Canadian Geospatial Data Infrastructure

Infrastructure canadienne de données géospatiales

A Developers' Guide to the CGDI: Developing and publishing geographic information, data and associated services

Developed by GeoConnections GéoConnexions Canada

Making Canada's geospatial databases, tools and services available online

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GeoConnections is a national partnership initiative led by Natural Resources Canada.
Through GeoConnections, governments are working with industry to build the Canadian Geospatial Data Infrastructure (CGDI), which is making Canada's geospatial databases, tools and services accessible online.

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MANUAL OVERVIEW

Welcome to the Canadian Geospatial Data Infrastructure

Welcome to the Canadian Geospatial Data Infrastructure (CGDI), an exciting and long-awaited partnership initiative to connect Canada's geospatial databases and make them available on the Internet.

The Guide to the CGDI describes the Canadian Geospatial Data Infrastructure, and explains how you can use it. If you would like to increase the accessibility and visibility of your organization's data and services within the CGDI, or build an application with CGDI-endorsed standards and specifications, the Guide to the CGDI will show you how.

The Guide to the CGDI is divided into four sections and seven appendices, each of which describes a different aspect of the CGDI, and how you can use it to benefit your organization.

This manual is intended for web developers and CGDI contributors with various levels of geomatics expertise; managers and users will find useful summaries in the introductions to each section and chapter.

Section I, What is the CGDI?, introduces you to the Canadian Geospatial Data Infrastructure, and explains why we need the CGDI, who is implementing it, what is guiding it, and how it is being built.

Section II, Discovering Geospatial Information, describes how you can use various discovery mechanisms to find geospatial data, services and organizations within the CGDI.

Section III, Searching Databases and Making Your Databases Searchable, explains how you can make your database searchable by connecting it to the CGDI. This allows your users to directly search your geospatial databases or catalogues, which increases your exposure internationally.

Section IV, Using CGDI Web Resources, describes the different ways you can use CGDI resources to make your organization's applications more "geospatially aware". The CGDI offers a number of standardized services and resources that allow you to access and use geospatial information, which can, in turn, enhance your online services for your own clients.

The appendices include Geospatial Web Services Specifications, The GeoConnections Discovery Portal Building Your Application with GeoConnections Discovery Portal APIs, Information Sources, a Glossary, List of

Abbreviations, and a discussion of The Effect of Policy on the evolution of the CGDI.

This manual is not intended to include all available services and technologies, but rather those that are currently developed. The most current version of this manual is available at http://www.geoconnections.org/en/communities/developers/essentialGuides in both English and French.

Please send your comments and suggestions about the Guide to the CGDI to info@geoconnections.org.

SECTION I

What is the CGDI?

This section introduces you to the Canadian Geospatial Data Infrastructure (CGDI), and explains why Canadians need the CGDI, who is implementing it, what is guiding it, and how it is being built. The chapters in Section I provide a general description of the CGDI, including the rationale for its creation, how it is being implemented, the general principles and benefits of the CGDI, and its basic architecture.

Chapter 1 highlights the burgeoning field of geomatics, as well as the challenge the Canadian government faces in increasing accessibility to its geospatial information.

Chapter 2 introduces the GeoConnections program, how it is being implemented and its role in building the CGDI.

Chapter 3 discusses the vision, mission, principles, objectives, goals and benefits of the CGDI.

Chapter 4 describes the basic architecture of the CGDI and its similarities to electrical infrastructures and other data infrastructures.

Universal access to geospatial data
Free promotion for geospatial services and data
Common standards and specifications
Regional, national and international partnerships

CHAPTER 1

Meeting Canada's Geospatial Challenge

This chapter describes the increasing importance of geospatial information in our knowledge-based economy, as well as the challenge Canada faces in making its geospatial databases and services more accessible. This chapter:

- Illustrates the increasing range of services that depend on geospatial information;
- Defines the field of geomatics; and
- Describes Canada's challenge to create a geospatial data infrastructure for the benefit of Canadian businesses, governments and organizations.

1.1 Geospatial Data and the Economy

Geospatial information answers the question, "Where on earth is it?". It defines the locations of things that can be described in terms of space-settlements, schools, hotels, roadways, administrative boundaries and various areas, such as flood-susceptible communities. Geospatial information does more than merely pinpoint a bridge on a map. It can also describe how the bridge is likely to weather over time or predict how well it will handle traffic volumes in five years' time. In other words, geospatial data provides us with a comprehensive picture of the physical world and our place in it.

Geospatial data is a key driver in the transition to a knowledge-based economy. A wide and rapidly expanding range of products and services rely on geospatial information. For example, we depend on geospatial data for:

- **Emergency response**, to rapidly convert the telephone number of an incoming emergency 911 call to a map that shows the location of the caller and the most rapid avenue of response.
- **Public safety**, to map similar crimes or accidents to identify patterns that can assist in solving crimes or preventing them.
- **Environmental protection**, to make land-use planning decisions using soil maps, population counts, road network information, among other information.
- **National emergency and disaster relief**, to identify potential flood victim locations and develop evacuation plans to respond more quickly to the emergency using satellite imagery and topographical information, combined with population data. Geospatial information also enables officials to track disease and monitor health risks due to contaminants, in order to prevent outbreaks of viruses and the spread of disease and sickness.
- **Economic benefit**, to identify and evaluate potential development sites, as well as transportation systems, qualified personnel, suppliers and utility infrastructures.

In fact, most sectors of the economy depend directly or indirectly on geospatial information to plan and maintain their activities and to work efficiently. Farmers, foresters, municipal planners, hydro developers, police, the military, telecommunications, and paramedics are just some of the people who rely daily on geospatial data to do their jobs.

1.2 What is Geomatics?

Geomatics is the collecting, managing, analyzing, interpreting and integrating of geospatial (spatial) data, which is often referred to as "geo-info". These activities and services enable Canadians to make better policy and business decisions. Examples of geo-info include topographic maps, aeronautical and nautical charts, geological, agriculture and forestry maps, legal surveys, property cadastre, aerial photography and satellite imagery.

Geomatics encompasses a broad range of disciplines that include surveying (geodetic, cadastral, hydrographic) and navigation and positioning/global positioning systems (GPS); mapping (photogrammetry, cartography, automated mapping, facilities management and charting); remote sensing (data acquisition and application); and geographic information systems (GIS).

Geomatics has been one of the fastest-growing technology sectors in recent years, and Canada is at its forefront. Canada's geomatics community is a recognized world leader in providing the software, hardware, value-added services and knowledge that help clients address challenges and opportunities in such areas as the environment, health care, land management and reform, development planning, infrastructure management, natural resource monitoring, weather reporting, education and school curriculum, recreational industries, sustainable development, and coastal zone management and mapping.

Indeed, the growing field of location commerce (or l-commerce) is creating many opportunities for businesses to incorporate geospatial information into all aspects of their operations.

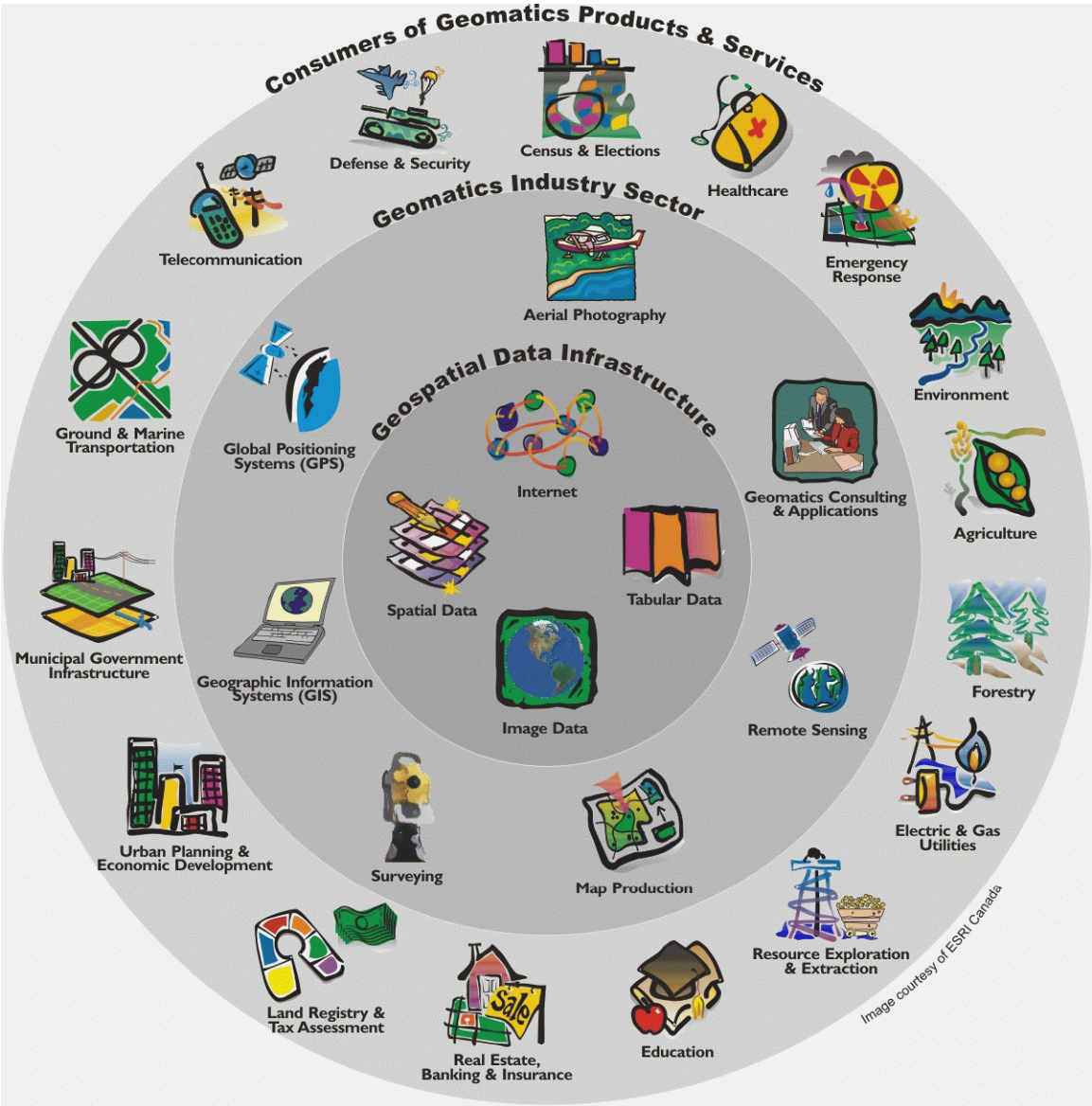

Figure 1 Geomatics and the Economy

1.3 Canada's Geospatial Challenge

Digital technology has removed many of the technical barriers to sharing geospatial data; nevertheless, new policies on such key issues as licensing, access and financing of geospatial data are needed to promote data exchange and integration, and to ensure that social and economic decisions are taken with the benefit of the best available information (Appendix 7, The Effect of Policy, discusses the impact of policy on the CGDI). Canada's challenge is to create an infrastructure of geospatial data to allow businesses better access to geospatial information for more effective decision-making and greater productivity.

The concept of a **Canadian Geospatial Data Infrastructure (CGDI)** responds to this challenge by coordinating the investments and developments of the federal, provincial, territorial and private sectors. The CGDI provides Canadians with common-window access to geospatial services and information through the Internet. It harmonizes Canada's geospatial information into easily accessible and searchable databases.

CHAPTER 2

The GeoConnections Initiative

GeoConnections is a program led by the Canadian government (Natural Resources Canada) to respond to challenges associated with advancing a culture and technology that supports the sharing and integration of geospatial data and services. This chapter:

- Describes the GeoConnections program;
- Examines GeoConnections' roles in building the CGDI; and
- Outlines how the renewed GeoConnections program is being implemented.

2.1 What is GeoConnections?

In 1999 the federal government made an important policy decision to launch GeoConnections - a national program that provides Canadians with location-based information via the Internet. The resulting 5 year, $60 million program achieved economic and social benefits by developing an enabling infrastructure (standards, framework data, technologies and policies) called the Canadian Geospatial Data Infrastructure (CGDI).

GeoConnections has two main roles:

1. To facilitate the creation of the CGDI, which will make Canada's geospatial databases and services available online.

2. To coordinate the investments and developments of the federal, provincial, territorial and private sector partners, who are contributing to the standards, protocols, access and maintenance processes of collections of geospatial data.

GeoConnections enables federal, provincial and territorial governments, along with the private and academic sectors, to work together to build the CGDI, ensuring fast, consistent and harmonized access to geospatial information and services for all Canadians.

The first phase of GeoConnections (1999-2004) saw the implementation of international standards by key partners, a network of data supply partnerships, new technologies harnessing the Internet and supportive policies for data sharing. GeoConnections established a solid foundation through partnerships with technology companies and content suppliers.

