE

Investigation of GeoNetwork Opensource

Marie-Odette St-Hilaire
Yannick Allard
OODA Technologies Inc.

Prepared by:
OODA Technologies Inc.
4891 Av. Grosvenor
Montreal, QC H3W 2M2

Project Manager: Anthony W. Isenor
Contract Number: Call-up 4, No. 4500862723 to W7707-115137
Contract Scientific Authority: Anthony W. Isenor and Andrew MacInnis

Defence R&D Canada – Atlantic

Contract Report
DRDC Atlantic CR 2012-020
May 2012

Canada

This page intentionally left blank.

Investigation of GeoNetwork Opensource

Marie-Odette St-Hilaire
Yannick Allard

Prepared by:

OODA Technologies Inc.
4891 Av. Grosvenor, Montreal Qc, H3W 2M2

Project Manager: Anthony W. Isenor
Contract Number: Call-up 4, No. 4500862723 to W7707-115137
Contract Scientific Authority: Anthony W. Isenor and Andrew MacInnis

Defence R&D Canada – Atlantic
Contract Report
DRDC Atlantic CR 2012-020
May 2012

Principal Author

Original signed by Marie-Odette St-Hilaire

Marie-Odette St-Hilaire

Approved by

Original signed by Francine Desharnais

Francine Desharnais
Head, Maritime Information and Combat Systems Section

Approved for release by

Original signed by Leon Cheng

Leon Cheng
Chair, Document Review and Library Committee

Abstract

This work investigates the feasibility of using the open source GeoNetwork application for information product management and access within TRINITY. GeoNetwork offers a management mechanism for the information products. It allows users to place and/or search all uploaded or linked products that are managed by the application. GeoNetwork supports spatial-temporal-keyword searching through the analysis of metadata associated with the spacial information product. This metadata follows international standards, and in some cases these standards have been used in the past by some TRINITY producers (e.g., Meteorology and Oceanography Office, MetOc). In general, information products produced on a regular interval (e.g., RMP) for a defined region are well suited to automated metadata creation, and thereby well suited to GeoNetwork.

Résumé

Ces travaux portent sur la faisabilité d'utiliser l'application ouverte GeoNetwork pour gérer les produits d'information et l'accès au centre TRINITY. GeoNetwork offre un mécanisme de gestion pour les produits d'information. Il permet aux utilisateurs de mettre en place et/ou de chercher tous les produits téléversés ou faisant l'objet d'un lien qui sont gérés par l'application. Grâce à GeoNetwork, on peut faire des recherches spatiales-temporelles-par mots clés par l'analyse des métadonnées associées au produit d'information spatiale. Ces métadonnées respectent les normes internationales et, dans certains cas, ces normes ont déjà été utilisées par différents producteurs TRINITY (p. ex. le Bureau de la météorologie et de l'océanographie [Mét Oc]). De façon générale, les produits d'information créés périodiquement (p. ex. RMP) pour une région définie conviennent bien à la création automatisée de métadonnées et, par conséquent, ils conviennent bien à GeoNetwork.

This page intentionally left blank.

Executive summary

Investigation of GeoNetwork Opensource

Marie-Odette St-Hilaire, Yannick Allard; DRDC Atlantic CR 2012-020; Defence R&D Canada – Atlantic; May 2012.

Background: Information management personnel, represented by MARLANT N6, are presently exploring the distribution of spatial data and information products relevant to the Recognized Maritime Picture (RMP). Currently, the primary means of geospatial product distribution from centres, such as the Regional Joint Operations Centre (RJOC), is via a web-based interface to a file repository existing on the Canadian Maritime Network (CANMARNET). However, there exists no formal management mechanism for spatial information products utilized by such centres.

DRDC Atlantic's Maritime Information and Combat Systems Section was requested by Canadian Forces Intelligence staff to investigate the capabilities and applicability of GeoNetwork for use in managing geospatial information products. The investigation was a contracted effort with OODA Technologies Inc, using DRDC Agility Funds, and managed under the Applied Research project 11HO titled *Situational Information for Enabling Development of Northern Awareness* (SEDNA).

Results: This investigation has shown that GeoNetwork is a viable geospatial product management system for DND TRINITY. GeoNetwork provides product storage and advertisement, allowing for user discovery of the product. This discovery is accomplished through the use of metadata that describes the product to varying levels of detail. The metadata descriptions are based on international standards, mandated by Canadian Treasury Board for government departments by 2014. As such, GeoNetwork can be viewed as part of a strategy for TRINITY to meet current Treasury Board requirements.

Significance: Awareness is built based on the information provided to the decision maker. Providing geospatial information products via a system that allows user discovery, empowers the user to identify products relevant to their particular needs. This not only reduces the time required to locate the product, but also to form the awareness in the mind of the decision maker. As well, user-directed access alleviates the product producer in spending time to address repeated queries on popular products.

Future Plans: GeoNetwork is being installed by MARLANT N6 in two locations: 1) the Integrated Testing Environment (ITE) for TRINITY, available only in building D201, and 2) on the Canadian Maritime Network (CANMARNET), available for use by other government departments. The ITE is an area for software evaluation in an operational context. The CANMARNET installation provides the service to DND partners.

Sommaire

Investigation of GeoNetwork Opensource

Marie-Odette St-Hilaire, Yannick Allard ; DRDC Atlantic CR 2012-020 ; R & D pour la défense Canada – Atlantique ; mai 2012.

Contexte : Le personnel de la gestion de l'information, représenté par FMAR(A) N6, explorent actuellement la distribution de données spatiales et de produits d'information pertinents pour la Situation maritime générale (RMP). Actuellement, la distribution des produits géospatiaux à partir de centres, comme le Centre régional des opérations interarmées (CROI), se fait principalement à l'aide d'une interface Web avec un dépôt de fichiers qui existe dans le Réseau maritime canadien (CANMARNET). Cependant, il n'existe aucun mécanisme formel de gestion pour les produits d'information spatiale qu'utilisent de tels centres.

Le personnel du Renseignement des Forces canadiennes a demandé à la Section de l'information maritime et des systèmes de combat de RDDC Atlantique d'étudier les capacités et l'applicabilité de GeoNetwork en vue de son utilisation pour la gestion de produits d'information géospatiale. L'étude a été menée dans le cadre d'un contrat conclu avec OODA Technologies Inc, financé par le fonds de gestion agile de RDDC, et géré dans le cadre du projet de recherche appliquée 11HO intitulé Situational Information for Enabling Development of Northern Awareness (SEDNA) [informations sur la situation pour permettre le développement des connaissances dans le Nord].

Resultats : Cette étude a démontré que GeoNetwork est un système viable de gestion de produits géospatiaux pour le centre TRINITY du MDN. GeoNetwork permet le stockage et l'annonce de produits, ce qui permet à l'utilisateur de découvrir les produits. Cette découverte se fait grâce à l'utilisation de métadonnées qui décrivent les produits à divers degrés de précision. Les descriptions des métadonnées sont fondées sur des normes internationales, imposées d'ici 2014 pour les ministères par le Conseil du Trésor canadien. À ce titre, on peut considérer que GeoNetwork fait partie d'une stratégie permettant au centre TRINITY de répondre aux exigences actuelles du Conseil du Trésor.

Importance : La connaissance de la situation se fonde sur les renseignements fournis au décideur. La fourniture de produits d'information géospatiale à l'aide d'un système qui permet la découverte de données par les utilisateurs habilite ces derniers à identifier les produits qui sont pertinents pour leurs besoins particuliers. Cela réduit le temps nécessaire pour trouver un produit et pour faire connaître la situation au décideur. De plus, l'accès dirigé par l'utilisateur allège la charge de travail des créateurs de produits qui devraient autrement répondre à des demandes répétées sur les produits populaires.

Perspectives : FMAR(A) N6 installe GeoNetwork à deux endroits : 1) l'environnement d'essai intégré (ITE) du centre TRINITY, accessible seulement dans l'immeuble D201, et 2) dans le Réseau maritime canadien (CANMARNET), que d'autres ministères peuvent utiliser. L'ITE est une zone d'évaluation de logiciels dans un contexte opérationnel. L'installation du CANMARNET permet de fournir des services aux partenaires du MDN.

This page intentionally left blank.

Table of contents

List of figures

List of tables

This page intentionally left blank.

1 Scope

1.1 Background

Information management staff as represented through N6[1] are presently exploring the distribution of geospatial data and information products[2], such as the Recognized Maritime Picture (RMP). As part of this exploration, N6 personnel wished to identify information asset management capabilities of the GeoNetwork application. N6 approached DRDC Atlantic Maritime Information and Knowledge Management (MIKM) group and, given MIKM's previous knowledge of GeoNetwork, an assessment of GeoNetwork was initiated. MIKM leveraged the DRDC Agility Fund to conduct this capability assessment.

1.2 Present situation

The primary means of product distribution from the Regional Joint Operations Center (RJOC) is via a web-based interface to a file repository existing on Canadian Maritime Network (CANMARNET). CANMARNET is the primary information access and sharing mechanism for the five security-related government departments.

The web interface built on CANMARNET is also the interface to the unclassified version of the Global Position Warehouse (GPW). Version 3 of this interface is now being developed by N6 at MARLANT. This upgrade allows the upload of Situational Awareness (SA) relevant information products by producers at TRINITY or by the Other Government Department (OGD) security partners.

The functionality offered by the upload site is somewhat limited. In simplistic terms, the upload site is equivalent to a File Transfer Protocol (FTP) site. This site offers functionality for computer file placement to the site, and file retrieval from the site. The site offers no management of the information products. Here, the term *management* refers to capabilities that help organize and provide access to the products. Functionality encompassed under the term *management* would be the ability to discover information products by searching; identifying quality characteristics of the product; identifying authorities for the product; etc.

GeoNetwork opensource[3] offers a solution to the management of the information products. GeoNetwork allows users to place and/or search all uploaded or linked products that are managed by the application. GeoNetwork supports spatial-temporal-keyword searching through the analysis of metadata associated with the SA product. This metadata follows international standards, and in some cases these standards have been used in the past by

[1] General staff system Navy 6 for Communications and Information management

[2] The term *product* will be used to refer to data, data sets, graphical output, or any information resource that has a relationship to a spatial position.

[3] *GeoNetwork opensource* is referred as *GeoNetwork* in this document.

some TRINITY producers (e.g., Meteorological and Oceanographic Office (MetOc)) in the product creation process.

1.3 Present study

This work investigates the feasibility of using GeoNetwork for information product management and access within TRINITY. GeoNetwork provides producers with the ability to upload or link their SA products to the GeoNetwork architecture. This in turn provides users (i.e., consumers) of GeoNetwork with spatial-temporal-keyword search capabilities to find the information products relevant to their particular activity.

This document summarizes all the technical activities and achievements of this investigation. It includes:

- Conceptual presentation of GeoNetwork (section 2);
- Description of the capabilities to search and analyze product information (section 3);
- Description of the metadata standards supported by GeoNetwork and the capabilities to create metadata (section 4);
- GeoNetwork capability to serve data (section 5);
- Metadata harvesting capabilities of GeoNetwork (section 6);
- Administration requirements such as installation, maintenance, security and networking limitations, and group and user account management (section 7);
- Example of GeoNetwork uses and suggestions on its use within TRINITY (section 8);
- Concluding remarks about the feasibility of using GeoNetwork for information product management and access within TRINITY (section 9).

Sections 2 to 7 cover GeoNetwork capabilities from the perspective of GeoNetwork characteristics/capabilities that may be pertinent to TRINITY. These sections are not intended to replace user guide to GeoNetwork. For the complete GeoNetwork user manual refer to [3].

2 High Level Description

GeoNetwork is a standards-based, open-source, decentralized, spatially referenced, resource management system. Using descriptive metadata [3], GeoNetwork is designed to enable access to geo-referenced databases and cartographic products from a variety of data providers.