Now in its second phase (2005-2010), GeoConnections has undergone a shift in emphasis towards building user capacity for a demand-driven infrastructure. In this user-driven approach, user needs direct the path forward on content improvement, technology advancement and policy development of the CGDI. Reflecting this shift, GeoConnections has been designed as a four pronged program focusing on the following areas: Users, Content, Technology & Infrastructure, Policy & Coordination. To focus efforts, GeoConnections is working within the following four priority user areas: public health, public safety/security, sustainable development and the environment, and Aboriginal communities.

Figure 2 The Four User Communities of GeoConnections

- **Public Health:** Public health practitioners can use location-based information to securely track pandemics, analyze trends, and monitor population health, thereby improving the health of Canadians. For more information see the GeoConnections web site: http://www.geoconnections.org/en/communities/publichealth/index.html

- **Public Safety & Security:** Using location-based information, public safety and security organizations can increase their situational awareness by better understanding incidents—and their management options. For more information see the GeoConnections web site: http://www.geoconnections.org/en/communities/publicsafety/index.html

- **Environment/Sustainable development:** Location-based data supports integrated approaches to land and water management, environmental assessments, and ecosystem monitoring—essentials for a healthy environment. For more information see the GeoConnections web site: http://www.geoconnections.org/en/communities/environment/index.html

- **Aboriginal Communities:** Location-based information connects Aboriginal people and their communities, enabling them to map their futures, manage resources, and capitalize on opportunities. For more information see the GeoConnections web site: http://www.geoconnections.org/en/communities/aboriginal/index.html

GeoConnections is partnering with user communities to develop their capacity to apply the CGDI in support of a range of priority policy/decision-making areas. The program is using a selection of approaches adapted to the range of

technological maturity in priority communities. For the less technologically mature communities, the program will help increase their readiness to use the CGDI. For those ready to use the CGDI, it will enable them to customize applications and information systems to address health, environment/sustainable development, public safety, and Aboriginal community issues. It will engage the more mature communities to guide the CGDI development in response to their needs. These communities will identify the content, technology and policies they need to address their issues and GeoConnections will optimize development efforts by focusing on addressing the common needs within and between these user groups.

Figure 3 Building CGDI Capacity

GeoConnections is facilitating access to content needed by users in a way that avoids duplication between governments of all levels. GeoConnections has agreements to allow users access to framework content. It is expanding available framework content by supporting access to additional datasets needed by user communities (see www.GeoBase.ca for available framework data). Beyond framework data, the program is connecting users with the thematic content they need.

GeoConnections is ensuring the core functions of the CGDI continue to respond to user requirements. To maintain the existing base functions of the infrastructure, technical components will be maintained and relevant standards and policies will be developed. The program will also continue to evolve the infrastructure in order to meet the requirements of new technologies, users and markets. This kind of responsive design will result in new functions such as the implementation of security/authentication mechanisms.

GeoConnections is facilitating forums to coordinate the management of geomatics policies across the country. Nationally, the program is engaging Federal/Provincial/Territorial agencies, Aboriginal, local and thematic user communities to identify and address policy and coordination needs through outreach products and workshops. At the federal level, the program is supporting a Federal Geomatics Strategy to guide and coordinate national & federal geomatics activities.

GeoConnections' projects leverage matching investments from all levels of government, Aboriginal communities, the private sector, academia and non-government organizations. It is anticipated that the investment of $60 million in GeoConnections will result in the minimum investment of another $40 million from partners.

The renewed GeoConnections program will deliver on the following key federal commitments:

- strengthening the Canadian federation through effective cost-shared programming and shared roles that meet the needs of public agencies and in all regions of Canada;
- furthering innovation, commercialization and growth of Canada's geomatics industry located in all regions of Canada;
- empower Aboriginal and northern communities to better manage their future through capacity development and tools for community/land-use planning.
- support health organizations improve public health surveillance by using information to monitor diseases and contain outbreaks ;
- improve public safety by facilitating response to emergencies involving both human and natural factors (e.g. forest fires, earthquakes, chemical spills);
- support Canada's public security organizations in protecting Canadian citizens, critical infrastructures and enhancing cross-border security as defined in the Smart Border for the 21st Century Declaration.

2.2 GeoConnections' Program Implementation

Strategic advice for the GeoConnections Program are prioritised through a Management Board comprised of representatives from various jurisdictions, Aboriginals, the private and academic sectors, and interest groups. The Board's make-up will vary throughout the program. The Management Board is chaired by the Assistant Deputy Minister of the Earth Sciences Sector, Natural Resources Canada.

The operational management and optimized selection of program activities is undertaken by the Operations Committee comprised of the Program Area Team Leads and the Program Director. The Operations Committee reports to the Management Board on progress and plans and seek its strategic advice.

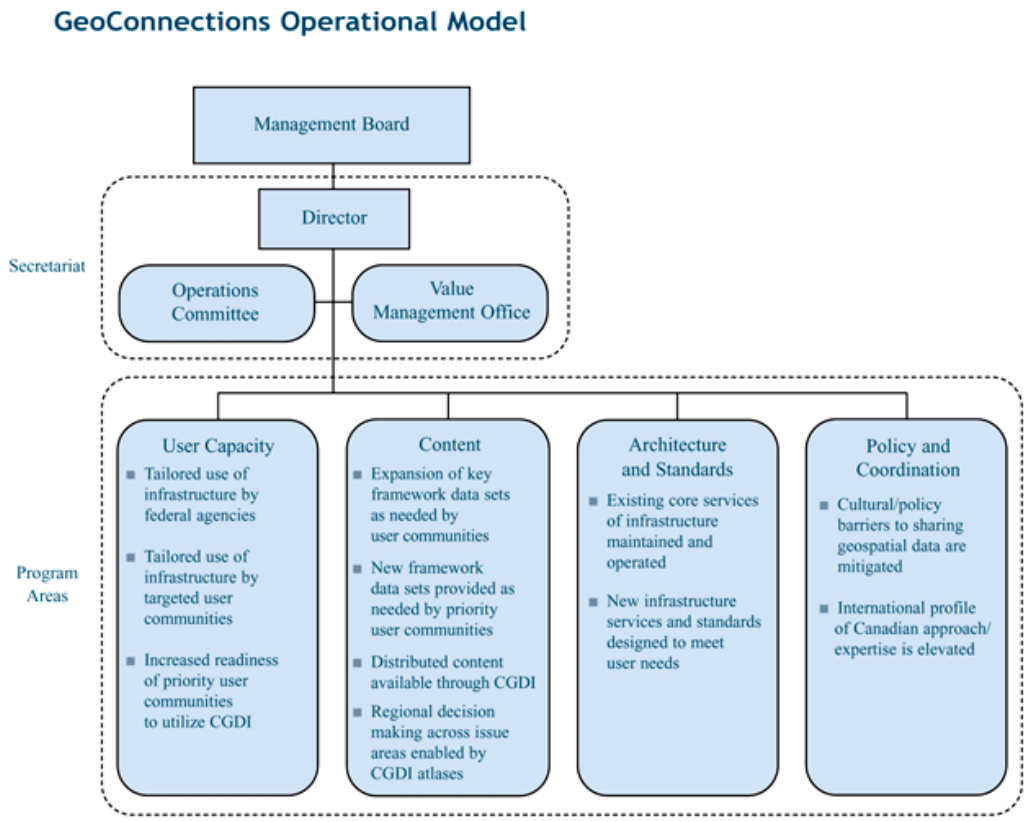

Figure 4 GeoConnections Operational Model

Four Program Area Teams (users, content, infrastructure and technology, and policy) are responsible to identify common priorities to attain the outcomes proposed. These activities respond to user needs common across themes, are prioritised by the Operations Committee and follow the strategic advice provided by the Management Board. The Program Area Teams report to the Operations Committee on progress and follow its direction on common activities to undertake.

Implementation teams work on a thematic basis across the four program areas (users, content, architecture and standards and policy and coordination) to identify the activities needed to deliver outputs and attain the outcomes proposed. These teams are responsible for establishing announcements of funding opportunities and for undertaking project evaluations with the support of the value management office.

Ensuring a user-driven approach requires a governance mechanism that allows for users in priority areas to communicate their needs for the CGDI to the respective Implementation Teams. Recognizing this, Thematic Advisory Committees for each of the priority areas (health, public safety/security, environment/sustainable development and Aboriginal) have been created. These

forums facilitate an identification of the communities' needs with respect to the CGDI.

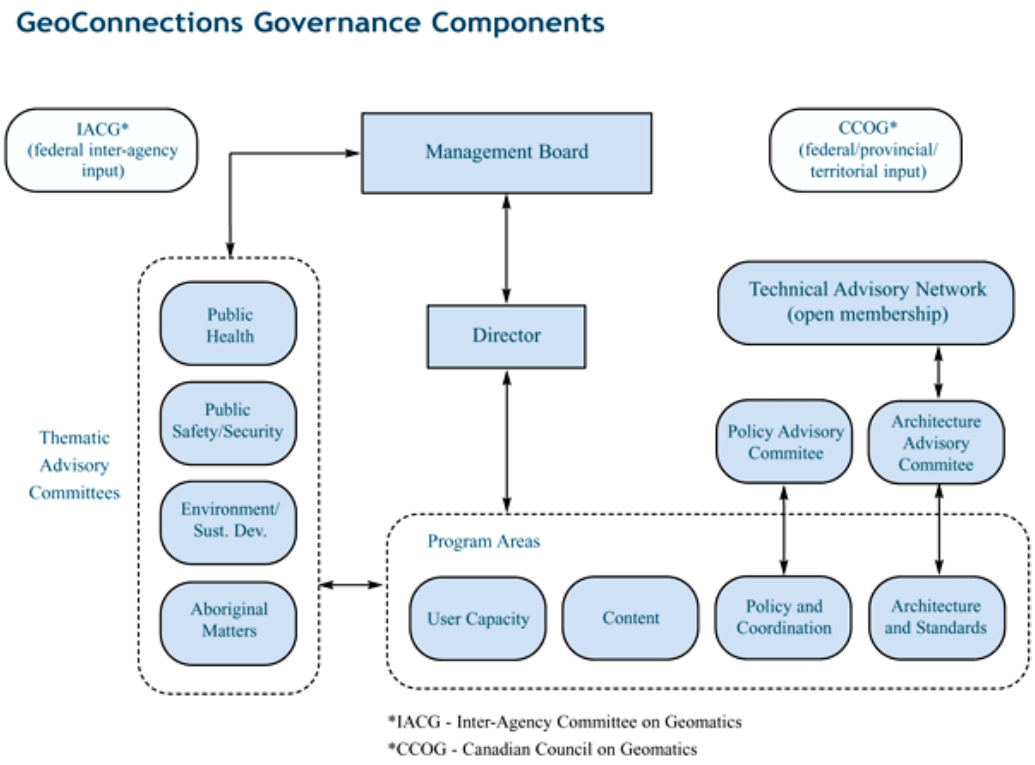

Figure 5 GeoConnections Governance Components

GeoConnections is continuing to work with the Inter Agency Committee on Geomatics, the Canadian Council on Geomatics and other large federal geospatial information initiatives.

Thanks to the CGDI, a new generation of geospatial applications is being developed. However, GeoConnections is not building these applications itself: rather, the user communities who need them are partnering in their development. GeoConnections' role is to provide the infrastructure for the development of the applications, as well as incentives to use the CGDI.

GeoConnections actively supports several **user communities**. A **user community** is a group of people who share an interest about a topic (domain), who interact on an ongoing basis, and who accumulate and disseminate knowledge in areas such as the environment, health, sustainable development, disaster management, community planning, transportation, and business development. For example, a watershed institute could collaborate with other organizations, municipalities, the provincial government and a federal government department to develop a water planning system that uses CGDI-endorsed standards to assist them in their decision-making.

CHAPTER 3

The Canadian Geospatial Data Infrastructure (CGDI)

The Canadian Geospatial Data Infrastructure aims to be a source for geospatial information and services in Canada. This chapter:

- Defines the scope of the CGDI;
- Describes its vision, mission, guiding principles and building principles;
- Lists the objectives and goals of the CGDI; and
- Outlines the benefits of the CGDI for Canadians.

3.1 What is the CGDI?

The Canadian Geospatial Data Infrastructure provides the technology, standards, access systems and protocols necessary to make Canada's geospatial databases available on the Internet.

Users of the CGDI can access and layer different kinds of location-based information through the Internet to create new perspectives for better decision-making. Information science research has estimated that 80 percent of all data worldwide is location-based, even if the primary reason for collecting it is not for geographical analysis. For example, health records are a priori about patients' health, however, they include location-based information describing where the patient lives, works and which hospital they visited. Once privacy safeguards are in place, these geographic references can be used to track the spread of diseases or illnesses as geographically related to other factors, e.g. water supply, restaurant/food chains, ambient air quality. The concept applies to almost any data.

Before the CGDI, various jurisdictions and organizations collected location-based data in disparate ways, using different standards. As a result, similar datasets were incomparable across jurisdictions. The impacts of the barriers to data access were magnified when opportunities for sharing geographic data through Internet mapping applications arose in the mid 1990s. These applications were difficult to develop, required sophisticated expertise, and were created from 'scratch' as isolated systems. Users were typically experts in sectors traditionally closely related to mapping (e.g. natural resource management and urban planning). The potential of these technologies to improve decision-making by handling location-based information over the Internet was being undermined.

By building the CGDI, GeoConnections has kept Canada at the leading edge of accessing, sharing and using location-based information over the internet. The CGDI's strength is drawn from its ability to enable sharing and integration of data required for decision-making on many inter-jurisdictional challenges. Many partners from industry, Federal/Provincial/Territorial agencies and municipalities are now either using the infrastructure to address their operational needs or view the CGDI as a solution to improve service delivery efficiencies and information flows between levels of government. Stakeholder feedback has supported the need for continued collaboration and investment on this important technological solution.

The CGDI's horizontal nature supports a cohesive national approach to the economic, social and environmental priorities of the federal government. GeoConnections' projects will extend capacity beyond a handful of early adopters, enabling mainstream users to benefit from the CGDI.

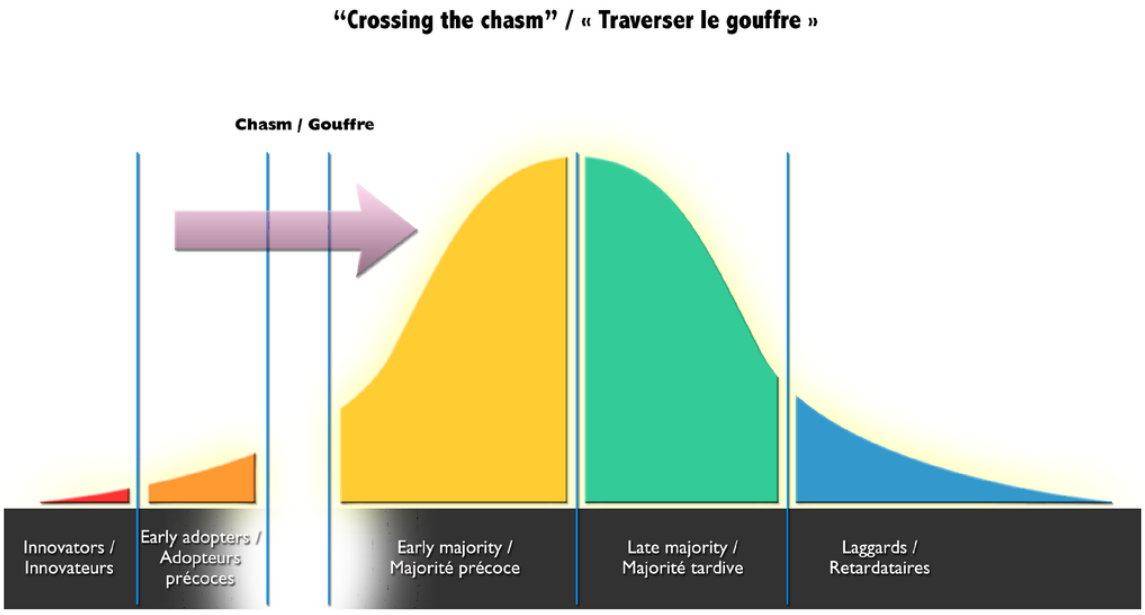

Figure 6 "Crossing the Chasm"

It is vital that there be standards and interoperability in the area of geospatial data technology. If not, time, money and effort will be duplicated, and Canada's geospatial data will be a patchwork at best. Through the CGDI, Canadian governments at all levels are managing their responsibilities more efficiently and enhancing decision making with more complete information at their disposal.

The CGDI was created to:

- Facilitate sharing of geospatial information;
- Improve planning for future investments in geospatial data;
- Expand collaborative partnerships that help leverage investments and reduce duplication;
- Encourage the adoption of standards for sharing and using geospatial information;
- Enable informed decision making by providing easy access to current information, knowledge and expertise;
- Promote efficiency by reducing duplication of efforts through national standards, specifications and services that support collaboration;
- Enable usability for Canadian governments, firms and individuals that need a reliable system, an "infrastructure" to access and use these resources;
- Facilitate growth in the export of Canadian technology, products, expertise, and services.

Canadians benefit from these advances whether as users or providers of data, technology and expertise. With continued advancement, Canadian

businesses will be able to sustain and enhance their position in global markets with sought-after geospatial data products, expertise, and services.

3.2 Vision, Mission, Guiding Principles and Building Principles

Like other national spatial data infrastructures, the Canadian Geospatial Data Infrastructure formalizes the structure and process for organizing, using and sharing geospatial data and services common to a broad spectrum of applications and users within a country. The concept of a geospatial data infrastructure is not new. Countries such as Australia and the United States of America have also established their own national geospatial data infrastructures, and others are following suit.

Note that while the terms "geospatial" and "spatial" are synonyms, "geospatial" is the preferred term in Canada. In this manual "geospatial" refers to the Canadian initiative, whereas "spatial" refers to other data infrastructures.

Access to data and services, data policy, framework data, technology, and standards are five major components common to any spatial data infrastructure. **Access** to data and services is a key feature of spatial data infrastructures and should include the ability to locate geospatial information and Web access. **Policies** with regards to sharing geospatial information (e.g. guides to best practices for dissemination of government geospatial data in Canada) are being implemented. For **framework data**, agreements are being ratified to establish national spatial data infrastructure framework layers, by coordinating the baseline information through partners and linking them to a common ground. With respect to **technology**, integration is the key to the success of any national spatial data infrastructure in which disparate hardware and software work seamlessly. Geospatial **standards** are essential to all national spatial data infrastructure components.

The **Vision** of the CGDI is:

> To establish a Canadian geospatial information infrastructure that is accessible to all communities, pervasive throughout our country, ubiquitous for its users, and self-sustaining, to support the protection and betterment of Canada's health, social, cultural, economic and natural resource heritage and future

To achieve the Vision of the CGDI, GeoConnections' **mission** will be to:

- Enable decision-making and policy development that address Canada's priority issues such as health, social, cultural, economic, and natural resources.
- Facilitate access to the leading sources of Canadian geospatial information.

- Provide continued involvement and leadership in the development of geospatial standards and specifications.
- Foster partnerships and sharing of geospatial information across all sectors, at all levels of government, and at the international level.
- Support a broad and vibrant user community.
- Ensure that infrastructure operations are on going and sustainable.

At its inception the **guiding principles** of the CGDI set the course and scope of the initiative. These principles remain relevant today, with some minor modifications. Combined, these guiding principles serve as the foundation upon which the Vision and Mission of the CGDI is built. During recent consultations, the geospatial community reviewed and endorsed the principles in addition to providing suggestions that three new building principles be included.

1. **Open**: The CGDI is based on open and shared specifications for operational transactions and information exchange. "Open and shared" in this context means that the specifications are available for the world to take, to use, and to modify for other purposes. These specifications are based on national and international standards where available.

2. **Transparent**: The CGDI allows users to access data and services seamlessly in a manner that removes the complexities of the underlying technology and information infrastructure. "Seamless" data access refers to the elimination or hiding of artificial spatial boundaries introduced by jurisdictional organization structure or by technical artefacts such as scale or quality of information.

3. **Cooperative**: The CGDI facilitates the cooperation and collaboration of participating organizations from all sectors, levels of government, and academia.

4. **Evolving**: The network of participating organizations encompasses new requirements and business applications for information and service delivery to their respective users. The CGDI will evolve to meet these changing requirements.

5. **Timely:** The CGDI is based on technologies and services that support timely or real-time access to information.

6. **Sustainable**: The CGDI will ensure its long-term sustainability through its relevance to the needs of the participating agencies and users.

7. **Self-organizing**: The CGDI enables various levels of participating organizations to contribute geospatial information, metadata, services and applications without the requirement for centralized administration, access and warehousing. Organizations are responsible for their own content.

Building Principles

1. **User-driven**: Future developments, services, and enhancements to the CGDI are driven by the needs of its four priority user communities, with an aim to facilitate policy and decision making.

2. **Closest to Source**: The CGDI will build upon its principle of self organization to encourage organizations that are closest to source to provide data. This increases quality and efficiency by eliminating duplication and overlap. The CGDI will be developed further through partnerships with municipal, provincial and territorial governments, other federal departments and agencies, as well as international sources.

3. **Secure**: The CGDI recognizes the importance of openness as one of its fundamental principles, but realizes that there is also a need to secure certain data that is sensitive or proprietary. In conjunction with this need for security is the need for high stability and for reliability of the data, to ensure that timely access is maintained.

3.3 Objectives and goals of the CGDI

For the Vision to be realized and the Mission to be effective, each Mission objective needs to be linked to measurable goals. An organization coordinating the further development of the CGDI must actively pursue targeted goals over the next five years. It should be noted that some goals can address multiple Mission objectives. The main objectives and corresponding goals for continued development of the CGDI are:

Objective 1: Support decision making and policy development to ensure Canada's health, social, cultural, economic, and natural resource heritage and future.

- Goal: Further improve policy development and further enable decision making based on geospatial information.

Objective 2: Facilitate access to the leading sources of Canadian geospatial information.

- Goal: Establish the CGDI as the primary channel for Canadian geospatial information, across all sectors and levels of government.
- Goal: Enable comprehensive federal, provincial and territorial, and municipal data to be made accessible via the CGDI.
- Goal: Continue excellence in technological infrastructure development.

Objective 3: Provide continued involvement and leadership in the development of geospatial standards and specifications.

- Goal: Monitor and contribute to the work of the Open Geospatial Consortium (OGC) and ISO (International Organization for Standardization) in partnership with industry, academia, and all levels of government.

Objective 4: Foster geospatial partnerships and contributions across all sectors, at all levels of government, and at the international level

- Goal: Continue relationships with existing advisory groups, and create new groups where needed.
- Goal: Communicate developments and create services to keep partners informed of opportunities and technology updates.
- Goal: Build on the foundation of the Canadian Geomatics Accord and look to formalize relationships at the provincial, local, and international levels.

Objective 5: Support a broad and vibrant user community

- Goal: Drive future CGDI development based on user needs.
- Goal: Foster opportunities within the geospatial and user community.
- Goal: Ensure there are appropriate service supports for users with the necessary financial and human resources available.

Objective 6: Ensure that the operations are on-going and sustainable.

- Goal: Secure funding to support the future operations of the CGDI.
- Goal: Investigate new models of governance with partners contributing to the self-sustainability of the CGDI.

3.4 Benefits of the CGDI

Canadians are benefiting from the Canadian Geospatial Data Infrastructure through:

- Universal access to geospatial information, anywhere, anytime;
- The development of applications to discover and access distributed online information;
- The integration of different geospatial information to provide seamless views;
- Seamless chaining of applications, data and services or combinations of these;
- Geospatial update and exchange capabilities, which enable collaborative activities;
- The sharing of geospatial semantics, allowing easier integration of information;

- Wide-scale interoperability, by adhering to common and open information standards and specifications; and
- The development of effective partnerships with regional and sector-specific spatial data infrastructures and linkages with other national spatial data infrastructures to form a global spatial data infrastructure.

Developing applications benefit from the infrastructure through:

- **Reduced costs**: Applications can be built by reusing existing services.
- **Reduced complexity**: Service interfaces hide the underlying complexity.
- **Less costly integration and interoperability**: Standard service interfaces simplify interconnection and integration.
- **Direct access** to current, authoritative source data.

In sum, the CGDI and the new applications it spawns lead to:

- **Informed decision-making**: The CGDI provides easy access to current information, knowledge and expertise.
- **Efficiency**: National standards and specifications, as well as access to services, reduce duplication of effort.
- **Usability**: The CGDI provides reliable access to geospatial information for Canadian governments, businesses and individuals.
- **Economic growth**: The CGDI encourages the profitable export of Canadian technology, products and services and internal growth with increased sales.

CHAPTER 4

The Architecture of the CGDI

The architecture of the Canadian Geospatial Data Infrastructure is similar to those of electrical power infrastructures and other data infrastructures. This chapter:

- Describes a basic geospatial data infrastructure;
- Uses the analogy of an electrical power infrastructure to describe the components of the CGDI;
- Illustrates the importance of common standards for geospatial data infrastructures; and
- Explains how the CGDI will join other spatial data infrastructures to form a global spatial data infrastructure.