The rapid development of spatial data sources has been observed within many organizations. Utilizing the web to provide these products to consumers has resulted in a large heterogeneous and decentralized environment. The goal of GeoNetwork is to manage these geospatial products for an organization. Proper management will enhance the spatial information exchange and sharing between organizations (or units within a single organization) and their consumers.

2.1 Decentralized Spatial Information Management

Information management within the GeoNetwork follows the common model of company, customer, and advertiser. As an example, a company (i.e., the product provider) places an advertisement in the Yellow Pages. A customer (i.e., the consumer of the product) examines the Yellow Pages based on a requirement they have for a product. When the consumer identifies that a particular company is likely able to meet the requirement, the consumer contacts the company to obtain more information and potentially obtain the product.

GeoNetwork follows a similar service oriented view. Figure 1 (adapted from [1]) illustrates a service oriented view applicable to the spatial information exchange and sharing within GeoNetwork. Note that the same view may be constructed using the company, customer, and advertiser model described above.

In Figure 1, the circles represent the diverse services involved in the information exchange. The arrows are the relations between these services. The cataloguing service (i.e., equivalent to the Yellow Pages) is used by consumers to find products that match certain criteria. The cataloguing service has the role of providing descriptions of the spatial product. These descriptions are realized via metadata that is structured according to open standards. If the consumer finds a product matching their search criteria, the service provides the consumer with the necessary information to acquire the products from the producer. In the case of GeoNetwork the *necessary information* could consist of things like a web service endpoint, a specific web site Uniform Resource Locator (URL), a specific FTP site, organization information, a contact name, etc.

An alternate scenario has GeoNetwork storing the product locally. In this scenario, the consumer can obtain the product directly from the GeoNetwork instantiation.

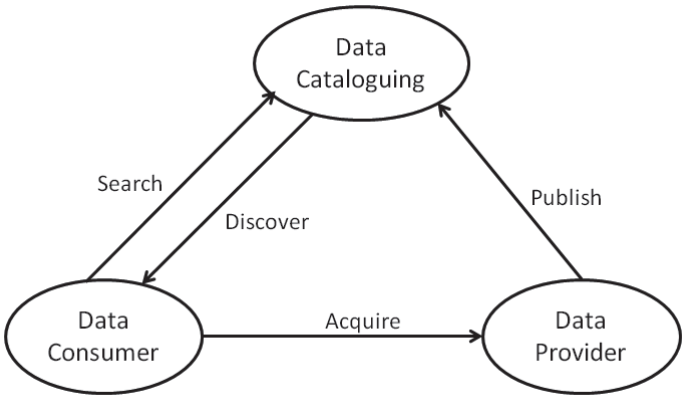

Figure 1: *A service view of the spatial information exchange and sharing between organizations and their audience. In this context, an organization could be a functional group of people, a department, a corporation, etc. (adapted from [1])*

The GeoNetwork application facilitates the exchange of information shown in Figure 1 by providing:

- Metadata cataloguing and editing (described in section 4). In terms of the Yellow Pages model, this functionality allows the provider to place and edit an advertisement to their product on GeoNetwork.;
- Advanced search discovery tool (section 3). This allows consumers to use search keywords, time-based search criteria, or spatial search criteria to locate products.;
- Access to data provider products through an interactive map viewer, download capability and online resources linking (e.g., web service, URL, FTP) (section 5). This allows consumers to view and acquire the product.;
- Scheduled harvesting and synchronization of metadata between distributed catalogues (see in section 6). This pertains to the addition of products to GeoNetwork. Acquiring these products may be automated.;
- Group and user management (section 7). This functionality address access to GeoNetwork.

It should also be made clear as to what GeoNetwork is NOT. GeoNetwork is not a:

- Geo-referenced database. GeoNetwork does not contain raw data from measurements georeferenced on the Earth. ;
- Data and map server. GeoNetwork does not serve observations or measurements from a dynamic database, in a manner like a map server.

2.2 Standards Based

The construction of GeoNetwork is based on open standards. This means GeoNetwork offers services and protocols based on these open standards and specifications. Three levels of GeoNetwork support are related to these standards and specifications:

1. Metadata: International Organization for Standardization (ISO) 19115 as realized through ISO 19139, Federal Geographic Data Committee (FGDC) standard and the Dublin Core standard;

2. Catalogue interface specifications: Catalog Service for the Web (CSW) 2.0.2 Open Geospatial Consortium (OGC) standard, Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) client and server specifications, GeoRSS server standards (for encoding location as part of a web feed), GEO OpenSearch server specifications (for the sharing of search geospatial results, based on GeoRSS standards), Web-based Distributed Authoring and Versioning (WebDAV) web protocol-based harvesting, GeoNetwork to GeoNetwork harvesting support and others.

3. Map service interface specifications: OGC standards such as Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and Keyhole Markup Language (KML) through the embedded GeoServer map server.

Metadata standards are described in section 4, map service interfaces are related to products access and are introduced in section 5 while catalogue interfaces are introduced in the context of harvesting in section 6.

2.3 Open Source

GeoNetwork is an opensource application released under the GNU General Public License (GPL) version 2. This license allows the source code to be available, to be modified, and re-distributed (under GPL terms and conditions). As a result of the GPL, several custom versions of GeoNetwork have been developed, some of which are also currently available under GPL.

There are many reasons one may wish to customize GeoNetwork. These include developing an ability:

- to support extensions of the already supported metadata standards. These extensions, known as *profiles* [4], modify the open standard to address the needs of a specific user community. An example is the Marine Community Profile (MCP) [2], which is an extension of the ISO 19115 metadata standard titled *Geographic information - Metadata*;

- to be integrated into a complete Spatial Data Infrastructure (SDI);

- to satisfy the needs of a specific user community (e.g., user interface modifications to include elements specific to a given geographical area).

The customization of GeoNetwork has been conducted by numerous organizations. One customization particularly relevant to this work is the Australia New Zealand Metadata Entry and Search Tool customization (ANZ-MEST[4]).

2.3.1 ANZ-MEST Software

The ANZ-MEST application is a recent and well supported customized version of GeoNetwork. ANZ-MEST provides embedded support for the MCP. Information about the development and the user community can be found in the ANZ-MEST TRAC site [5].

The development of ANZ-MEST was originally referred as BlueNetMEST (i.e., pre 2011) and was funded by the Australian government. The latest ANZ-MEST version is based on GeoNetwork version 2.4 and includes features from GeoNetwork 2.6 and 2.7 (i.e., the latest GeoNetwork versions). ANZ-MEST also has a slightly different user interface offering features specific to the needs of the Australia and New Zealand (ANZ) users.

The interest in ANZ-MEST for this investigation is a result of its support to the MCP. N6 expressed an interest in providing products and metadata in forms consistent with other Canadian users. Department of Fisheries and Oceans (DFO) has considerable experience with similar geospatial products and metadata, and have developed considerable expertise in the MCP. As a result, a GeoNetwork implementation that supports the upload and editing of metadata based on the MCP is considered a worthwhile functionality.

Two GeoNetwork versions have been used during this investigation: the basic[5] and ANZ-MEST. In both cases, the latest version was installed (see section 7.1 for installation details). The functionalities described in this document are common to both versions. However, when there is a difference between the two versions, in particular in the user interface, the text will note the difference. The user interface description and screen captures are all from the ANZ-MEST version. It is also worth mentioning that the look and feel of the ANZ-MEST is far more attractive as compared to the basic version.

[4]Available for download at `http://bluenetdev.its.utas.edu.au/download/bluenetmest.html`.

[5]*Basic version*, as opposed to customized versions like ANZ-MEST, refers in this document to the GeoNetwork latest original version. When *GeoNetwork* is used without any mention to the version, then the text refers to functionalities common to both versions.

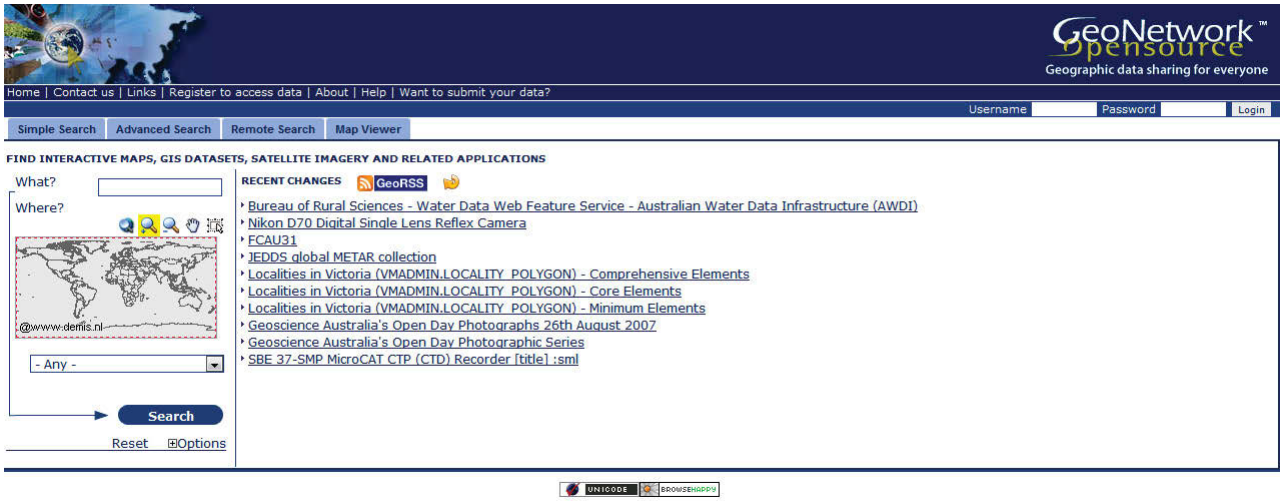

Figure 2: *The open-source Geonetwork software at the ANZ-MEST home page http://imosmest.aodn.org.au/geonetwork/srv/en/main.home*

3 Searching and Discovering

GeoNetwork facilitates the consumer search and discovery process for spatial products. The search and discover aspects of the spatial information exchange and sharing loop are illustrated by the dashed arrows in Figure 3. This section presents the GeoNetwork capabilities in terms of searching and analyzing product information.

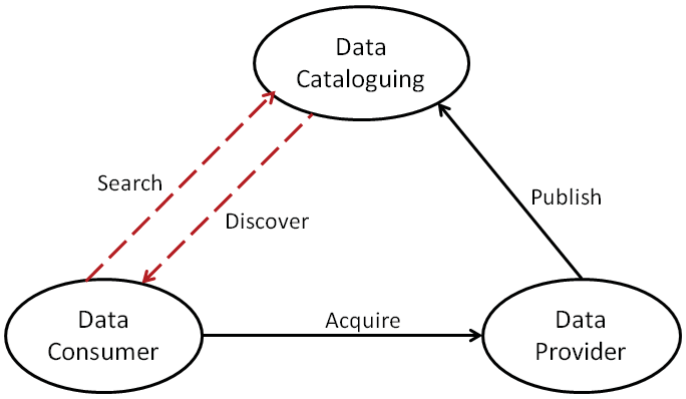

Figure 3: *A service view of the spatial information exchange and sharing between organizations and their audience. This section will focus on the GeoNetwork search and discover capabilities (adapted from [1]).*

3.1 Searching

GeoNetwork allows the consumer to use a web browser[6] to search the metadata that describes the geospatial products. There are two main interfaces to the search capability: the default, and advanced search. Both the default and advanced search interfaces are divided into two parts:

What? for the text search, and;

Where? for the geographical search.

There is a third section available in the advanced search:

When? for the temporal search.

[6]The web browsers currently supported by GeoNetwork are Internet Explorer v6+ (Windows), Firefox v1.5+ (All), Safari v3+ (Mac OS X Leopard). Note that Google Chrome was used for this investigation without any noticeable problem.