4.1 Spatial Data Infrastructures

The term **spatial or geospatial data infrastructure (SDI)** is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. The Global Spatial Data Infrastructure (GSDI) describes infrastructures in the following manner:

> The spatial data infrastructure provides a basis for spatial data discovery, evaluation, and application for users and suppliers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general.
>
> The word infrastructure is used to promote the concept of a reliable, supporting environment, analogous to a road or telecommunications network, that, in this case, facilitates the access to geographically-related information using a minimum set of standard practices, protocols, and specifications. Like roads and wires, a spatial data infrastructure facilitates the conveyance of virtually unlimited packages of geographic information.
>
> A spatial data infrastructure must be more than a single dataset or database; it includes geographic data and attributes, sufficient documentation (metadata), a means to discover, visualize, and evaluate the data (catalogues and web mapping), and some method to provide access to the geographic data. Beyond this are additional services or software to support applications of the data. To make a spatial data infrastructure functional, it must also include the organizational agreements needed to coordinate and administer it on a local, regional, national, and or trans-national scale.
>
> The creation of specific organizations or programs for developing or overseeing the development of spatial data infrastructures, particularly by governments at various scales, can be seen as the logical extension of the long practice of coordinating the building of other infrastructures necessary for ongoing development, such as transportation or telecommunication networks (http://www.gsdi.org/pubs/cookbook/chapter01.html).

4.2 Anatomy of an Infrastructure

To understand the architecture of the CGDI, it is useful to consider the anatomy of another common infrastructure: electricity. Any electrical power infrastructure has three main components:

1. **Suppliers**: Those who supply electrical power to the infrastructure.

2. **Users**: Those who consume electrical power. Users consume electrical power for a variety of different purposes, many of which were not conceived when the infrastructure was created.

3. **Interconnection Medium (link)**: The connections between the suppliers and users. Suppliers generate electricity in a variety of manners (e.g. nuclear, hydroelectric), and users consume electricity for different purposes. What allows all parties to work together successfully are the standards embodied in the interconnection medium. Of course, for the infrastructure to be successful, some initial investments must be made in building the link.

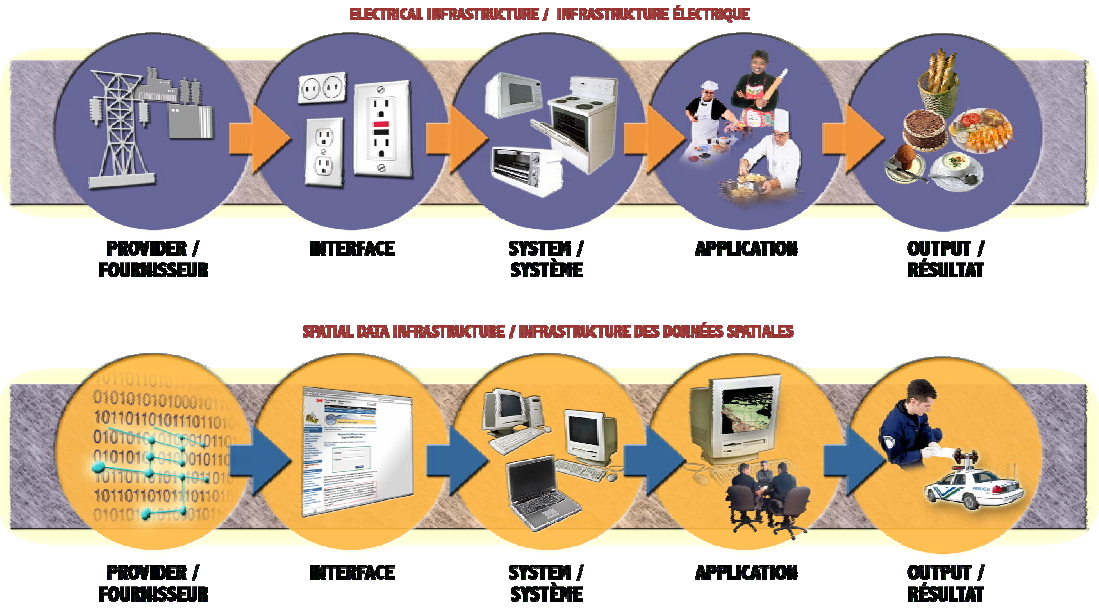

Figure 7 The Interconnection Medium

The general description of any electrical power infrastructure does not focus on specific suppliers or users of electricity, given the diversity of both, but rather on the standards and interconnection mechanisms that allow them to interoperate. This is a general feature of all infrastructures.

Spatial data infrastructures have many similarities to electrical power infrastructures. Users and suppliers exchange the infrastructure's "currency"; in the case of spatial data infrastructures, the currency is geospatial information.

Like power infrastructures, the architecture of a spatial data infrastructure is best described in terms of the standards and interconnection mechanism and not the details of particular applications of its currency.

A spatial data infrastructure facilitates the flow of geospatial information between suppliers and users. Suppliers make data available through standard services, and users use the data and services to build applications. The infrastructure includes these services and applications, but the core architectural components are the standards and interconnection mechanisms that make the interoperability possible.

4.3 Components of the CGDI

Similarly, the core of the CGDI is the link that enables users to build applications from geospatial data and services made available by its numerous suppliers. With electricity, a network of electrical power lines connects suppliers and users; for its part, the CGDI relies on the Internet to interconnect its suppliers and users.

Both infrastructures, however, require standards of use. The electrical network in North America, for example, uses standards that allow anyone to safely plug a toaster into any outlet, knowing that it will deliver electricity at 110V 60Hz. However, different standards are used in Europe and North American toasters do not work there without adapters. In the same way, the CGDI uses standards that enable geospatial data to be easily exchanged over the Internet from suppliers to users. Specific CGDI standards are discussed in Section 9.2.1.

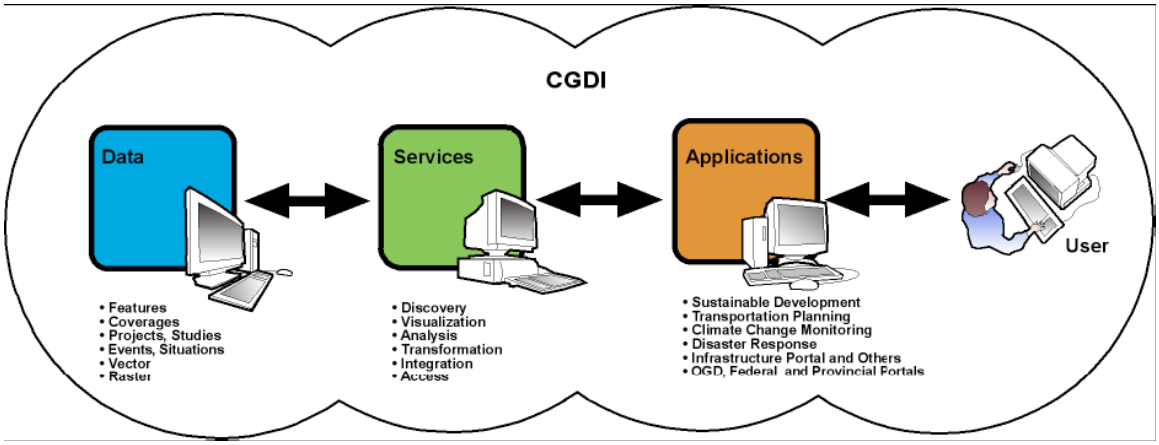

Figure 8 Components of the CGDI

4.4 Common Standards

Developing, maintaining and upgrading any type of infrastructure requires the coordinated efforts of many organizations. Implementing the foundation of a system, however, can often involve many different techniques. Just as an electrical power infrastructure is coordinated by multiple bodies, so too is the

Canadian Geospatial Data Infrastructure. Despite this mixture, organizations are working together by using **common CGDI-endorsed standards**.

More specifically, the CGDI conforms to a published **web services architecture** in order to leverage the underlying information technology (IT) and infrastructure of the Internet along with ongoing developments in web service technology.

A web service is composed of reusable software components that encapsulate discrete functionality; it is distributed over standard Internet protocols. The functionality conforms to a defined interface and provides transparency to users as to how and where the service is implemented.

Within the CGDI, access to geospatial data is provided through web services. Various services have been defined for specific functions required by types of geospatial data, and for multiple access systems (e.g. "search metadata" versus "retrieve data").

In defining these services, the CGDI uses existing standards and specifications such as those from the United States Federal Geographic Data Committee (FGDC), International Organization for Standardization (ISO) 19100 series, and Open Geospatial Consortium Inc. (OGC) standards and specifications. In this way, the CGDI is able to integrate and function with other federal, provincial, territorial, municipal and industrial geospatial infrastructures and initiatives throughout Canada and abroad.

4.5 Common Framework Data

The Canadian Geospatial Data Infrastructure facilitates the use of and access to all geospatial data.

The CGDI also promotes sharing and compatibility of geospatial data by defining a common set of framework data.

Framework data is geographic data that provides context and reference information for Canada. You can incorporate framework data into your application to provide context to other information. For example, to show your business location on a map, framework data will provide the surrounding roads; all you need to do is provide the location of your business and the framework data provides the geographic context or background information.

Framework data comprises features that are composed of a geometric representation and their related attributes. Moreover, attributes are those that can provide context and reference information for the country, namely those that can either underpin or enable most geospatial applications. When applicable, toponymy (place names of a region) is one specific attribute of the features that compose framework data.

For instance, users have access to free framework data such as geodetic network, national road network, geopolitical boundaries, geographical names, digital elevation data and satellite imagery through the GeoBase portal (www.geobase.ca). Use is unrestricted.

See Section 9.3.1 for more information.

4.6 Joining the Global Spatial Data Infrastructure

As a result of these common standards and framework data, the Canadian Geospatial Data Infrastructure is able to join with other national spatial data infrastructures to form a **global spatial data infrastructure**, providing Canadian data and information suppliers with access to global markets. The Global Spatial Data Infrastructure describes the globalization of geospatial data infrastructures in this way:

> Just as spatial data infrastructure programs necessarily involve the alignment of scarce resources for achieving success, so too it is necessary to ensure that spatial data infrastructure initiatives develop in harmony with each other in order to maximize the impact of these programs. In reality, many initiatives are working in isolation, not necessarily developing in harmony with others and consequently unable to reap the benefits of working together.
>
> Anyone who is involved in a project of which spatial information forms an integral part and who intends leaving a legacy of spatial data or tools to exploit the data that lasts beyond the period of funding for the project is, by definition, participating in some of the fundamental elements required by a spatial data infrastructure. As coordination between such organizations expands, these projects very often lay the foundations on which initiatives formally dedicated to the establishment of spatial data infrastructures can then build.
>
> At a global scale, the most prominent examples of formal spatial data infrastructure programs are on a national scale. Most of these are driven by national or federal governments (e.g. the NSDI in the USA, the SNIG in Portugal, Australia's ASDI, Malaysia's NaLIS, South Africa's NSIF, Colombia), but there are exceptions such as the Uruguay Clearinghouse and NGDF in the United Kingdom, which have largely been driven by the private sector.
>
> In most cases the need for wide participation in the development of lasting, useful spatial data infrastructures is acknowledged, and so private-public partnerships are encouraged. The beneficiaries of spatial data infrastructures are generally seen to derive from the public and private sectors, academia and non-governmental organizations, as well as

individuals. Federal countries are often able to build their national spatial data infrastructure programs on spatial data infrastructure programs being driven by provincial or state governments (e.g. the ASDI of Australia). Trans-national spatial data infrastructure initiatives often arise out of existing trans-national structures (e.g. the Permanent Committee for GIS Infrastructure in Asia and the Pacific was formed through the UN Regional Cartographic Conference for the Asia-Pacific region) (http://www.gsdi.org/pubs/cookbook/chapter01.html).

Joining the global spatial data infrastructure via the CGDI will provide Canadian data and information providers with access to global markets. This in turn provides users and organizations from around the world with access to Canadian data, services and organizations. A barrier-free geospatial infrastructure, at both the national and global levels, is of great economic and social benefit to Canadians. In short, a global geospatial data infrastructure will give Canadians a better view of the world and its issues.

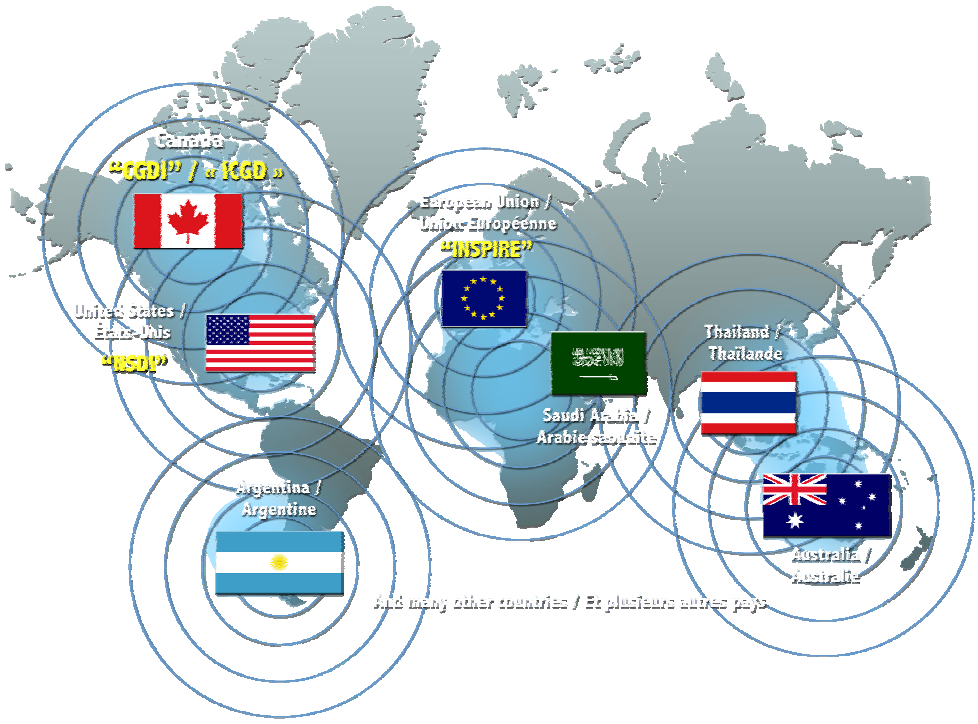

Figure 9 Global Spatial Data Infrastructure

SECTION II

Discovering Geospatial Information

You can use the Canadian Geospatial Data Infrastructure to promote your data and services to users from across Canada and around the world. The first step in promoting your services is to choose a discovery mechanism. This section explains how discovery mechanisms connect users and suppliers of geospatial services and resources.

Chapter 5 explains what a discovery mechanism is, and how it allows users to search remote databases as well as describes the various discovery mechanisms (provincial, thematic and national) with which you can find geospatial resources within the CGDI.

Find geospatial data, services and organizations from across Canada and around the world
Evaluate available resources to ascertain whether they meet your needs
Access the geospatial resources of interest to you

CHAPTER 5

Using Discovery Mechanisms within the CGDI

The first step in promoting your services within the Canadian Geospatial Data Infrastructure is to choose a discovery mechanism. Discovery mechanisms connect users and suppliers of geospatial services and resources. This chapter:

- Explains how users find, evaluate and access geospatial resources with a discovery mechanism; and
- Describes the provincial, thematic and national discovery mechanisms within the CGDI.

5.1 Mechanisms to Discover Geospatial Resources

In a data infrastructure like the CGDI, a **discovery mechanism** is an online service that brings together suppliers (those providing resources) and users (those using the resources). Discovery mechanisms allow users to discover, evaluate and access geospatial information in the form of data products, services, resources or organizations.

Users perform a search within the chosen discovery mechanism to find a resource. They can then access the desired resource using whatever access methods the supplier has provided for those products.

Figure 10, Using a Discovery Mechanism, illustrates how a user typically finds, evaluates and accesses resources from a discovery mechanism within the CGDI.

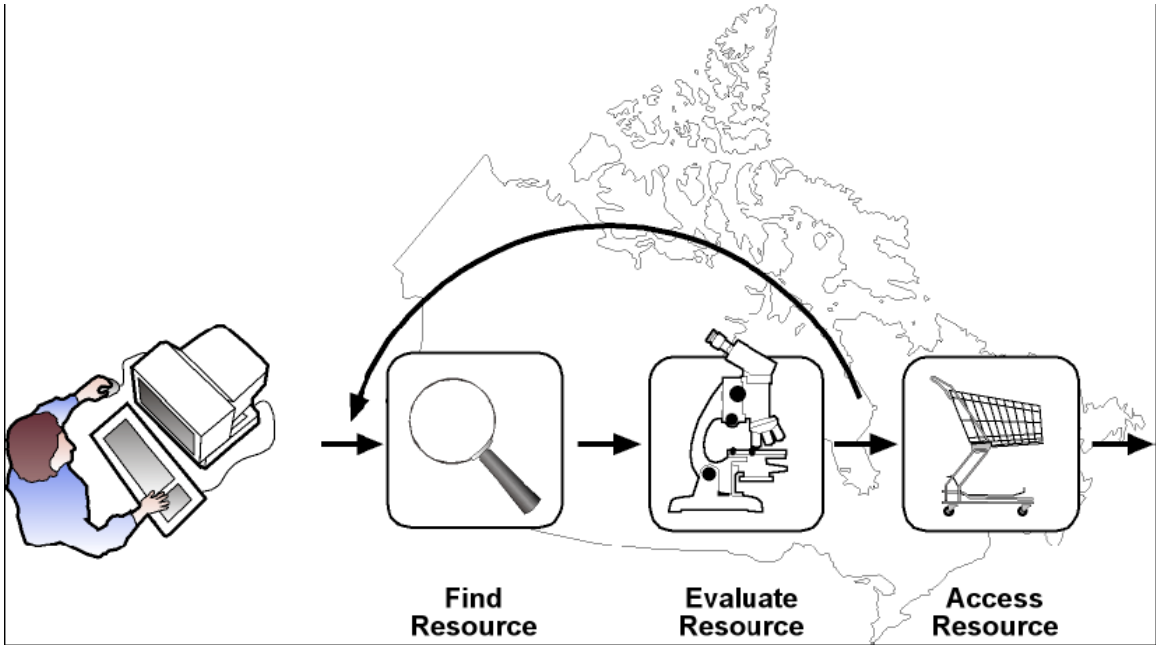

Figure 10 Using a Discovery Mechanism

5.1.1 Finding Resources

The first step in **finding resources** is to browse or search through a directory or inventory of geospatial data and services. A **directory** is a type of catalogue in which collections of data are described through metadata. An **inventory** is a catalogue that lists individual data products. A **catalogue** is a complete list of things, usually arranged systematically. Most **databases** are comprised of inventories and catalogues.

5.1.2 Evaluating Resources

Once users have found a resource of interest to them, the next step is to evaluate it to see how and if the resource meets their needs.

There are several ways of **evaluating resources** found through a discovery mechanism. The first is with a textual description. **Metadata** (information about data) offers a standardized group of categories that describes a data product or service. Metadata allows users to evaluate a resource using detailed and resource-specific information. For satellite imagery, for example, this would include the resolution, cloud cover, time and year the image was acquired.

The second evaluation method is to use **visualization tools**. For satellite imagery, low-resolution pictures provide a means for visual evaluation. For other data, web map servers allow users to view and interact with the dataset.

5.1.3 Accessing Resources

Once users have found and evaluated the desired resource, there are several ways for them to **access**, or obtain, the resource in question, depending on whether the resource involves data products or services.

Users can directly access data by web access, Internet downloading, telephone ordering, email ordering, Internet-based I-commerce and format conversion services used in conjunction with one of these means of access. Some directory services also provide a means to broker data whereby the directory service acts as an initial intermediary between the user and the data supplier. Other means of access included using web services or visualization services.

5.2 CGDI Discovery Mechanisms

There are several kinds of discovery mechanisms in the Canadian Geospatial Data Infrastructure these can originate from user communities, provinces, industry, governments and can be regional to national in scope.

Not all discovery mechanisms are infrastructures since they do not all meet the requirements of spatial data infrastructures as discussed in Section 4.1 - Spatial Data Infrastructures.

You may choose the discovery mechanism(s) that best fits your needs.

5.2.1 Provincial Discovery Mechanisms

Provinces are contributing at different levels towards the Canadian Geospatial Data Infrastructure. The Canadian Geomatics Accord was created in an effort to record the interest, will and commitment of federal, provincial and territorial

governments and Crown corporations to cooperate in geomatics initiatives of mutual interest.

A new Geomatics Accord is being signed. It is expected that all provinces and territories will sign the Accord.

They are cooperating together towards the following goals:

- The establishment of a Canadian geospatial data infrastructure;
- Data and information production, integration, and sharing;
- Data distribution and licensing;
- Standards and specifications;
- Technical and policy research; and
- Applications development.

The CGDI comprises provincial geospatial data infrastructures that include directories of data and services of interest on a provincial level. These **provincial discovery mechanisms** include:

- **Land Information Ontario** (www.lio.mnr.gov.on.ca/), an application that enables users to quickly examine land information. Land Information Ontario's web-enabled data browser makes it possible to access a growing collection of seamless geospatial, base and thematic data.
- **GeoNOVA** (http://www.gov.ns.ca/geonova/home/default.asp) aims to provide Nova Scotians with online access to the discovery, sharing and use of Nova Scotian geospatial data, services and applications. The intent is to make Nova Scotia geographic data accessible on the Internet and to participate in the Canadian Geospatial Data Infrastructure. Tools include a map viewer, coordinate transformation service, atlas service and a civic address application.
- **British Columbia – Land and Resource Data Warehouse (LRDW)** (http://www.lrdw.ca), the information service initiative of the British Columbia Ministry of Sustainable Resource Management. It is a new vision for the effective delivery of integrated, science-based land, resource and geographic information in support of government's vision of economic development and a vibrant provincial economy, a sustainable environment and health communities.

The following provincial discovery mechanisms have geospatial data available on the Internet but are not infrastructures:

- The **Atlantic Coastal Information Portal (ACIP)** (http://aczisc.dal.ca/acip) is an online catalogue of geospatial data. ACIP was implemented in May 2005 as the latest phase in development of the Atlantic Coastal Database Directory which was initiated in 1992 as an inventory describing databases of relevance to the integrated management and sustainable development of the coastal zone of Atlantic Canada.

- **AltaLIS Ltd** (www.altalis.com/) is responsible for making Alberta's base mapping infrastructure more available, accessible, accurate and affordable. It provides urban and rural cadastral data, topographic data and small scale data for the province of Alberta. AltaLIS features four primary provincial mapping datasets: Urban Cadastral, Rural Cadastral, Topographic and Small Scale.

- **Service New Brunswick (SNB)** (www.snb.ca) delivers transactional services to the residents of New Brunswick and leads the management of government information infrastructure such as land information and personal and property registry data. SNB's Real Property Information Internet Service (RPIIS) provides Internet-based access to the property map and ownership information on all land parcels in the province.

- **Service Nova Scotia and Municipal Relations (SNSMR)** (http://www.gov.ns.ca/snsmr/land/) is responsible for developing, maintaining and distributing the province's corporate, primary geographic information, including the Nova Scotia Topographic Database, the Nova Scotia Coordinate Reference System, the Nova Scotia Property Records Database, and the Nova Scotia Aerial Photography Archive which consists of maps, electronic databases and aerial photographs.

- **British Columbia – Integrated Land Management Bureau** (http://ilmbwww.gov.bc.ca/bmgs/) specializes in the provision of base map and geo-referencing data, corporate datasets and derived products as well as derived information to clients in government and the private sector.

- The **Manitoba Land Initiative (MLI)** (http://web2/mli) is the source for geospatial information from the Government of Manitoba. It enables online access to the MLI metadata catalogue, land data warehouse and digital maps.

- **Le Territoire** (http://www.mrnfp.gouv.qc.ca/english/home.jsp) provides a wealth of information about Quebec's territory and energy, forestry, wildlife and mineral resources as well as legal and technical tools related to the sustainable management of these resources and their development.

- **Information Services Corporation of Saskatchewan** (http://www.isc.ca/default.aspx?DN=1,Documents) integrates all land

transactions and land-based infrastructure-based resources, mapping and geographic information system needs for the province of Saskatchewan. It is a one-stop source that integrates all land titles, provincial survey, mapping and geographic information system (GIS) needs of everyone doing business in Saskatchewan.

- **Indian and Northern Affairs GeoPortal** (http://geoportail-geoportal.ainc-inac.gc.ca/main_e.html) makes location-based data and geographic map visualization available to Canadians and the first Nations community with an interest in geomatics. The INAC GeoPortal project, initiated by Corporate Services Information Management Branch (IMB) and developed in partnership with the INAC Geomatics community of practice and the GeoConnections Program, enables users to quickly view maps on-line within a First Nations context

5.2.2 Commercial Discovery Mechanisms

The CGDI links to **commercial discovery mechanisms** that publish information and services for people who use a common application or product.

- ESRI Canada **Geography Network** (www.geographynetwork.com/) is a global commercial network of geographic information users and suppliers. It provides the infrastructure needed to support the sharing of geographic information among data suppliers, service providers, and users around the world. Through the Geography Network, you can access many types of geographic content including dynamic maps, downloadable data, and more advanced web services.

  The Geography Network is managed and maintained by ESRI, a company specializing in GIS products and services. ESRI sponsors the Geography Network to promote the sharing and discovery of geographic information and services. It is intended to support the vision of a spatial data infrastructure enabling ready access to geographic information.