Each part contains a list of fields that define the search criteria. All search fields, across all parts, are logically related with a *AND* operator. The default search is a subset of the advanced search, meaning that the advanced search allows more specific search criteria. With ANZ-MEST the default search interface is named *Simple Search*.

There is also a search capability interface named: *Remote Search*. The ANZ-MEST remote search allows the user to search through a pre-defined set of ANZ remote nodes, using the criteria set in *What?* and *Where?* search interfaces.

Figure 4 is a screen capture of the *Advanced Search* interface of the ANZ-MEST version. The sections that follow provide an overview of the advanced search capabilities. This describes the searching functionalities, but does not provide detailed instructions about how to use each functionality. For the detailed instructions, refer to the official GeoNetwork user manual [3].

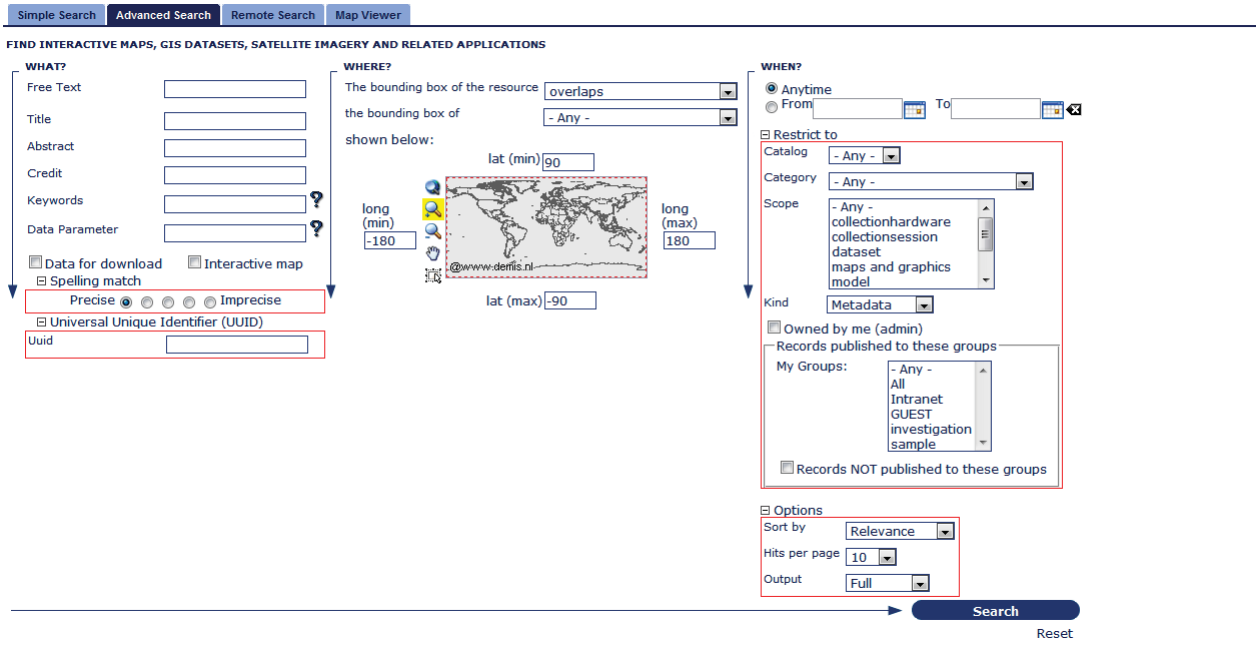

Figure 4: *ANZ-MEST Advanced Search interface.*

3.1.1 Text Search

Text search is based on the Apache Lucene search engine [6]. Within GeoNetwork the product metadata is stored within eXtensible Markup Language (XML) trees. Since multiple information standards are supported, different XML trees exist. In this case, a mechanism is needed to search across the different XML metadata trees (i.e., the standards and their extensions). This is done by mapping metadata elements to a common set of indexed

Lucene fields. For example, `gmd:abstract` to `abstract` [7]. This internal abstraction by GeoNetwork allows seamless searches across all support metadata standards.

In the free text area (see left panel of Figure 4), quotes around text are used to find exact combinations of words and operators *AND*, *OR* and *NOT* are accepted. Moreover, text search is not case sensitive. The use of the wild cards * and ? is also allowed. Keyword searches, however, only perform an exact match. It is also possible to set the level of spelling match accuracy, from precise to imprecise.

3.1.2 Geographical Search

The position search (see middle panel of Figure 4) allows the user to define a geographic extent, and base the search on this extent. Extent query parameters may be predefined regions, free coordinates (i.e., a range of latitude/longitude), or be based on a map selection tool. Once a bounding box is selected, with whatever type of geographic search, it is possible to set the search type based on the options: *is*, *overlaps*, *encloses*, *is fully outside of*. Note that with the ANZ-MEST version the *lat(min)* is along the top of the box, while *lat(max)* is at the bottom of the box. This apparent switch in labels does not impact search capabilities (i.e., remember, it was developed by countries in the southern hemisphere) and can be modified by a javascript/HTML developer.

3.1.3 Temporal Search

The temporal search (see right panel of Figure 4) allows the user to query the catalogues in terms of product creation or metadata publication date.

The temporal search section also includes a filter named *Restrict to*. This filter allows the user to restrict the search results to a data category, catalogue, and/or a user group. The possible data categories are applications, audio/video, case studies, proceedings, datasets, interactive resources, maps, photos, directories and others.

3.2 Discovering

After the search criteria are established, and the search is executed, the results of the search are displayed to the user. The results are provided as descriptions of those products matching the search criteria. The results appear on the bottom part of the display (or right side for the basic version).

For each description, a set of options, rendered by buttons, are available at the bottom of the description. These available buttons are dependent on the user and metadata privileges (see section 7.3 for more details on metadata privileges). The metadata option is always

available. The metadata is accessible by clicking on the name of the product for ANZ-MEST and by clicking the *Metadata* button at the bottom left of the description panel for the basic version.

Information about how to acquire the product will hopefully be part of the valid metadata, whether it is served by GeoNetwork or not. This information allows the consumer to acquire the product from the provider or directly from GeoNetwork (the acquiring relation is displayed at bottom part of Figure 3).

In the case when the product is acquired from GeoNetwork extra buttons will appear under the product's name (again depending on the user privilege):

Download allows the user to download the product;

Interactive Map allows the user to visualize and interact with the related WMS online resource (see section 5.1 for details about WMS) within GeoNetwork *Map Viewer*;

Google Earth allows the user to download the KML format of the data to visualize and interact with the data within Google Earth (GE) display.

The GeoNetwork *Map Viewer* allows the user to load and merge the map with other WMS maps, or download the map as a PDF file, among others options.

In the case GeoNetwork does not serve the product, the valid metadata should provide the information on how to acquire the product. This information is in the *Metadata* section of the product's metadata in *Contact*.

It is possible to use the selected search results from the interface to create a PDF file, export as ZIP, or as a TXT file. This is done by selecting the descriptions (via the check box next to the title) and clicking on the *actions on selection* button. Note that the ZIP and TXT export options are not available with ANZ-MEST (only PDF).

4 Cataloguing

GeoNetwork eases and standardises the process of publishing and managing decentralised spatial data descriptions. This publishing aspect of the spatial information exchange and sharing loop is illustrated by the dashed arrow in Figure 5. This section presents the GeoNetwork capabilities in terms of creating and publishing metadata to describe geographic information.

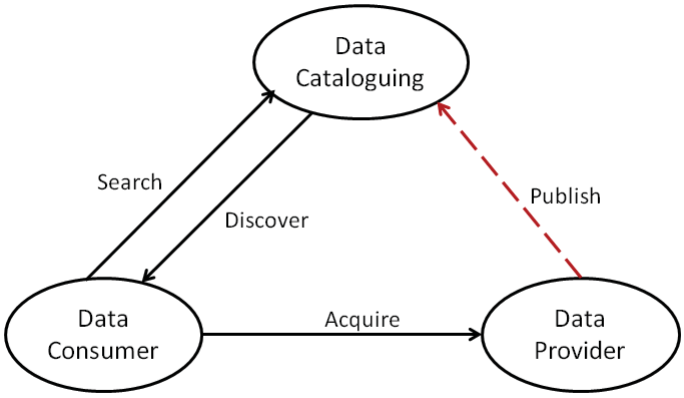

Figure 5: *A service view of the spatial information exchange and sharing between organizations and their audience. This section will focus on the GeoNetwork metadata publishing capability (adapted from [1]).*

4.1 Geographic Information Metadata Standards

The entry of metadata, when the metadata is based on standards, ensures information consistency and quality, and helps avoid loss of knowledge important to describing the product [3].

The metadata standards supported by the basic GeoNetwork are:

ISO 19115:2003 Approved by the international community in April 2003 as a tool to define metadata in the field of geographic information [8];

FGDC The metadata standard adopted in the United States (US) by the Federal Geographic Data Committee [9];

Dublin Core The metadata standard used for the description of general documents [10].

One possible format of an ISO19115:2003 compliant metadata file is XML. GeoNetwork uses the *ISO Technical Specification 19139 Geographic information - Metadata - XML*

schema implementation [11] for the encoding of the ISO metadata in XML. The FGDC version used is FGDC-STD-001-1998.

The ANZ-MEST software also supports the MCP extension of the ISO 19115 standard.

4.1.1 Metadata Standards Across North American Governmental Agencies

Within the Canadian government, the ISO 19115 standard took effect on June 2009. As stated by the Canadian Treasury Board, Canadian government departments have until May 31, 2014 to fully implement ISO 19115 for their geospatial data. Compliance requires that core and extended metadata related to existing in-use and new geospatial data and applications be in conformance to ISO 19115. Conditions applying to the implementation of ISO 19115 and details on that policy can be found in [12].

The ISO 19115 is also used by the US Department of Defense (DoD) [13]. Moreover, the National Geospatial-Intelligence Agency (NGA) has taken the lead within the DoD to develop an extension of the standard to include support for imagery, gridded data and other remotely sensed data such as monitoring stations (*ISO 19115-2 Geographic Information - Metadata - Part 2: Extensions for Imagery and Gridded Data* [14]). These standards are being widely adopted and implemented within the Geospatial Intelligence commercial and user communities, and NGA's long term strategy is to adopt and use these standards.

GeoNetwork does not support the imagery extension of ISO 19115. However, as will be explained in the next section, it is possible to modify GeoNetwork to support extensions of already supported standards. For instance, the National Oceanic and Atmospheric Administration (NOAA)'s National Geophysical Data Center has added support for ISO 19115-2 schema in their local GeoNetwork version [15].

The NASA is currently engaged in analyzing their current data models and is interested in making these models compliant with the ISO 19115 and ISO 19115-2 standards [16]. The NASA is developing a comprehensive plan/roadmap for ISO 19115 adoption by the Earth Observing System Data and Information System's (EOSDIS). This will include future and legacy metadata repositories and the development of the core fields for a NASA-specific convention dealing with the use of ISO 19115.

Finally, even though several US agencies are adopting ISO 19115, the FGDC-STD-001-1998 is the current official US federal metadata standard [9].

4.1.2 Metadata Profiles and Extensions

For this description, we must first understand the difference between profiles and extensions (see [17]).

Extensions are a set of added elements that extend the standard by adding elements to contain a particular metadata description.

Profiles are custom adaptations of the standard. Profiles can include restricting the types of elements, and introducing or relaxing conditions based on content. Profiles may specify specific domain values for existing metadata elements and/or increase conditions placed on a specific element. Profiles may also include extensions.

The MCP, introduced in section 2, is an example of a profile. MCP includes extensions to ISO 19115 to include new elements and customized codelists to meet the needs of the marine community.

Figure 6 (from [2]) illustrates the relationship between the standard, profiles, and extensions. The standard, represented by the comprehensive metadata profile defines almost 300 metadata elements. The standard includes a set of core metadata components that must exist (i.e., are mandatory) in any profile of the standard. The MCP developed from the standard is also shown. The MCP contains the core components and other components from the standard. The MCP also contains extensions as represented by the shaded region outside of the comprehensive profile.

GeoNetwork supports multiple metadata profiles. Profiles can take the form of Templates that can be created using the metadata editor (see section 4.2.1 above). It is also possible for an experienced XML/XSL developer to modify GeoNetwork to support extensions. The instructions to add a profile of ISO 19115 to GeoNetwork can be found in Pigot's presentation [18]. The ANZ-MEST includes such customization.

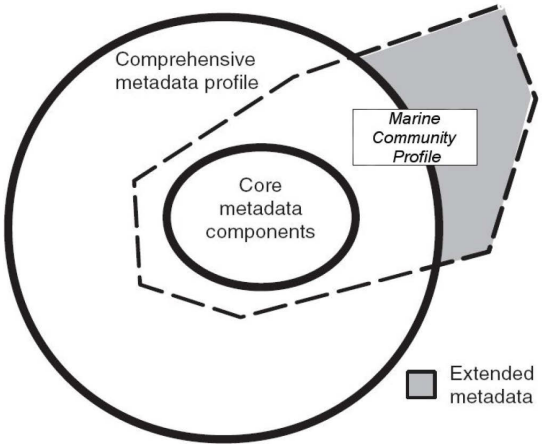

Figure 6: *Metadata Marine Comunity Profile [2] in relation with the comprehensive and core ISO 19115 standard.*

4.2 Publishing Metadata

This section describes the process of adding new metadata records to GeoNetwork. To add or edit records, the user must be logged in as *Editor* or *Administrator* (see section 7.3 for details about the user profiles). Creation of new reports are done using either the online metadata editor (described in 4.2.1) or one of the two metadata insert tools (4.2.2 and 4.2.3).

In all cases, the steps to create new records are:

1. Use the template system to enter the metadata;
2. Validate metadata (optional);
3. Add a thumbnail (optional);
4. Upload product and/or link to services (see section 5);
5. Assign privileges;
6. Assign categories.

The following text focuses on points 1 (from 4.2.1 to 4.2.3), 2 (see 4.2.4) and 5 (in 4.2.5). The addition of a thumbnail and category selection are simple and are described in detail in the user manual [3].

The methodology to create valid metadata is outside the scope of this investigation.

4.2.1 Online Metadata Editor

The online metadata editor is realized as a form in a browser window. This form is available by clicking on the *New Metadata* link in the top section of the main page, or within the *Administration* panel for the basic version (see Figure 9 for a screen capture of the *Administration* interface).

Next, the user must select the metadata template. The template indicates the standard (e.g., MCP, FGDC, Dublin Core, etc.) that the metadata entry will follow. The user must also select the group of users who will own the record. Moreover, clicking on the *Edit* button within the product display brings the user to the same metadata editor.

Once the record is created, the metadata editor allows the user to switch from the default view to the XML view. The default view divides the information into sections and allows the user to navigate between these sections. Fields are either free text fields or dropdown lists. Note that any editor element, such as a dropdown list, can be modified by a Javascript/HTML developer. The *Geographic bounding box* for ANZ-MEST is an example of where such customization would be applicable, as this presently offers a selection of predefined ANZ geographical areas. These could be changed to Canadian-specific regions.

4.2.2 XML Metadata Insert

In the case where providers are already using a metadata editor, such as jMetaWriter 2[7] for instance, the online metadata editor becomes a time consuming extra step. In that case, the *XML Metadata Insert* tool is a better option to add records to GeoNetwork. The tool is accessed from the *Administration* interface.

The user can either select the file (XML or Metadata Exchange Format (MEF)) containing the XML encoding of the metadata, or directly paste the XML. The selected metadata should be in one of the standards supported by the GeoNetwork version used. It is also possible to apply a stylesheet to convert the metadata input from one form to another (e.g., from OGCSLD to ISO 19139). The user group and the data category can also be selected from that interface.

4.2.3 Batch Import

The *Batch Import* is similar to multiple applications of the *XML Metadata Insert*. The *Batch Import* allows a set of metadata records to be imported at one time. Instead of providing the name of the file containing the metadata to insert, as with the *XML Metadata Insert* tool, the user provides the path of the directory that contains all the metadata files to be uploaded. It is important to note that *this is the directory on the server machine* and not a directory on the client (i.e., not on the user machine who is doing the import). The same file formats as for the *XML Metadata Insert* are accepted.

This *Batch Import* functionality is available only to the *Administator* user profile.

It is possible to specify parameters in order to get a structured import. This feature is triggered when the specified folder contains the `import-config.xml` file. When this happen, this file is read by the importer. Instructions in this file alter the standard set of import switches to those settings found in the config file. Details about this file configuration can be found in [3].

4.2.4 Metadata Validation

It is possible to validate metadata records for the three approaches described above. With the online editor, validation is started by clicking on the *Check* button, while for the XML insert it is done by checking the *Validate* box.

For all standards, a first level of validation is made for XML metadata validation based on XML Schema Definition (XSD). For ISO 19139 records, other rules based on ISO and GeoNetwork recommendations are checked. When validation is conducted via the

[7] Available for Windows at `http://members.oceantrack.org/etc/jmw2`.

online metadata editor, the validation output is displayed within the metadata editor itself. Otherwise, the error details are displayed within an error box.

4.2.5 Access Privilege Settings

Privileges have to be assigned to each metadata record. This means that it is the editor's role to identify who can access the product description (i.e., which user group has the associated privileges of view, download, etc.). Figure 7 is a screen capture of the privileges setting interface.

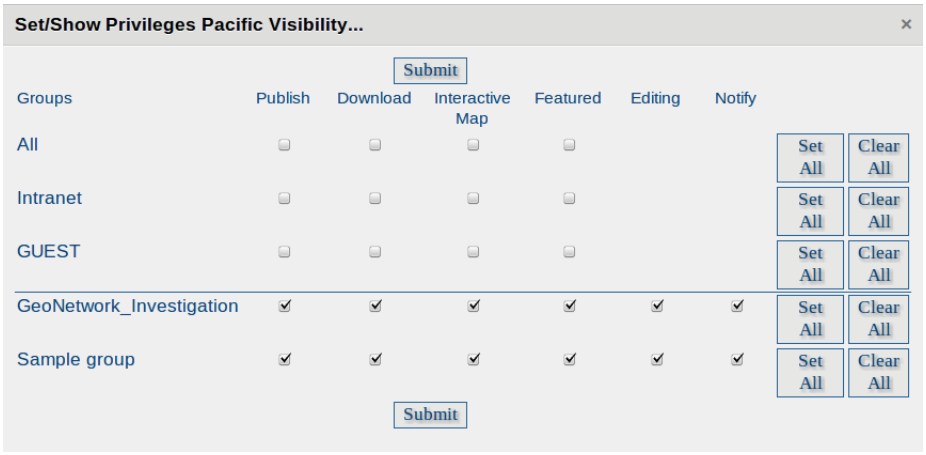

Figure 7: *Screen capture of the privileges settings interface.*

Each privilege is briefly described:

Publish: Users in the specified groups are able to see the record if searching with matching criteria.

Download: Users in the specified groups are able to download the product.

Interactive Map: Users in the specified groups are able to get an interactive map.

Featured: When selected, the record is placed in the *Features Maps* of the home page and it appears there randomly.

Editing: Users in the specified groups are able to edit the record.

Notify: Users in the specified groups receive notification that the record has been modified.

5 Serving Products

GeoNetwork allows publishers to link their products to the metadata description they publish in the catalogue. In other words, GeoNetwork offers mechanisms allowing consumers to acquire products directly from a catalogue. This acquiring aspect of the spatial information exchange and sharing loop is illustrated by the two dashed arrows in Figure 8. To illustrate the GeoNetwork capability to serve a product, an additional *Acquire* arrow was added between the data consumer and the data cataloguing aspects of the information exchange. This capability provides the consumer with an extra means to get the product.

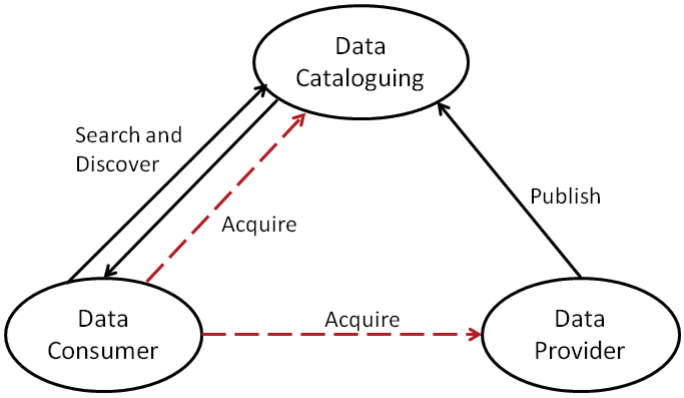

Figure 8: *A service view of the spatial information exchange and sharing between organizations and their audience: focus on the GeoNetwork product serving capability (adapted from [1]).*

It is worth recalling that GeoNetwork should not be viewed as a geospatial database. It is catalogue web application that can be used to facilitate product acquisition by offering capabilities for the publisher to link their products to the descriptions published in the catalogue. In fact, GeoNetwork acts as a client to several kinds of servers: WMS compliant, FTP, Hypertext Transfer Protocol (HTTP), ArcIMS, and others.

Valid metadata provides the information on how to acquire the product. This section will focus on the case where the product is served by GeoNetwork. Products can have all kinds of digital file formats; for example, images, PDF, doc, audio, maps served by online resources such as WMS servers, etc. However, a distinction is made with GeoNetwork between interactive maps and the other products. As mentioned in section 3.2, when searching metadata that has a related WMS online resource, the *Interactive Map* button is displayed and when it has related downloadable data, the *Download* button is displayed. The following describes the possible mechanisms to link these two categories of products to metadata. In both cases, creating a link between product and related description is done by editing the metadata *Distribution/On-Line Resource(s)* field.

5.1 Interactive Maps

Metadata records represented in ISO 19139 XML can be related to resources defined in WMS services. WMS is an OGC standard protocol for serving geo-referenced map images over the Internet that are generated by a map server using data from a Geographic Information System (GIS) database [19]. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc.) that can be displayed in a browser application (i.e., GeoNetwork in this case) [20].

Several software applications provide web map services; the more popular ones being GeoServer, MapServer and ArcGIS Server. GeoServer[8] is distributed with GeoNetwork. Technically, GeoNetwork acts as a client to these diverse web map services.

If a product publisher wants to link a map to its description via GeoNetwork, then serving the map while using a web map service such as GeoServer, is an option. The first step is to either have:

- GeoServer (or another map server) installation up, running and maintained with the related layers defined; or
- when the map comes from another provider: the information (URL and protocol) on the service offering this map.

The second step is to reference the map in the metadata. The WMS online resource can be referenced in metadata by selecting the appropriate Web Map Service protocols and specifying the service URL. The selected protocol should match the WMS service protocol that is to be linked. The name of the resource field can be left empty or used to specify the name of the layer to be loaded in the map viewer.

5.2 Other Datasets

Files in all formats can be linked to the metadata descriptions and provided for download: doc, PDF, images in all formats, vector data such as shapefiles, etc. There are two ways to serve these kinds of products with GeoNetwork:

1. upload the product from the providers local computer to the GeoNetwork server;
2. use online resources, like a FTP or HTTP server, to provide the product.

In both cases, products for download can be referenced in metadata by specifying the name and the description of the resource in the *On-Line resource* field. The description should

[8] `http://geoserver.org/`

include the size of the file linked for download. It is recommended to distribute vector data in a compressed file including, if available, legend and documentation that can help the interpretation of the product. The difference between the two serving methods has to be specified in the protocol and URL selection.