5.2.3 Thematic Discovery Mechanisms

The CGDI connects to **thematic discovery mechanisms** based on topics of interest such as ecology, forestry, geology, etc. Thematic discovery mechanisms are coordinated by several organizations at the federal, provincial, municipal, commercial and national levels, and include the following:

- The **Ecological Monitoring and Assessment Network (EMAN)** (http://www.eman-rese.ca/eman/datamanage.html) is comprised of linked organizations and individuals involved in ecological monitoring in Canada to better detect, describe, and report on ecosystem changes. The network is a cooperative partnership of federal, provincial and municipal

governments, academic institutions, aboriginal communities and organizations, industry, environmental non-government organizations, volunteer community groups, elementary and secondary schools and other groups and individuals involved in ecological monitoring.

- The **National Forest Information System (NFIS)** (http://nfis.org) will enable the consolidation, coordination and analysis of dispersed forestry-related information held by resource management agencies such as federal, provincial and territorial governments and others in support of national and international reporting requirements for sustainable forest management. The NFIS provides forestry-related information and integrates remotely-sensed data and provincial data in support of national and international reporting requirements for sustainable forest management.

- The **Canadian Geoscience Knowledge Network (CGKN)** (http://cgkn.net/2002/index_e.html) is an initiative of the National Geological Surveys Committee (NGSC) to provide an Internet portal to Canadian geoscience information. Through the CGKN web site, clients are able to discover, view, evaluate and obtain consistent and standardized geoscience data, maps and publications. The NGSC has coordinated partnerships with federal, provincial, and territorial government agencies, as well as private-sector organizations, to establish a nationally comprehensive network in the CGKN. As one of the partners, GeoConnections is the program responsible for the Canadian Geospatial Data Infrastructure; for its part, the CGKN will become the geoscience component of the CGDI.

- The Department of Fisheries and Ocean Canada's **GeoPortal** (http://geoportal-geoportail.gc.ca/index_en.html) provides on-line mapping capability through the use of web-mapping services that enable the visualization of DFO maps, local aeronautical charts, hydrographic surveys and data display.

- **RésEau** enables access to water information from many jurisdictions across Canada. RésEau offers a vision of providing water information to Canadians in an easy, transparent way. RésEau equips you with modern search tools, interactive mapping, and downloadable applications - all accessible in one place (http://map.ns.ec.gc.ca/reseau/en/).

5.2.4 National Discovery Mechanisms

The **GeoConnections Discovery Portal** (http://geodiscover.cgdi.ca/) is both a dedicated geospatial search engine and a national discovery mechanism for the CGDI. It allows users to find, evaluate and access resources within the CGDI. The GeoConnections Discovery Portal's key component is its **directory**. The directory contains descriptions of geospatial data, services (including web

services) and the organizations that provide them. Users can search for content using spatial, temporal, keyword and textual constraints or browse the directory contents. Suppliers can register and update their registration information from their web browser into the GeoConnections Discovery Portal. Appendix 2, The GeoConnections Discovery Portal, provides more details about this national discovery mechanism.

GeoBase (www.geobase.ca) is a federal, provincial and territorial government initiative that is overseen by the Canadian Council on Geomatics (CCOG) (http://www.geobase.ca/geobase/en/about/ccog.html). It is undertaken to ensure the provision of, and access to, a common, up-to-date and maintained base of quality geospatial data for all of Canada. Through the GeoBase portal, users with an interest in the field of geomatics have access to quality geospatial information at no cost and with unrestricted use. For more on GeoBase initiative: (http://www.geobase.ca/geobase/en/about/index.html;jsessionid=4713C51D55A417901A2140E7AE8B87F4).

The **National Land and Water Information Service** (http://www.agr.gc.ca/nlwis-snite/index_e.cfm) provides agri-environmental resource data on land use, soil, water, climate and biodiversity to assist land-use decision makers.

RésEau (http://map.ns.ec.gc.ca/reseau/en/) establishes partnerships and projects to demonstrate the sharing, discovery, access, and use of water information over the Internet. Its user-driven focus targets information for a wide range of generalists and specialists - from high school-level youth to water resource managers.

SECTION III

Searching Databases and Making Your Database Searchable

This section explains how you can make your database searchable by connecting it to the Canadian Geospatial Data Infrastructure. This allows users to directly, and remotely, search your geospatial databases or catalogues, which increases your exposure internationally.

Chapter 6 describes what happens when you, or others, search for geospatial resources in the CGDI, including the role of search servers and the search process.

Chapter 7 explains the function and structure of search protocols in the CGDI, describes stateful and stateless searches, and outlines the features of the Z39.50 search protocol, describes the Catalogue Service for Web (CSW) and the ISO 19115 metadata schema.

Chapter 8 describes the benefits of making your database searchable and the process for setting up a Z39.50 FGDC/GEO search connection.

Search for geospatial resources
Allow users to search your geospatial databases
Discover tools to connect your database to the CGDI

CHAPTER 6

Architecture for Distributed Searches

Before you allow others to search your geospatial data products or collections through the Internet, you may be interested to learn more about exactly what happens when someone performs a remote search. This chapter:

- Explains the roles of a search server, which connects your database to a discovery mechanism such as the GeoConnections Discovery Portal; and
- Describes the communication process between your search server and the discovery mechanism.

6.1 Search Servers

A **search server** connects your database to a discovery mechanism such as the GeoConnections Discovery Portal. A search server is a program on a computer that is connected to the Internet. It accepts search queries through the Internet, then queries a database connected to the same local area network (LAN) as its host computer. The database returns the result to the search server, and the search server returns the result to the Internet client that originated the request (e.g. the GeoConnections Discovery Portal).

Figure 11, shows a search server positioned at a data supplier's (i.e. your organization's) web site.

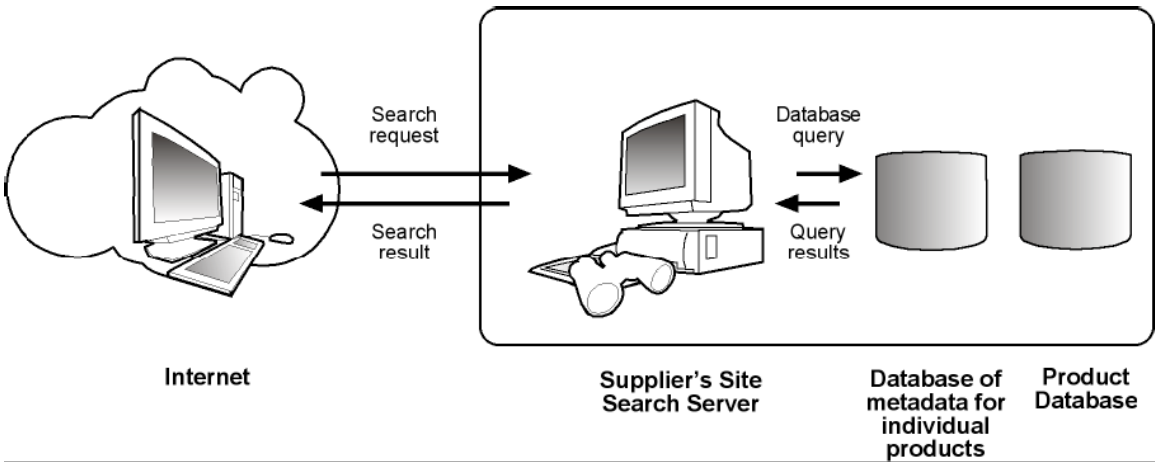

Figure 11 Search Servers

There are special types of servers available specifically to publish geospatial data on the Internet. The kind of search server that you install or create depends on the search protocol that you use. Different protocols have different demands and different advantages and disadvantages.

The search server acts as a "go between" between the Internet and your database. It has two roles to fulfill:

1. **Translator**: It must translate between the language spoken in the search request or result over the Internet and the language or mechanism used to query your database where the information about the individual product(s) is actually held.

2. **Search and Result Server**: It must pass on the translated query to your database and get the results of the query from the database. For example, the search server may be on a different physical machine than the database (but both are still at your site), and it may communicate with the database via an intranet. The search server must then send the query to

your database over the intranet, and then receive the result over the intranet. Typically these roles are filled using a mechanism such as Structured Query Language Network (SQLNet), Visual Basic Script (VBScript), Eiffel Structured Query Language Library (ESQL), or Open Database Connectivity (ODBC). The kind of search server that you install or create depends on the search protocol that you use; different protocols have different demands.

6.2 The Search Process

How the discovery mechanism finds your search server

A discovery mechanism such as the GeoConnections Discovery Portal must know the Internet Protocol address (IP address) of your search server and, depending on the search protocol, the database name and the specific port to connect to on your server. All this information is contained in the product registration information (e.g. in the GeoConnections Discovery Portal directory). As a data supplier, you maintain total control over your data product registration and may create, delete or modify your registration at any time using a standard web browser.

What the discovery mechanism sends to your search server

The discovery mechanism must somehow send the search to your remote search server. The search query provides the geographic area the user is interested in, the keywords the user is looking for, the desired time period, and other, more detailed criteria. The exact way in which this happens, and exactly what is sent between the discovery mechanism and your search server, is dictated by the search protocol.

What the search server sends back

After sending a query to your search server, the discovery mechanism expects some kind of response back. Typically, the response includes:

- The number of individual products (or, more technically, database records) which matched the query criteria;
- A list of unique identifiers for those individual products (this could be an inventory number, product identification, or image number);
- The geographic location of the individual products; and
- Other optional information about the individual products.

The exact nature of what is sent back by the search server is dictated by the search protocol. Regardless of the protocol, your search server sends back

enough information for users to distinguish between, and evaluate, the individual data products that you have made available.

CHAPTER 7

Using Search Protocols

Search protocols are another element in the process of searching for resources within the CGDI. Since you will be using search protocols when you make your database searchable, it is useful to understand their function and structure. This chapter:

- Provides a definition of a search protocol;
- Explains the architecture of most search protocols, and the difference between stateless and stateful searches;
- Describes the GEO profile of the Z39.50 search protocols
- Describes the Catalogue Service for Web (CSW); and
- Describes the ISO 19115 metadata schema.

7.1 What are Search Protocols?

A **search protocol** is a standard way of asking questions (or queries), getting answers, and exchanging information between two computers over the Internet. A search protocol is akin to a technical language. It specifies the transport mechanism for the information flow between the two computers.

For example, the information may travel over the hypertext transfer protocol (HTTP) on top of the transmission control protocol/Internet protocol (TCP/IP) using sockets. These are not the only transport mechanisms available, but they are the most commonly used.

- When a search protocol uses HTTP as the transport mechanism, the two computers use the HTTP standard to send information back and forth; they "find" each other via IP addresses and use the "known" HTTP port on the computer (e.g. port 80) when connecting to each other.

- When TCP/IP sockets are used as the transport protocol, the information passes back and forth via TCP/IP packets and the computers again "find" each other via IP addresses but the port number can be variable.

A search protocol also specifies the information that is passed back and forth between the computers. The type of information passed includes:

- How the computers initiate contact between each other;

- What information is contained in a query and exactly how it is specified;

- What information is contained in the reply to a query and exactly how it is specified; and

- How the computers terminate contact between each other.

When the search server translates between the search protocol and the database, there are two elements involved:

1. Since the metadata is in a database, the search server must know what to look for in the database. Each search server understands its own metadata format or content standard. When the search server is set up, the server can create a translation mapping between the server's metadata fields and the database fields.

2. The search server must be able to interpret the message contained in the query. If the search protocol is the language, there are many messaging schemes that can be formulated in that language. The server understands a specific messaging scheme (or profile) that is tightly coupled with the

metadata content standard used to represent the metadata in the search server.

7.1.1 Search Protocol Architecture

Figure 12 illustrates the function of the search protocol in the communication flow between the user and the supplier's product database:

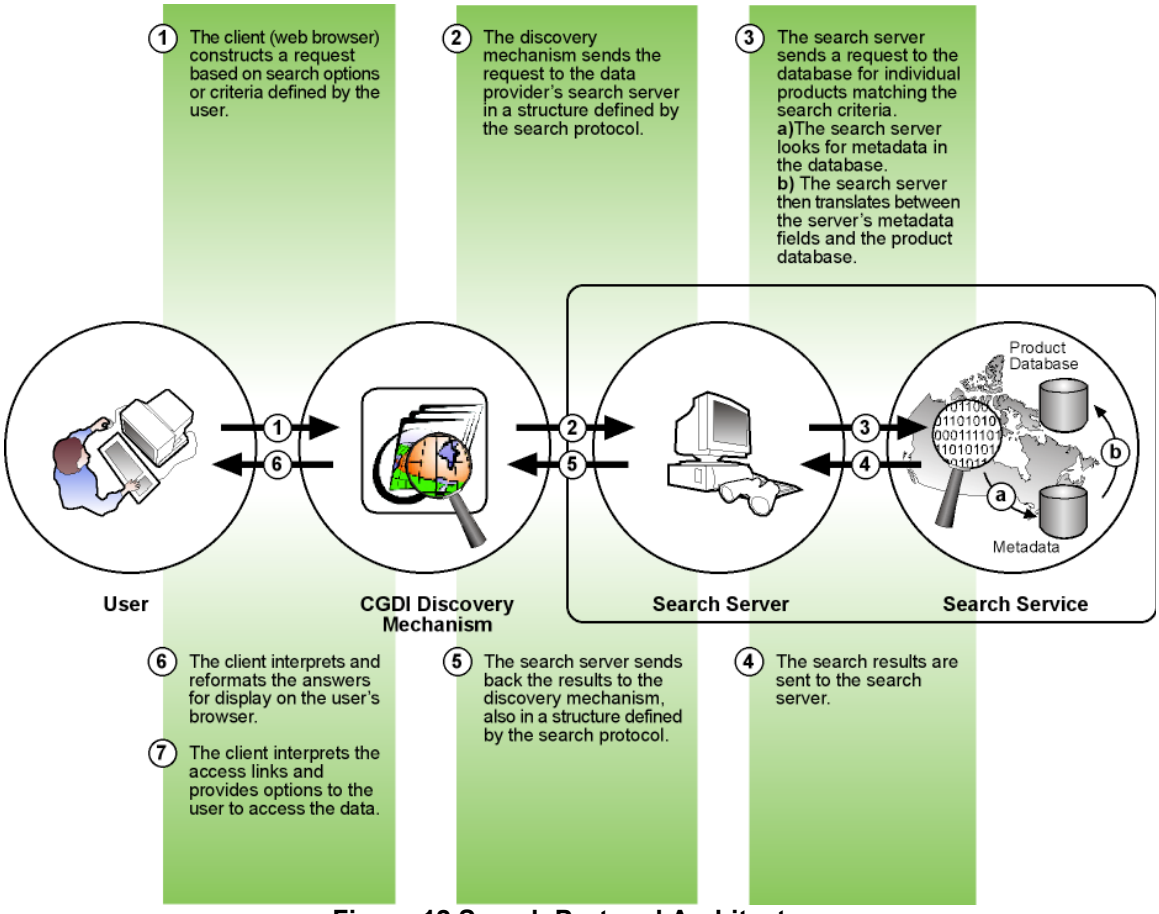

Figure 12 Search Protocol Architecture

7.1.2 Stateless Versus Stateful Searching

Search protocols can be either stateless or stateful.

A **stateless protocol** means that the discovery mechanism opens a connection with your search server, sends a bit of information, gets back a bit of information, and then closes the connection. The search session consists of a series of such open-send-receive-close interactions between it and your search server. Each open-send-receive-close interaction is independent of the others. Your search server handles each one independently; there is no "history" of preceding interactions and so it is called "stateless". In this case a user who requests ten

data products could not examine the results of the data product search until all ten results are returned.

A **stateful protocol** means that the discovery mechanism opens a connection with your search server and keeps it open for the entire duration of the search session. This enables a user who selects ten data products, for instance, to examine the results of the data product search after the first data product is received, before all ten results are received.

See A1.8, Geodata Discovery Service, to see how this CGDI specification applies the stateless and stateful protocols to retrieve metadata about geospatial data.

7.2 CGDI Search Protocols

The GeoConnections Discovery Portal mainly supports the following geospatial search protocol:

- Z39.50 FGDC/GEO profile search protocol.

The following geospatial search protocols were previously supported by the GeoConnections Discovery Portal but will no longer be supported for new suppliers:

- Simple Search protocol; and
- Information Management System (IMS) search protocol.

The American National Standards Institute/National Information Standards Organization's **ANSI/NISO Z39.50 search protocol** is a computer-to-computer communications protocol designed to support searching and retrieval of information, full-text documents, bibliographic data, images and multimedia in a distributed network environment.

A protocol specification standardizes the query syntax, search field identities and default format of returned records, and provides mechanisms for access control, and server self-description. Based on client/server architecture and operating over the Internet, the Z39.50 protocol is supporting an increasing number of applications. Like the dynamic network environment in which it is used, the standard is evolving to meet the changing needs of information creators, suppliers, and users.

To its credit, Z39.50 is very comprehensive. At the same time, it can be quite complex for a data supplier to install Z39.50 server software and configure it to search a dataset. This runs counter to the goal of GeoConnections to keep the cost of supplier participation to a minimum. To overcome this problem, a FGDC

metadata toolkit (http://www.sco.wisc.edu/wisclinc/metatool/noaasea.htm) has been developed which packages the necessary Z39.50 GEO software in a manner that makes it easy for suppliers to install and configure.

The Z39.50 search protocol is a message-based protocol that utilizes request/response pairs for each of the services it supports. Its essential services are:

1. **Init**, which establishes a session between the client and the database server;

2. **Search**, which conveys the search criteria to the target database, and responds with statistics on the matches, such as the total number of matches. The response to a search request does not include the actual records from the database that match; and

3. **Present**, which follows a search response, and is used to request the actual matching records, or a subset of the records. The mechanism is very powerful because the result set is managed at the target server and the complete result set does not have to be returned over the network.

There are additional services which provide access control, resource management and self-describing facilities for the target databases, etc.; however, these are less often supported by client and server software than the three basic services described above.

The Init request/response (the process where two servers are synchronized so they can communicate) allows both computers to introduce themselves and indicate which services (i.e. functions) of Z39.50 they support.

The Search request contains the parameters of the information retrieval request. It consists of one or more Attribute/Relation/Value restrictions (e.g. height > 5).

- **Attributes** are the parameters that are allowed in a search request (e.g. author, title, abstract, date of publication). Each attribute is assigned a numeric ID and is universally understood by that ID in all Z39.50 server implementations. To keep things simple, the attributes are grouped into large attribute sets so that a particular Z39.50 server can simply indicate what attribute sets it accepts. These attribute sets are officially registered with the maintainers of the Z39.50 standard.

- **Relations** (e.g. greater than, equal) are also assigned unique numeric IDs by the Z39.50 standard.

The response contains either the resulting set of records or just the count of the number of matching records. If only the record count was received, the request can be used to request sets of those matching records.

For more information about the Z39.50 search protocol, refer to:

- The National Information Standards Organization:
    - http://www.cni.org/pub/NISO/docs/Z39.50-brochure/

  There are two official versions of the ANSI/NISO standard in general use today: Version 2 is ANSI/NISO Z39.50-1992, and Version 3 is ANSI/NISO Z39.50-1995. The GeoConnections Discovery Portal uses Version 2. An HTML copy of the Version 2 standard can be viewed at http://www.cni.org/pub/NISO/docs/Z39.50-1992/.

- The U.S.A Library of Congress: http://lcWeb.loc.gov/z3950/agency/

7.2.1 The GEO Profile of Z39.50

Some search protocols have several profiles. A **profile** identifies a set of base standards, together with appropriate options and parameters necessary to accomplish identified functions for purposes including: (a) interoperability, and (b) methodology for referencing the various uses of the base standards, meaningful both to users and suppliers.

The Z39.50 information retrieval model is independent of its domain. Domain specializations are provided by an additional mechanism, referred to as "application profiles". Specific profiles exist for the messaging scheme of geospatial-type queries and results. These profiles are tightly coupled with specific metadata content standards for geospatial metadata. The FGDC has developed a Z39.50 application profile for geospatial metadata, called GEO, which provides a specification on how to implement the Content Standard for Digital Geospatial Metadata (CSDGM) metadata elements within a Z39.50 service.

Using this profile achieves interoperability with the FGDC Clearinghouse, amongst others. Furthermore, the Earth observation community, in the guise of the Committee for Earth Observation Satellites (CEOS) agencies, is working to ensure that the GEO and Catalogue Interoperable Protocol (CIP) protocols (both of which are based on Z39.50) are interoperable. The CIP defines a single interface to Earth observation catalogues. The GEO profile standardizes (on top of Z39.50) the data model for search and retrieval, the query language operators (including spatial operators), etc.

The Z39.50 GEO profile states that a Z39.50 GEO profile server must:

- Use Init, Request, Present, 3 of the 10 **services/operations** available;
- Understand **340 attributes** defined by the profile. The server must support 17 of those attributes for use in a client search request. Each attribute also

has a recommended data type defined for implementation (e.g. string, integer); and

- Understand **18 relations** (e.g. equal, near) that must be supported in a client search request.

Furthermore, the Z39.50 GEO profile offers the following:

- **Extensions**: The GEO profile is built on top of the Z39.50 profile called BIB-1. Some of the Z39.50 profiles such as the Z39.50 GEO profile build on the core BIB-1 by using a subset of it and defining extensions.
- **International use**: The Z39.50 GEO profile search protocol is widely adopted by agencies around the world. Other spatial data infrastructures that use this protocol are able to directly connect to any Z39.50 search server, or as peer clients to the distributed search server.
- **Registered profile**: The Z39.50 GEO profile is a registered profile of the Z39.50-1992 standard to incorporate the FGDC's Content Standard for Digital Geospatial Metadata (June/94 issue).
- **Implementation**: Assuming that you already have some sort of searchable database or product inventory, then creating an FGDC/GEO Search connection should take about three to ten days of effort to complete.
- **No need for WWW server**: The Z39.50 GEO profile search protocol is a TCP/IP socket-based protocol, and as such does not require a web server to be installed at your site. Since the computers connecting to your search server connect directly to a port on your search server, no web server is needed in between.
- **Email ordering**: Your order desk can receive email orders from GeoConnections Discovery Portal and other users who have discovered your products through a search.

You can view the full Z39.50 GEO profile at:

http://www.blueangeltech.com/standards/GeoProfile/geo22.htm

The many profiles of the Z39.50 standard are listed at:

http://lcWeb.loc.gov/z3950/agency/profiles/profiles.html

Figure 13 illustrates the Z39.50 GEO architecture as implemented in the GeoConnections Discovery Portal

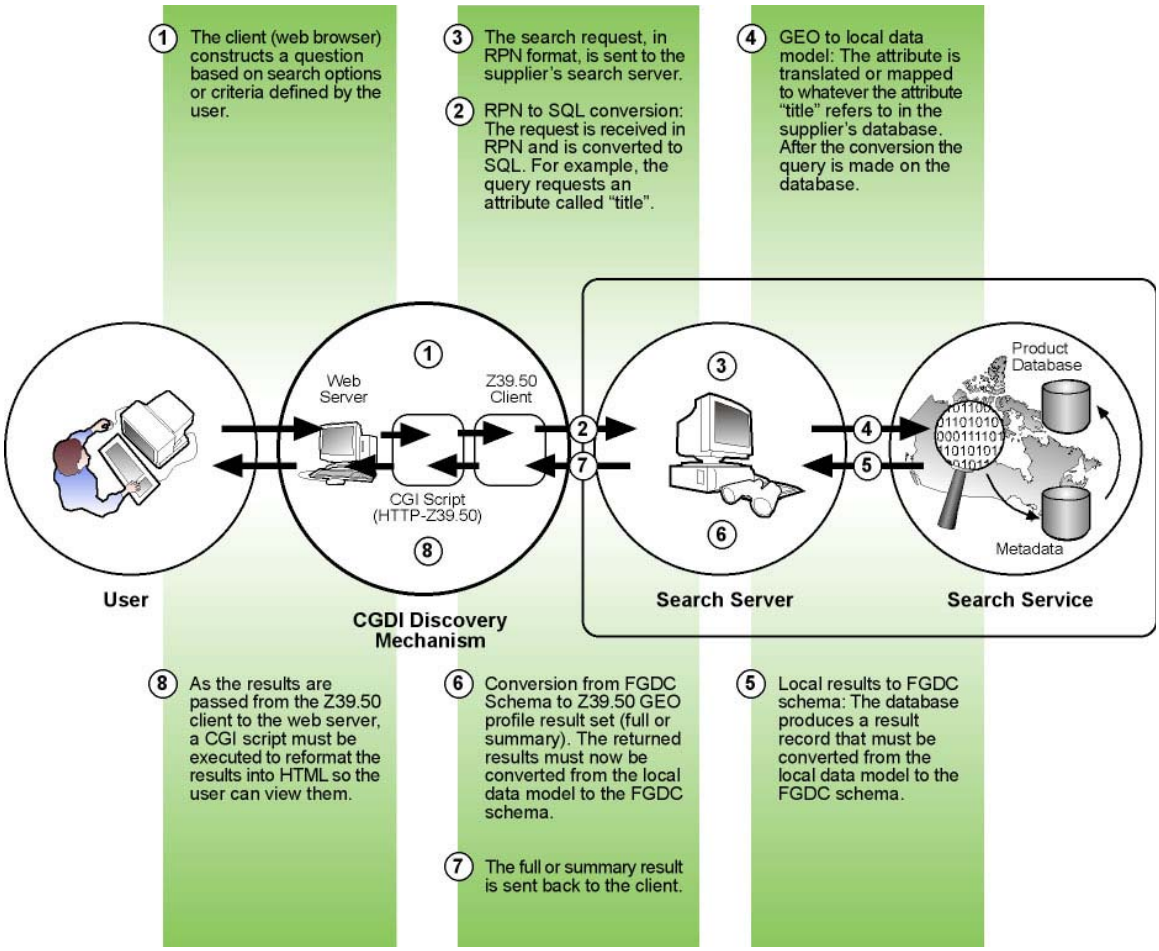

Figure 13 Z39.50 Architecture

The GeoConnections Discovery Portal previously supported multiple protocols such as Z39.50-based FGDC/GEO Profile, lightweight HTTP-based Simple Search protocol, and NASA's Information Management System (IMS) V0 protocol. Currently, the GeoConnections Discovery Portal supports only the Z39.50 protocol for new connections. Canadian organizations can make their databases searchable by installing a tool kit that utilizes the Z39.50 protocol. See Chapter 8, Connecting a Search Server, for full details.