Whatever method is selected to serve the product files, it should be noted that GeoNetwork only provides upload/download capability for these products. As well, there is no direct interaction between GeoNetwork and the files it serves; and nothing on this topic seems to be planed for the future. GeoNetwork does not offer product conversion (e.g., shapefile to JPG) nor does it offer support for deep linking within files (e.g., a hyper link in a PDF file that points to other product served by GeoNetwork). However, products may be linked together through appropriate metadata definitions. For example, records in ISO 19115 can be related to one another using the parent/child relation that is present in the standard.

5.2.1 Uploaded Product

If the product has been uploaded from the user's local computer to the GeoNetwork server, the selected protocol should be *File for download*. The *Upload* button will appear and clicking on it allows the provider to browse the folders and select the resource. If the URL field is left empty (recommended), the system will automatically fill it. This option makes a copy of the resource in the `GEONETWORK_HOME/data`[9] directory of the machine hosting GeoNetwork.

The file to upload should have no spaces in its filename, only alphanumeric characters, underscores, dashes, periods and commas are accepted. Spaces are replaced with underscores and all other symbols are stripped. Also, uploaded files, compressed or not, should not exceed 50 MB. Otherwise, consider serving the product with online services as described in section 5.2.2.

The digital file management with GeoNetwork when operating in a distributed environment, has one subtle issue. This issue applies to the users who use the computer on which GeoNetwork is installed. This can be illustrated with the following example.

Suppose that computers A and B are on the same network, with GeoNetwork installed on A. If files are uploaded from computer B, they will be stored in the directory `GEONETWORK_HOME/data` of A and made accessible for all the computers on the network (including B). If files are uploaded from A, the administrator of this data has to make sure that the URL created by GeoNetwork contains the machine Internet Protocol (IP) address and not `localhost`. If `localhost` is used, the product file would not be available for download from B, since the `localhost` location from B's perspective would be pointing to computer B.

[9] Directory `GEONETWORK_HOME` is the root of the GeoNetwork installation.

5.2.2 Online Resources

If a publisher wants to link the product to its description via GeoNetwork, then serving the product with a FTP or HTTP server is also an option. This requires the user to have either:

- HTTP or FTP server up, running and maintained; or
- when the product comes from another provider: the URL (and login/password if required) of the service offering this product.

If the product for download is to be available through an FTP site or web service, the appropriate protocol (*File for download* through FTP or URL) has to be selected with the URL correctly identified. Again, the resource name and description fields should be edited accordingly. With this option, no local copies of the product are made on the machine hosting GeoNetwork, which is a clear benefit for large catalogues.

6 Harvesting

Harvesting is the process of collecting remote metadata records and storing them locally for a faster access. This is a periodic process, with the harvesting cycle set by the administrator. Harvesting is not a simple import, it is actually an alignment process that keeps the remote and GeoNetwork metadata consistent. In the harvesting process, the remote site is contacted on a pre-defined cycle and any metadata that have been modified at the remote site are updated to the GeoNetwork site.

Harvested metadata provides instant access to metadata when searching while the product for download and related services remain at the originating agency. Concretely, it means that the linked product is not imported but remains accessible (if the metadata privileges allows it) from the producer's server.

Currently, GeoNetwork is able to harvest from the following sources :

- Another GeoNetwork node (version 2.1 or above);
- An old GeoNetwork 2.0 node;
- A WebDAV server: protocol based on the HTTP to facilitate collaboration between users in editing and managing documents and files stored on web servers;
- A CSW 2.0.1 or 2.0.2 catalogue server: OGC standards for catalogue information access;
- An OAI-PMH server: services, responses and data model specifications and implementations for repository interoperability;
- Any OGC service using its `GetCapabilities` document. These include WMS, WFS, WCS and Web Processing Service (WPS) services;
- An ArcSDE server: server-software sub-system (produced and marketed by Esri) that aims to enable the usage of relational Database Management System (DBMS) for spatial data.

6.1 Mechanism and Life Cycle

The harvesting mechanism is based on the concept of a *Universally Unique Identifier (UUID)* and the *last change date* of the metadata. Every time a metadata record is modified, its *last change date* is updated. Just storing this parameter and comparing it with a new one allows any system to find out if the metadata record has been modified since the last update. When an update is needed to be performed, the harvesting takes care of it.

During the first harvesting run, all remote matching metadata records are retrieved and stored locally. After the first run, only changed metadata (as described above) are retrieved.

Harvested metadata from a remote site are not editable as any local changes will be overwritten with remote changes. Moreover the local change to the last update date would compromise the harvesting mechanism.

The harvesting process on a GeoNetwork node goes on until an administrator deactivates the node or if an exception arises. When an harvesting node is removed, all harvested metadata are removed from the local database as well.

6.2 Setup Example

This section describes how to setup a node to be used in the harvesting of metadata records. The Food and Agriculture Organization (FAO) is taken as example. A list of public nodes can be found at `http://geonetwork-opensource.org/gallery/gallery.html`.

1. Log in as an administrator;
2. Select the *Administration* panel on the GeoNetwork home page and select *Harvesting Management* (see Figure 9).
3. Click on the *Add* button and select the *Geonetwork Remote Node (v 2.1)* on the drop down menu.
4. Fill the following fields :

   Site Name : FAO

   Site host : `www.fao.org`

   Site port : 80

   Site servlet : geonetwork
5. Hit the *Retrieve Source* button in the search criteria and select the one of interest.
6. In the *Options* section, set the harvesting life-cycle period to your preference.
7. Set the privileges and categories for the metadata you want to retrieve (e.g., datasets).
8. Click on the *Save* button.
9. Select the FAO site from the list of nodes, and trigger the harvesting by activating the node by pressing the *Run* button.

It may be required for the user setting up the harvesting, to logout, do a refresh, and log in, to see the harvested product using the search functionalities of GeoNetwork .

With harvesting, GeoNetwork must be able to connect to remote sites and this may be denied if a proxy server is used. In this case, GeoNetwork must be configured to use the proxy server in order to route outgoing requests. Proxy configuration is defined with the *System configuration* interface accessible by the *Administration* page.

The complete description of the harvesting management for each type of node listed above can be found in the GeoNetwork user manual [3].

6.3 Issues Identified with the ANZ-MEST Version

One very minor issue or annoyance has been found with the harvesting management within ANZ-MEST. This is the lack of response from the interface after an initial (or manual) harvesting run. The administrator needs to refresh or completely reload the web page (logout, close the page, and log back in) to see the harvested data.

Also, the harvesting management page is not showing anything from time to time. Right-clicking and selecting refresh usually solves this problem, but this may have to be done numerous times.

7 Administration

Figure 9 is a screen capture of the *Administration* interface where the main administration controls are available. This section describes the main administration tasks:

- installation,
- maintenance and security, and
- user and group management.

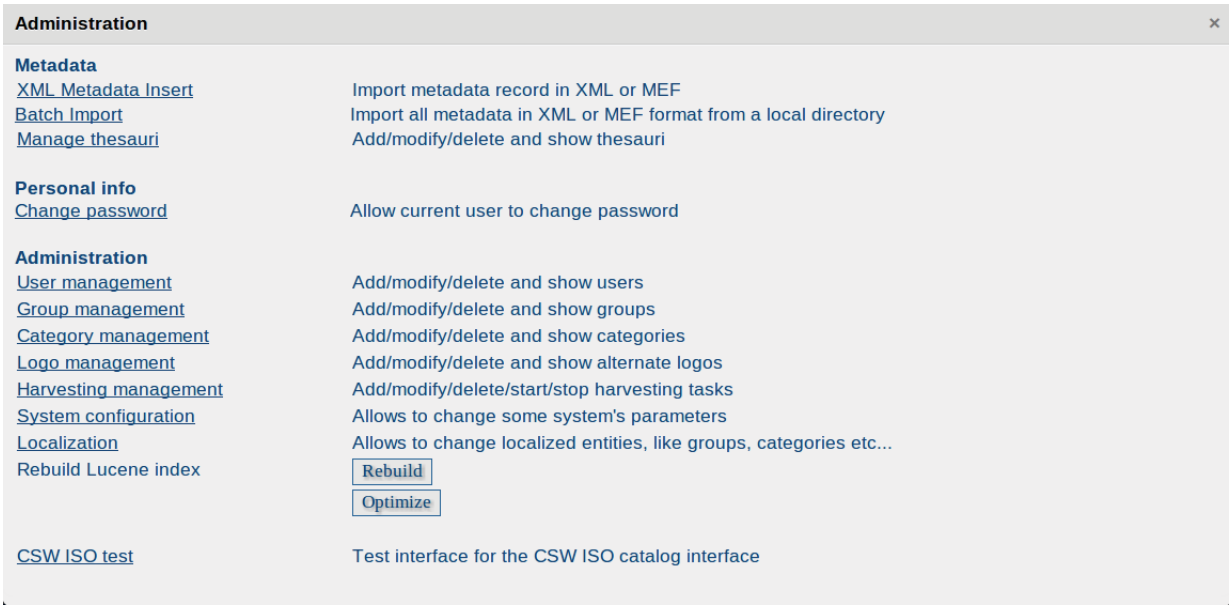

Figure 9: *Administration interface when logged as an administrator.*

7.1 Installation

The basic setup of GeoNetwork is simple and can be done on Windows, Linux or iOS. Since TRINITY run the Linux distribution CentOS 5.5, the installation was tested on that operating system with Ubuntu Lynx Lucid. No specifics on the installation, use, or maintenance when using different Linux distributions were found in the documentation.

It is not recommended to use GeoNetwork versions older than 2.4 because of performance [21] and security issues.

GeoNetwork requires a database and a servlet enabled web server to function. The database is used to store the metadata records and the administration data, such as the user and group

management information. GeoNetwork is a web application based on Java servlet interface and thus requires a servlet container to run.

The basic installation software is distributed at `http://sourceforge.net/projects/geonetwork` under the GPL license and it comes with Jetty web servlet and McKoi database embedded. The installation procedure is described for Windows and Linux in the user manual [3].

It is possible to use another servlet container other than Jetty, and it is also possible to use another database rather than McKoi. For instance, if Tomcat is installed on the machine that will host GeoNetwork and MySQL is accessible on the network, it is possible to use these applications for the installation. All combinations of the software presented in Table 1 are possible in theory. However, in this investigation, only MySQL was tested as an alternative database.

The main reason to use Tomcat over Jetty is to reuse an existing configured and running web server. Most organizations have a Tomcat server up and running. Load balancing between GeoNetwork nodes is possible with both servers. McKoi database is only for test purposes where the speed is not an issue. McKoi does not handle concurrent transactions well and is not suited for more than 10 000 metadata files.

Installation	**Servlet Container**	**Database**
Basic	Jetty	McKoi
Custom	Tomcat (v5.5+)	MySQL (v5.5+), PostgreSQL (v7+), Oracle

Table 1: *Software requirements for GeoNetwork on both Linux and Windows.*

7.1.1 ANZ-MEST Version

The procedures to install the ANZ-MEST version under a Linux operating system using Tomcat and MySQL as a database are described in detail in Annex A. Note that these instructions differ slightly from instructions found in documentation such as [22]. For unknown reasons, the procedure to deploy ANZ-MEST described in [22] failed to work.

7.2 Maintenance and Security

Maintenance of the GeoNetwork node is the role of the administrator. Minimal maintenance is required after the initial setup. The maintenance actions identified are the following:

- Database backup, which is usually taken care of by the network administrator with daily/weekly backups of the entire system;

- Metadata uploading in the local node;
- Setting up harvesting nodes;
- Modifying the system's configuration;
- Creating new user accounts and granting privileges;
- Upgrading the system with new releases.

The maintenance time/cost of GeoNetwork appears to be quite low after the initial setup.

From a security point of view, the use of GeoNetwork does not appear to pose any threat. It is recommended, however, to use a custom setup like the one described in section 7.1.1. With that kind of setup, GeoNetwork should be viewed as a web service deployed in Tomcat which accesses a MySQL database upon request. Security management issues associated with MySQL and Tomcat are well documented and organizations usually have security policies regarding these applications and web services. Moreover, it is assumed that access to TRINITY's GeoNetwork would be restricted to a closed network, and not for the open web.

Any access to the underlying database is protected by the administrator password. Passwords are stored in the MySQL database in encrypted form. Metadata access requires a user name and password and access to the metadata is limited by the privileges set up by the administrator for a particular user. Most other security aspect is taken care of by the web server, e.g. Tomcat.

Since version 2.4, the addition of GeoNetwork does not represent an additional security weakness for an organization already having MySQL installed and running web services with Tomcat. It is however recommended, like with any kind of software, to keep track of new releases and upgrade when required.

7.3 Groups and Users Management

There are three aspects to consider when it comes to defining the visibility of a given metadata record to particular users:

1. the user profile;
2. the group of users, and;
3. metadata privileges.

Group and user management is performed by the administrator of the GeoNetwork system. The *Administration* panel (Figure 9) enables fast and easy user and group creation.

A profile, and one or many groups, have to be assigned to each created user. A profile defines what tasks the user can perform (i.e., the user's rights over the metadata). While a user can only have one associated user profile, it can be part of several groups. The combination of user rights over the groups defines the total rights of a user over the metadata. There are a total of 5 user profiles:

Administrator: has special privileges that give access to all available functions;

User Administrator: is administrator of his/her own group;

Content Reviewer: is the only person allowed to give final clearance on the metadata publication on the Intranet and/or on the Internet;

Editor: can edit the metadata;

Registered User: has more access privileges than a non-authenticated guest.

A complete description of user profiles and of user and group creation by the administrator can be found in the user guide [3].

Access privileges can also be set on a per metadata record basis. Privileges relate to visibility of the product and the linked data. This defines who (users and groups) has access to the record and how. The access levels are described in section 4.2.5 and illustrated in Figure 7.

To summarize, the user profile is used to define capabilities related to metadata creation and products linking while the privileges are used to limit the visibility of a record.

8 GeoNetwork Usage

In this document, GeoNetwork was presented in the abstract context of a system capable of spatial information exchange and sharing. GeoNetwork works in a distributed environment, where spatial information is described, published, searched, discovered and finally acquired. Sections 3, 4, 5 and 6 showed how GeoNetwork can be used to facilitate each of these tasks.

The implementation of these capabilities within an organization is often referred as a Spatial Data Infrastructure. A SDI can be defined, like in [23], as the policies, standards, human resources, technology, and related activities necessary to acquire, process, maintain, preserve, distribute, and use spatial data.

It is now common to see GeoNetwork used *as is*, or being modified to be part of a SDI. DFO MEST[10] [24], NOAA [15] and FAO GeoNetwork[11] are some examples of such usage.

This section presents usage approaches and proposes suggestions on the use within TRINITY. The section also provides comments on the potential benefits and costs of using GeoNetwork within TRINITY.

8.1 Usage Approaches

There are different levels of GeoNetwork usage within a SDI. At a minimum, GeoNetwork is used for cataloguing, searching, and discovering the described spatial data product. Some implementations are implemented to serve some of the products described in the catalogue, while other implementations serve all products.

In some cases, the product is held as a local copy in the GeoNetwork server. For small catalogues this proves to be an efficient method. However, for more intensive uses, this approach is not sufficient due to its limited performance and maintenance issues. For a more efficient management, the spatial data product should be served using web technologies such as:

1. GeoServer or other map server;
2. FTP sites or download URL.

GeoNetwork is often mistaken as a user interface to a spatial database. This is incorrect since GeoNetwork does not store the spatial data. Therefore, it also does not support queries against the data. This confusion comes from the fact that GeoNetwork can serve

[10] `http://isdmwebdev.chs.gc.ca:8080/geonetwork/`
[11] `http://www.fao.org/geonetwork/srv/en/main.home`

products. In this case, GeoNetwork provides a means to access the products that are described within GeoNetwork .

Figure 10 illustrates the relation between the GeoNetwork database (in the top section) and the databases (spatial or not), other data stores, or data services, containing or providing the data product described in the GeoNetwork catalogue. Spatial databases (such as Oracle Spatial/Locator or PostgreSQL with PostGIS) and GeoNetwork are different concepts. They are related only if GeoNetwork lists information about products contained in the spatial database, and this link is maintained manually by data producers. However, nothing omits the use of a spatially enabled database such as Oracle Spatial or PostgreSQL/PostGIS, to store the metadata for GeoNetwork.

It should be mentioned, though, that some SDI prototypes propose a bridge between GeoNetwork and spatial databases. For instance, the Faculty of Science in Charles University in Prague, has a GeoNetwork system directly serving spatial data stored within a PostgreSQL/PostGIS database [1]. In this application, they have modified GeoNetwork so that instead of storing products (e.g., shapefiles) locally on the server, the product is stored within the spatial database.

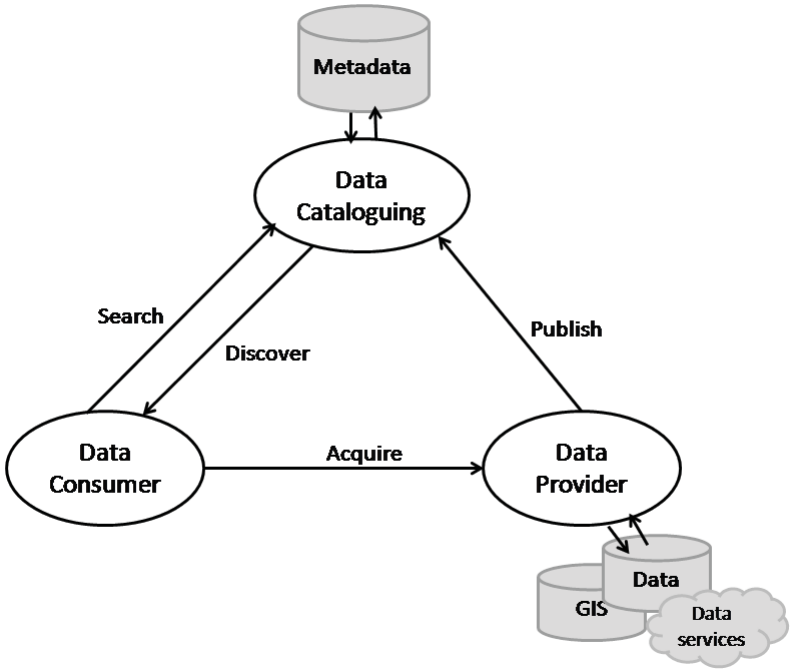

Figure 10: *The databases involved in the service view of the spatial information exchange and sharing between organizations and their audience.*

8.2 Suggestions On The Use Within TRINITY

This section provides suggestions on the use of GeoNetwork within TRINITY and comments regarding the potential benefits and costs. Each suggestion is numbered, and all are based on the experience and knowledge gained with GeoNetwork and ANZ-MEST during this investigation. This experience is, however, limited to small catalogues and limited number of users. The experience of other agencies with cataloguing large datasets would complement the following suggestions. For instance, DFO had setup a BlueNetMEST version of GeoNetwork called DFO MEST [24], cataloguing 902 datasets[12].

8.2.1 Setup

This section presents a list of suggestions related to the setup of GeoNetwork within TRINITY. It assumes the following:

- Tomcat is already up and running with the proper security configurations;
- Oracle or MySQL server[13] is up and running with the proper security configurations.

GeoNetwork Version

The first suggestion is as follows:

1. Use the ANZ-MEST version instead of the basic GeoNetwork.

The main reason for this is the embedded support for MCP. Implementing the version that supports MCP would allow TRINITY to:

- have a GeoNetwork instantiation consistent with other Canadian users, like DFO;
- have a GeoNetwork instantiation consistent with Australian and New Zealand military partners;
- help meeting the Canadian Treasury Board requirement to fully implement ISO 19115 for geospatial data;
- leverage metadata creation software from DFO (i.e., jMetawriter).

[12] As of July 2011.
[13] Note that MySQL was tested in this investigation; while Oracle was not tested.

Modifications

Some modifications are required to the ANZ-MEST to better meet Canadian user needs. To address these needs we recommend:

2. the lat(min) and lat(max) position in the *Advanced Search* panel be changed to indicate the northern and southern latitude boundaries;

3. the drop down menu items within the metadata editor be changed to Canadian specific entries.

Other modifications may be required based on user feedback.

Web Server

4. Deploy ANZ-MEST on a Tomcat server. Apply the organization's usual security policies for web services. GeoNetwork should be viewed as a web application based on Java servlet interface deployed in Tomcat.

Database

5. Use MySQL or Oracle for metadata and administration information storing and management.

Metadata Creation

6. Decide on the scope of the product integration: identify which products will be catalogued (e.g., products created prior to the installation of GeoNetwork, products related to a specific field only, etc.) and which ones require the creation of metadata.

7. Define a strategy to create the metadata for already existing products and future products. This strategy will include the choice of metadata creation tools such as jMetaWriter (see section 8.2.3.2) and the data producers team (see next recommendation).

Privileges

8. Create different user groups for the TRINITY data producers.

9. Designate a user administrator for each group.

These groups should be created to reflect data needs and management within TRINITY. Consider also the option of having more than one catalogue.

Data serving

10. Decide if products will be served by ANZ-MEST and if yes, decide which data and how. In the case it is decided to serve products, as discussed above in 8.1, the upload option makes local copies on the server. This option can thus increase data management efforts. The other option is to serve data with web technologies such as maps server, FTP sites or HTTP. This requires one to setup or identify the required data servers (e.g. FTP and map servers) and make sure these sites are maintained.

It is important to keep in mind that not all products have to be served by GeoNetwork. For instance, a link to the product's location could be sufficient (e.g., a link to GPW).

Harvesting

11. If deemed relevant by TRINITY data consumers, setup harvesting for identified nodes.

This step may require someone to contact other agencies or nodes of interest. These nodes could be within the Department of National Defence (DND) network. For instance, a GeoNetwork (or similarly ANZ-MEST node) or a WMS server could be setup at Defence Research and Development Canada (DRDC) Atlantic. TRINITY could setup harvesting for that DRDC Atlantic node. In this case, DRDC Atlantic metadata would then automatically be imported and updated at the local TRINITY GeoNetwork application. This would require DRDC Atlantic to provide access to their data source (GeoNetwork or other protocols supported by GeoNetwork harvesting).

8.2.2 Potential Benefits

Figure 11 illustrates the spatial information exchange and sharing without the cataloguing capability. In this decentralized environment the search and discovery function is much more difficult since there is no metadata description to support the discovery process. Therefore, one of the main benefits of a GeoNetwork, specifically the spatial-temporal-keyword searching capability, is lost.

Another benefit is the fact that GeoNetwork (and so ANZ-MEST) is open source. One of the key benefits to open source, is the ability to modify the application. Customization can facilitate the adoption of the tool by the users.

The growing number of users and developers also indicates that GeoNetwork will be used and maintained in years to come. This is further emphasized by the frequent updates to the software.

Finally, the fact that GeoNetwork is a web based application means reduced maintenance efforts as compared to a desktop application.

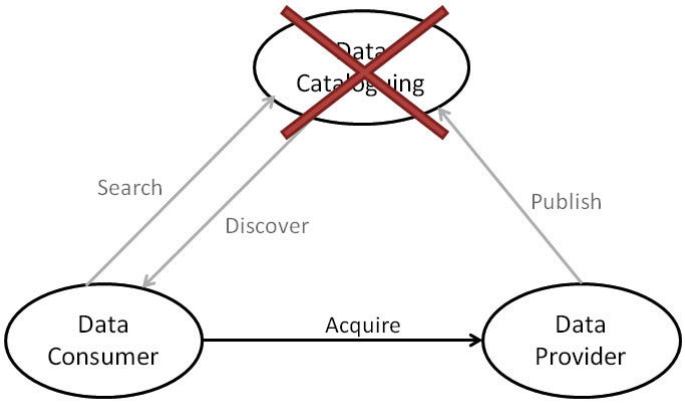

Figure 11: *A service view of the spatial information exchange and sharing without the cataloguing capability (adapted from [1]).*

8.2.3 Human Costs

Human costs related to the usage of GeoNetwork within an organization can be evaluated for three types of organization members:

- system administrators,
- data producers and
- data consumers.

The following considers the human cost for each of these actors. Note that a data consumer can also play the role of data producer and vice versa.

8.2.3.1 Administrators

As mentioned in section 7.2, administration tasks are

1. Installation and modification of the system's configuration;
2. Creating new user accounts and groups, and granting privileges;
3. Setting up harvesting nodes;
4. Upgrading the system with new releases;
5. Database backup, which is usually taken care of by the network administrator with daily/weekly backups of the entire system.

The first task is the most demanding one, while others are relatively simple and require low effort.

In order to install ANZ-MEST, the administration staff should have a good understanding of:

- DND's network security constraints;
- Tomcat, web protocols (e.g., HTTP) and web services;
- JDBC compliant DBMS (MySQL or Oracle depending on the setup);
- Ant;
- organization's operating system
- web map service technologies; and
- potentially Apache Subversion (SVN).

These system administration requirements are standard for an organization running web applications. Also, the documentation cited in this document along with the instructions detailed in the Annex A should be sufficient to install ANZ-MEST properly.

It is expected, however, that the installed ANZ-MEST will require customization to better satisfy the specific needs of the users. To modify ANZ-MEST, the following developer skills are required:

- JavaScript/HTML;
- Java;
- Ant;
- Tomcat;
- Java Database Connectivity (JDBC) and;
- MySQL or Oracle.

For the reasons mentioned above, administration costs are considered to be at a medium level. Most of the efforts are concentrated in the installation and customization. Not much maintenance is needed after the initial setup. An important factor to also consider is the size of the user and developer communities. The GeoNetwork community is very active resulting in accessible resources and support on the web.

8.2.3.2 Data Producers

The efforts required to learn how to use GeoNetwork to publish metadata are low. The user manual is sufficient for training. However, there is always a cost related to the production of metadata. Even if XML editor tools ease the creation of standard based metadata, it is still more time consuming than producing no metadata. The challenge thus comes in finding the balance between GeoNetwork benefits and metadata creation efforts.

The most evident benefit of GeoNetwork is its capability to search and discover relevant products based on various criteria. However, the search capabilities of GeoNetwork only reflect the quality of the metadata. Products described by incomplete and imprecise metadata are problematic, because the search engine will not identify the products in cases where the product *should* match the search criteria. Since producers are often also consumers, this fact becomes a clear motivation to produce quality metadata.

In terms of the creation of metadata, it is clearly easier to produce metadata with a tool that is considered to be comfortable by the user. For metadata creation tools, the GeoNetwork on line editor is another option; but for ISO 19115 (and MCP) metadata creation tool *jMetaWriter* was found to be superior. jMetaWriter version 5 includes full support to the MCP elements and has undergone numerous enhancements to address usability and to incorporate recommended best practices when authoring metadata [24]. jMetaWriter indicates what fields are mandatory (i.e., must be completed for compliance to the standard) by showing fields using red text, has field definition help, and includes an extensive user guide.

Another important aspect to consider is the scope of the product integration. If it is decided that products created prior to the installation of GeoNetwork are to be catalogued, then extra effort is required. This step would be time consuming especially if no metadata existed for these products.

8.2.3.3 Data Consumers

For data consumers the cost of using GeoNetwork is associated with the learning to use the system. For GeoNetwork this cost is considered to be very low. The user interface is intuitive and the system's behavior is predictable. The user manual covers in depth all data consumer functionalities. It is, however, worth mentioning that the overall user experience (for searching and discovering) could be improved. The system was found to sometimes lack responsiveness (in terms of response time), especially for the tasks related to search and record browsing. These delays are not important enough to cause user frustration, but may be considered disappointing. In this investigation, the state of the network was found to be an important factor in the GeoNetwork performance.

9 Concluding Remarks

The feasibility assessment of using GeoNetwork for information product management and access within TRINITY can summarized using two aspects:

Technical feasibility: Whether TRINITY has the capability, in terms of software, hardware, personnel and expertise, to handle the installation, use and maintenance of GeoNetwork.

Operational feasibility: How well GeoNetwork meets TRINITY's information product management and access requirements.

Other areas of feasibility assessment such as legal, economic and scheduling are outside the scope of this study.

9.1 Technical Feasibility

Section 8.2.3 commented on the human cost in terms of administration, data producers and consumers. From that analysis and discussions with the scientific authority, we consider it very likely that TRINITY has the capabilities, in terms of software, hardware, personnel and expertise, to handle the installation, use and maintenance of GeoNetwork. Also, the increasing number of organizational users and related development activities should be considered as a sign that GeoNetwork will be used and maintained in years to come. This lowers the risks related to GeoNetwork maintenance and development for TRINITY.

From a network security point of view, the addition of GeoNetwork does not represent an additional security weakness if TRINITY already has MySQL installed and is running web services with Tomcat with the proper security configurations; and performs system updates when required.

9.2 Operational Feasibility

The operational feasibility of GeoNetwork is mainly concerned with the following question: *Will GeoNetwork be used if implemented?*

The answer to this question depends mainly on capabilities offered by GeoNetwork and how these capabilities align with requirements. Within the scope of this study, the capabilities of GeoNetwork were investigated and shown to be applicable to an organisation wishing to serve geospatial products to a user community. However, we should recall that our experience was limited to small catalogues and limited number of users. And that experience of other agencies with larger scale implementations would help to complete the picture.

Productivity

Sections 3 to 7 covered GeoNetwork capabilities in terms of information product management and access. From that analysis, it is clear that GeoNetwork improves spatial information accessibility and sharing in a decentralized environment.

Usability

The usability of GeoNetwork was covered through the capabilies overview and also in section 8.2.3. To summarize, GeoNetwork was found easy to use and intuitive, for both producers and consumers. Regarding the noticed lack in responsiveness, it is worth mentioning that the state of the network was found to be an important factor in the GeoNetwork performance. Also, the overall performance (including indexing, search, bulk import, etc.) is improved in almost every new release of GeoNetwork. With the large and active developer community, it is easy to find documentation and tips on the web to improve performance for different setups.

Resistance

As discussed in section 8.2.3.2, resistance to GeoNetwork could happen because it may necessitate extra efforts for the creation of metadata. However, the Canadian Treasury Board stated that Canadian government departments have until May 31, 2014 to fully implement ISO 19115 for their geospatial data. GeoNetwork can thus be viewed as part of a strategy to fulfill this requirement. Also, the production of quality metadata increases the search capabilities of GeoNetwork, which can also be used as a motivation for its adoption.

Reputation

The most popular alternative cataloguing open-source application to manage spatially referenced resources is ESRI Geoportal Server[14]. A comparison between both applications can be found in [25] and [26] for an old version of GeoNetwork. It is hard to determine which one is better suited to TRINITY's needs based on these studies. Geoportal seems to be more popular in the US, while GeoNetwork seems preferred in European Union (EU) and is part of the Open Source Geospatial Foundation software stack. However, DFO selected the ANZ-MEST distribution of GeoNetwork for its cataloguing application.

[14] http://www.esri.com/software/arcgis/geoportal/index.html

References

[1] (2010), Usage and modication of Geonetwork opensource to automate spatial data publication through map server (online), Geoinformatics, Faculty of Civil Engineering, Czech Technical University in Prague, http://geoinformatics.fsv.cvut.cz/gwiki/Usage_and_modication_of_Geonetwork_opensource_to_automate_spatial_data_publication_through_map_server (Access Date: Dec. 2011).

[2] Reed, Greg (2008), Marine Community Profile of ISO 19115, Version 1.4, Technical Report Australian Ocean Data Centre.

[3] (2011), User Manual v2.6.4 (online), GeoNetwork Opensource, http://geonetwork-opensource.org/manuals/2.6.4/users/index.html (Access Date: Dec. 2011).

[4] Isenor, Anthony W. and Spears, Tobias (2006), A Conceptual Model for Service-Oriented Discovery of Marine Metadata Descriptions. CMOS Bulletin, Vol. 35, No. 3.

[5] (2011), ANZ-MEST TRAC Site (online), ANZ-MEST Software, http://anzlicmet.bluenet.utas.edu.au/ (Access Date: Dec. 2011).

[6] (2011), Apache Lucene (online), The Apache Software Foundation, http://lucene.apache.org/java/docs/index.html (Access Date: Dec. 2011).

[7] Pigot, Simon (2009), Implementing GeoNetwork (online), http://www.geospatial.govt.nz/geonetwork-does-the-trick (Access Date: Dec. 2011).

[8] ISO (2009), ISO 19115:2003 Geographic information - Metadata (online), \url{http://www.iso.org/iso/catalogue_detail.htm?csnumber=26020} (Access Date: Dec. 2011).

[9] (2011), Content Standard for Digital Geospatial Metadata (online), Federal Geographic Data Committee, http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/index_html (Access Date: Dec. 2011).

[10] (2011), Dublin Core Metadata Initiative Metadata Terms (online), Dublin Core Metadata Initiative, http://dublincore.org/documents/dcmi-terms/ (Access Date: Dec. 2011).

[11] ISO (2010), ISO/TS 19139:2007 Geographic information - Metadata - XML schema implementation (online), \url{http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32557} (Access Date: Dec. 2011).

[12] (2009), Standard on Geospatial Data (online), Treasury Board of Canada, http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=16553&section=text (Access Date: Dec. 2011).

[13] Program Executive Officer, GIG Enterprise Services (2011), Department of Defense Discovery Metadata Specification (DDMS), Version 4.0.1, Technical Report Defense Information Systems Agency, Department of Defense.

[14] ISO (2009), ISO 19115-2:2009 Geographic information - Metadata - Part 2: Extensions for imagery and gridded data (online), \url{http://www.iso.org/iso/catalogue_detail.htm?csnumber=39229} (Access Date: Dec. 2011).

[15] (2009), NOAA GeoNetwork Target (online), NOAA, https://www.ngdc.noaa.gov/wiki/index.php?title=GeoNetwork_target (Access Date: Dec. 2011).

[16] Mitchell, Andrew (2011), Metadata Requirements - Base Reference for NASA Earth Science Data Products, Technical Report NASA, Earth Science Data and Information System Project, Code 423.

[17] Isenor, Anthony W. (2011), Discipline-Specific Standards for the Marine Community (online), The MMI Guides: Navigating the World of Marine Metadata; Marine Metadata Interoperability Project, http://marinemetadata.org/guides/mdatastandards/comstds/disciplinespecificprofandext (Access Date: March 20, 2012).

[18] Pigot, Simon (2010), Implementing GeoNetwork - Advanced (online), \url{http://www.geospatial.govt.nz/geonetwork-does-the-trick} (Access Date: Dec. 2011).

[19] (2011), Web Map Service (online), Wikipedia, http://en.wikipedia.org/wiki/Web_Map_Service (Access Date: Dec. 2011).

[20] (2011), OpenGIS Web Map Service (WMS) Implementation Specification (online), Open Geospatial Consortium, http://www.opengeospatial.org/standards/wms (Access Date: Dec. 2011).

[21] (2010), Capacite d'ingurgitation de GeoNetwork (online), neogeo technologies, http://www.neogeo-online.net/blog/archives/428/ (Access Date: Dec. 2011).

[22] Pigot, Simon (2011), ANZMEST and GeoNetwork (online), \url{http://www.osdm.gov.au/Metadata/GeoNetwork/Resources/10_SPigot_GN_ANZMEST_20111114.pdf/?id=1177} (Access Date: Dec. 2011).

[23] The White House, Office of Management and Budget (2005), Circular No. A-16 Revised (online), \url{http://www.whitehouse.gov/omb/circulars_a016_rev#2} (Access Date: Dec. 2011).

[24] Black, Terry, Spears, Tobias, Bond, Shelley, and Hayden, Helen (2011), jMetaWriter and the Fisheries and Oceans Canada National Science Metadata Initiative (online), http://www.necodp.org/workshops/metadata-workshop/2011-annual-meeting-presentations-1/ (Access Date: Dec. 2011).

[25] Pigot, Simon (2011), Comparison between GeoNetwork 2.7 and ESRI Geoportal - Draft (online), \url{www.osdm.gov.au/Metadata/GeoNetwork/Resources/21_SPigot_GN_ESRIGeoportal_20111115.pdf} (Access Date: Dec. 2011).

[26] Michelle Anthony, Eric van Praag (2008), GeoNetwork and ESRI GIS Portal Toolkit Comparison (online), \url{http://www.geosur.info/geosur/contents/estudio_geosur_comparacion_de_geoportales.pdf} (Access Date: Dec. 2011).

This page intentionally left blank.

Annex A: Installation of ANZ-MEST using Tomcat and MySQL

This section presents the procedures to install the ANZ-MEST version under a Linux operating system using Tomcat and MySQL as a database. It assumes that Tomcat and MySQL are up and running. The tested installation has both MySQL and Tomcat on the same machine, but in theory MySQL can be hosted by another machine on the network.

Building the directory

1. Download the software from `http://bluenetdev.its.utas.edu.au/download/BlueNetMEST-1.4.8-020811.zip`.
2. Unzip the `BlueNetMEST-1.4.8-020811.zip` file.
3. Run `java-jarBlueNetMEST-install-1.4.8-stable.jar`
4. In the `BlueNetMEST` directory, run `ant` on the `build.xml` file. This will create the components necessary to complete the installation.

Database setup using GAST (GeoNetwork's Administrator Survival Tool)

1. Start GAST using `BlueNetMest/bin/gast.sh`.
2. Select the *DBMS* option under *Configuration* on the left side panel.
3. Select MySQL from the drop down menu and fill the fields (default port for MySQL is 3306). Make sure that the database name is a valid, and an empty database name is already present in MySQL. Click on the *Save* button.
4. Select the *Setup* option under *Database* on the left side panel and press the *Setup* button. This will create and fill the necessary SQL tables.

Deployment under Tomcat

1. In the `BlueNetMest/bin` directory, modify the `start-geonetwork.sh` and `stop-geonetwork.sh` scripts by changing the `CONTAINER` variable from `jetty` to `tomcat`.
2. Modify the `start-geonetwork-tomcat.sh` and `stop-geonetwork-tomcat.sh` scripts by setting the `catalina_home` variable to `COMPLETE_PATH_TO_YOUR_TOMCAT_DIRECTORY` (e.g., `/home/your_name/Tomcat`).

3. It is recommended to modify the `start-geonetwork-tomcat.sh` to allow more memory to the application and avoid the intense garbage collection activity that slows down GeoNetwork. It is done by adding the following code before the last (exec) line:

```
JAVA_OPTS="
-server
-Xmn128m
-Xms512m
-Xmx2g                                # to increase Heap Memory
-XX:PermSize=128m
-XX:MaxPermSize=256m
-XX:+UseParallelGC                    # accelerate Garbage Collection
-XX:+AggressiveHeap
-XX:SoftRefLRUPolicyMSPerMB=36000 # minimize timeout
impacts on soft references
-Djava.awt.headless=true
-XX:+HeapDumpOnOutOfMemoryError   # for debug purpose only
-XX:HeapDumpPath=/tmp             # for debug purpose only
-Dmime-mappings=../web/geonetwork/WEB-INF/mime-types.properties";
export JAVA_OPTS
```

   Make sure that these configuration settings do not conflict with the installed Tomcat configurations.

During the database configuration and setup, the `config.xml` file of the GeoNetwork webservice should have been modified to reflect your database setup. However, you need to modify Tomcat `context.xml` file to declare the database resource. Include the following resource definition in the context.xml file of Tomcat working directory (located in `BlueNetMest/tomcat/conf`):

```
<Resource name="main-db"
  auth="Container"
  type="javax.sql.DataSource"
  username="yourusername"
  password="yourpassword"
  driverClassName="com.mysql.jdbc.Driver"
  url="jdbc:mysql://localhost:3306/yourdbname"
  maxActive="10"
  maxIdle="10"
  removeAbandoned="true"
  removeAbandonedTimeout="3600"
  logAbandoned="true"
```

```
  testOnBorrow="true"
  defaultAutoCommit="false"
  validationQuery="SELECT 1"
   />
```

GeoNetwork within Tomcat and MySQL can now be run using `BlueNetMest/bin/start-geonetwork.sh` and stopped with `BlueNetMest/bin/stop-geonetwork.sh`.

Make sure also that the start process is run when rebooting the server.

List of symbols/abbreviations/acronyms/initialisms

ANZ Australia and New Zealand

CANMARNET Canadian Maritime Network

CSW Catalog Service for the Web

DBMS Database Management System

DFO Department of Fisheries and Oceans

DND Department of National Defence

DoD Department of Defense

DRDC Defence Research and Development Canada

EU European Union

FAO Food and Agriculture Organization

FGDC Federal Geographic Data Committee

FTP File Transfer Protocol

GE Google Earth

GIS Geographic Information System

GPL GNU General Public License

GPW Global Position Warehouse

HTTP Hypertext Transfer Protocol

IP Internet Protocol

ISO International Organization for Standardization

ITE Integrated Testing Environment

JDBC Java Database Connectivity

KML Keyhole Markup Language

MCP Marine Community Profile

MetOc	Meteorological and Oceanographic Office
MEF	Metadata Exchange Format
MIKM	Maritime Information and Knowledge Management
NGA	National Geospatial-Intelligence Agency
NOAA	National Oceanic and Atmospheric Administration
OAI-PMH	Open Archives Initiative Protocol for Metadata Harvesting
OGC	Open Geospatial Consortium
OGD	Other Government Department
RJOC	Regional Joint Operations Center
SA	Situational Awareness
SDI	Spatial Data Infrastructure
SVN	Apache Subversion
URL	Uniform Resource Locator
US	United States
UUID	Universally Unique Identifier
WebDAV	Web-based Distributed Authoring and Versioning
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
WPS	Web Processing Service
XML	eXtensible Markup Language
XSD	XML Schema Definition

This page intentionally left blank.

Distribution list

DRDC Atlantic CR 2012-020

Internal distribution

1 R. Cross

1 F. Desharnais

1 T. Hammond

2 A. W. Isenor (1 hardcopy; 1 electronic copy)

1 L. Lapinski

1 A. MacInnis

1 D. Schaub

1 S. Webb

3 Library (1 hardcopy; 2 CDs)

Total internal copies: 12

External distribution

1 Library and Archives Canada

1 NDHQ/DRDKIM 2-2-5

1 Peter Bartlett
MARLANT HQ
TRINITY CFIUSC
MSOC(E) CCG
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 Sgt Wayne Boudreau
MARLANT HQ
TRINITY CFIUSC
D201 4th Floor
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 Lt(N) Joe Collins
MARLANT HQ
TRINITY CFIUSC
D201
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 Andrew DeBaie
MARLANT HQ
ACOS (IM) N6
D201 3rd Floor
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 LCdr Tom Fredericks
MARLANT HQ
Current Intelligence
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 Jurgen Mack
NDHQ - 101 Colonel By Dr
Bldg 16 Tunney's Pasture, 101
Ottawa ON
K1A 0K2

2 Marie-Odette St-Hilaire (1 hardcopy; 1 electronic copy)
OODA Technologies Inc.
4891 Av. Grosvenor,
Montreal Qc, H3W 2M2

1 Scott Syms
MARLANT HQ
ACOS (IM) N6
D201 3rd Floor
PO Box 99000 Stn Forces
Halifax NS B3K 5X5

1 Marc Zandvliet
NDHQ - 101 Colonel By Dr
Bldg 16 Tunney's Pasture, 101
Ottawa ON
K1A 0K2

Total external copies: 12

Total copies: 24

This page intentionally left blank.

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when document is classified)

1. ORIGINATOR (The name and address of the organization preparing the document. Organizations for whom the document was prepared, e.g. Centre sponsoring a contractor's report, or tasking agency, are entered in section 8.)

OODA Technologies Inc.
4891 Av. Grosvenor, Montreal Qc, H3W 2M2

2a. SECURITY CLASSIFICATION (Overall security classification of the document including special warning terms if applicable.)

UNCLASSIFIED

2b. CONTROLLED GOODS

(NON-CONTROLLED GOODS)
DMC A
REVIEW: GCEC JUNE 2010

3. TITLE (The complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S, C or U) in parentheses after the title.)

Investigation of GeoNetwork Opensource

4. AUTHORS (Last name, followed by initials – ranks, titles, etc. not to be used.)

St-Hilaire, M.-O.; Allard, Y.

5. DATE OF PUBLICATION (Month and year of publication of document.)	6a. NO. OF PAGES (Total containing information. Include Annexes, Appendices, etc.)	6b. NO. OF REFS (Total cited in document.)
May 2012	68	26

7. DESCRIPTIVE NOTES (The category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.)

Contract Report

8. SPONSORING ACTIVITY (The name of the department project office or laboratory sponsoring the research and development – include address.)

Defence R&D Canada – Atlantic
PO Box 1012, Dartmouth NS B2Y 3Z7, Canada

9a. PROJECT OR GRANT NO. (If appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant.)	9b. CONTRACT NO. (If appropriate, the applicable number under which the document was written.)
	Call-up 4, No. 4500862723 to W7707-115137

10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document.)	10b. OTHER DOCUMENT NO(s). (Any other numbers which may be assigned this document either by the originator or by the sponsor.)
DRDC Atlantic CR 2012-020	

11. DOCUMENT AVAILABILITY (Any limitations on further dissemination of the document, other than those imposed by security classification.)

(X) Unlimited distribution
( ) Defence departments and defence contractors; further distribution only as approved
( ) Defence departments and Canadian defence contractors; further distribution only as approved
( ) Government departments and agencies; further distribution only as approved
( ) Defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (Any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11)) is possible, a wider announcement audience may be selected.)

13. ABSTRACT (A brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual.)

This work investigates the feasibility of using the open source GeoNetwork application for information product management and access within TRINITY. GeoNetwork offers a management mechanism for the information products. It allows users to place and/or search all uploaded or linked products that are managed by the application. GeoNetwork supports spatial-temporal-keyword searching through the analysis of metadata associated with the spacial information product. This metadata follows international standards, and in some cases these standards have been used in the past by some TRINITY producers (e.g., Meteorology and Oceanography Office, MetOc). In general, information products produced on a regular interval (e.g., RMP) for a defined region are well suited to automated metadata creation, and thereby well suited to GeoNetwork.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus. e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

geonetwork
metadata
maritime situation awareness
database
recognized maritime picture
spatial product

This page intentionally left blank.

Defence R&D Canada

Canada's leader in defence
and National Security
Science and Technology

R & D pour la défense Canada

Chef de file au Canada en matière
de science et de technologie pour
la défense et la sécurité nationale

DEFENCE DÉFENSE

www.drdc-rddc.gc.ca