7.3 Catalogue Service for Web

In January 2007, the Open Geospatial Consortium, Inc.® (OGC) selected the OASIS standard ebRIM (electronic business Registry Information Model) as the preferred cataloguing meta-model foundation for future application profiles of the Open Geospatial® Catalogue Service for Web (CSW) specification. The catalogue specification defines the information required to support discovery and search for data and services and ebRIM provides the requirements to support registration of services like those specified in many OGC standards, as well as geospatial data and other resources.

The Consortium views search and discovery frameworks such as Universal Discovery, Description, and Integration (UDDI), registry capability such as ebRIM, and unstructured text searches to be competing for dominance in the Service Oriented Architectures marketplace. However, none of these three options completely satisfies the geospatial requirements defined by the members. ebRIM was selected as the preferred meta-model because of its extensibility and ability to handle geospatial services and a variety of other supporting registry requirements such as symbol libraries, coordinate reference systems, application profiles, and application schemas as well as geospatial data.

What is a Catalogue Service:

1. A service for publishing and discovering geospatial data, related services and other resource information;
2. A service that stores metadata about geospatial resources and generalized properties that can be queried and returned for evaluation;
3. A service that is used to find geospatial resources information and invoke the resources referenced within the metadata content; and
4. A general Catalogue Interface model that is supported by a protocol binding such as CORBA, Z39.50, or HTTP and an Application Profile.

While the primary target audience of the Catalogue Service Specification are the implementers of Catalogue products with server-side and client-side applications, users of geospatial data benefit from the Catalogue Service by using these applications through GeoPortals and other applications.

The Catalogue Service Specification has been developed to support many application profiles supporting specific catalogue information models (specific catalogue repositories) such as FGDC, Australia New Zealand Land Information Council (ANZLIC), ISO 19119/ ISO 19115, etc as well as more generic information models such as ebRIM. In turn, ebRIM as a generic metadata model can accommodate multiple metadata models such as FGDC, ANZLIC, ISO 19119/ ISO 19115, etc within a single catalogue repository.

Catalogue Services support the ability to publish and search collections metadata for data, services, and related information (http://portal.opengeospatial.org/modules/admin/license_agreement.php?suppressHeaders=0&access_license_id=3&target=http://portal.opengeospatial.org/files/index.php?artifact_id=20555). Metadata in catalogues represent resource characteristics that can be queried and presented for evaluation and further processing by both humans and software.

Metadata act as generalized properties that can be queried and returned through catalogue services for resource evaluation and, in many cases, invocation or

retrieval of the referenced resource. For another description of Metadata, refer to Section 9.4 of this document. Catalogue services support the use of one of several identified query languages to find and return results using well-known content models (metadata schemas) and encodings.

The interoperability goal is supported by the specification of a minimal abstract query (predicate) language, which shall be supported by all compliant Open Geospatial Catalogue Services. This query language supports nested Boolean queries, text matching operations, temporal data types, and geospatial operators. The minimal query language syntax is based on the SQL WHERE clause in the SQL SELECT statement. Implementations of query languages that are transformable to the OGC_Common Catalogue Query Language are the OGC Filter Specification and the CIP and GEO profiles of Z39.50 Type-1 queries.

The minimal query language assists the consumer in the discovery of datasets of interest at all sites supporting the Open Geospatial Catalogue Services. The ability to specify alternative query languages allows for evolution and higher levels of interoperability among more tightly coupled communities of Catalogue Service Providers and Consumers.

For more information, following the links to the Open Geospatial Catalogue Services Specification document: http://www.opengeospatial.org/standards/cat.

7.3.1. Core catalogue schema

Metadata structures, relationships, and definitions -- known as conceptual schemas -- exist for multiple information communities. For the purposes of interchange of information within an information community, a metadata schema may be defined that provides a common vocabulary which supports search, retrieval, display, and association between the description and the object being described. Although this specification does not require the use of a specific schema, the adoption of a given schema within an information-sharing community ensures the ability to communicate and discover information.

ISO Technical Committee 211 is formalizing a schema for geospatial metadata that is intended to apply to all types of information. This metadata standard, ISO 19115:2003 includes a proposal for core metadata elements in common use. ISO Draft Technical Specification 19139 defines a formal encoding and structure of ISO metadata for exchange. Where a catalogue service advertises such application schemas, catalogues that handle geographic dataset descriptions should conform to published metadata standards and encodings, e.g. ISO 19115:2003, and support XML encoding per ISO 19139 or profiles thereof. Service metadata elements should be consistent with ISO 19119. More information on ISO 19115 is presented in Section 9.4.3.2.

7.3.2. Core queryable properties

The purpose of defining core queryable properties is to achieve interoperability among catalogues that execute the search protocol. Catalogues implement different protocol bindings through the use of “bridges” or protocol adapters. Defining a set of core queryable properties also enables simple cross-profile discovery, where the same queries can be executed against any catalogue service without modification and without detailed knowledge of the catalogue's information model. This requires a set of general metadata properties that can be used to characterize any resource.

Tables 1, 2 and 3 define a set of abstract queryables that binding protocols shall realize in their core queryable schemas. Binding protocols shall further specify a record identifier (ID) based on the native platform ID types. Binding protocols shall also specify how the values of core queryable properties shall be encoded in service requests. Binding protocols may choose to use a single comma-separated list for a compound datatypes or may label each sub-element for clarity and order flexibility. Application profiles may further modify or redefine the realization of the core queryables and how their values are encoded.

Name	Definition	Data type
Subject [a]	The topic of the content of the resource [b]	CharacterString
Title [a]	A name given to the resource	CharacterString
Abstract [a]	A summary of the content of the resource	CharacterString
AnyText	A target for full-text search of character data types in a catalogue	CharacterString
Format [a]	The physical or digital manifestation of the resource	CharacterString
Identifier [a]	An unique reference to the record within the catalogue	Identifier
Modified [c]	Date on which the record was created or updated within the catalogue	Date-8601
Type [a]	The nature or genre of the content of the resource. Type can include general categories, genres or aggregation levels of content.	CodeList [f]
BoundingBox [d]	A bounding box for identifying a geographic area of interest	BoundingBox, See Table 2
CRS [e]	Geographic Coordinate Reference System (Authority and ID) for the BoundingBox	Identifier
Association	Complete statement of a one-to-one relationship	Association, See Table 3

a Names, but not necessarily the identical definition, are derived from the Dublin Core Metadata Element Set, version 1.1:ISO Standard 15836-2003 (February 2003)

b Typically, a Subject will be expressed as keywords, key phrases or classification codes that describe a topic of the resource. Recommended best practice is to select a value from a controlled vocabulary or formal classification scheme.

c DCMI metadata term <http://dublincore.org/documents/dcmi-terms/>.

d Same semantics as EX_GeographicBoundingBoxclass in ISO 19115.

e If not supplied, the BoundingBox CRS is a Geographic CRS with the Greenwich prime meridian.

f A "CodeList" is a CharacterString taken from an authoritative list of CharacterStrings or Identifiers. The authority may optionally be identified in the value.

Table 1 Common Queryable Elements

Name	Definition	Data type
WestBoundLongitude	Western-most coordinate of the limit of the resource's extent, expressed in longitude in decimal degrees (positive east)	numeric
SouthBoundLatitude	Southern-most coordinate of the limit of the resource's extent, expressed in latitude in decimal degrees (positive north)	numeric
EastBoundLongitude	Eastern-most coordinate of the limit of the resource's extent, expressed in longitude in decimal degrees (positive east)	numeric
NorthBoundLatitude	Northern-most, coordinate of the limit of the resource's extent, expressed in latitude in decimal degrees (positive north)	numeric

Table 2 Composition of Compound Element "BoundingBox"

Name	Definition	Data type
Target	Referenced resource	Identifier
Source	Referencing resource	Identifier
Relation	The name of the description of the relationship	CodeList or Identifier

Table 3 Composition of Compound Element "Association"

All realizations of the core queryable properties in a binding protocol shall include all the properties listed in Tables 1,2 or 3 even if the underlying information model does not include information that can be mapped into all properties. Core properties that cannot have a value assigned to them because the information is not available in the information model of the catalogue shall be considered as having a value of NULL.

The properties “Title”, “Identifier” and the pseudo-property “AnyText” shall be supported as mandatory queryables in all implementations. Protocol bindings shall describe mechanisms to identify and elaborate on the queryables and operations supported by a given catalogue service.

For more information, follow the link to the Open Geospatial Catalogue Services Specification Document (http://www.opengeospatial.org/standards/cat).

7.4 Catalog service – ISO 23950

The ISO 23950 standard defines a network client-server service whereby a client can precisely specify a search request and preferences for the response that retrieves search results. The standard includes a definition for search request/response using the HTTP (Hypertext Transfer Protocol). This part of ISO 23950 is known as SRW (Search and Retrieve for the Web) or SRU (Search and Retrieve via URL. See http://www.loc.gov/standards/sru/ for more information. SRW and SRU are designed for both the HTTP GET and HTTP POST interfaces, and for both Web Services using SOAP (Simple Object Access Protocol) as well as CGI (Common Gateway Interface, formally specified in the Request For Comment (RFC) 1738).

For example, the following ISO 23950 SRU search request finds Library of Congress catalogue entries containing the word "fruit":
http://z3950.loc.gov:7090/voyager?operation=searchRetrieve&version=1.1&maximumRecords=20&recordSchema=dc&query=fruit

As required by RFC 1738, the request has two component parts: a "base URL" and a "searchpart", separated by a question mark ("?"). The base URL identifies the server host and port (here, "z3950.loc.gov:7090") and the ISO 23950 service (here, "voyager"). The searchpart consists of parameters separated by "&", each with the structure "key= value". The names of the parameters in this ISO 23950 service description are the "key" strings within the URL, here: "operation", "version", "maximumRecords", "recordSchema", and "query".

Here is an example of an ISO 23950 SRU search request using a geospatial index:

http://www.search.gov/gsdi/sru2kml.php?operation=searchRetrieve&version=1.1&maximumRecords=100&recordSchema=XML&query=geo.boundswithin/partial/nwse "43.772 -101.411 31.7723 -77.7499"

This example specifies that the search targets the "geo.bounds" index, an index for bounding coordinates defined for the geospatial search community. This kind of search is not a text matching operation, but a search for points of overlap between available geographic "footprints" and the area being searched. The

concept of overlap is given here by the search qualifier: "within/partial". The query also specifies, through the "nwse" qualifier, that the bounding box is given in decimal degrees of latitude and longitude, with coordinates in the order of northernmost, southernmost, westernmost, easternmost.

CHAPTER 8

Connecting a Search Server

Connecting a search server will make your database searchable. When you make your database searchable, you make your in-house databases and/or catalogues available for remote searching through the Internet within and outside of the CGDI. This chapter:

- Highlights the numerous benefits of making your database searchable;
- Lists the requirements for connecting a search server; and
- Explains how to set up a Z39.50 FGDC/GEO search connection.

8.1 Why Make Your Database Searchable?

There are many benefits to making your data available through the CGDI.

Join one of the largest online geospatial communities

When you publish your geospatial data within the Canadian Geospatial Data Infrastructure, you will be joining an ever-growing number of organizations and individuals who have made their data collections available to others through the CGDI.

More users will be able to find and use your data and services

If you are providing commercial data or services, additional customers will result in increased revenues. If you are providing data or services for the public good, more of the public will be better served.

Enjoy flexible options for access and delivery of data products and services

When you make your database searchable, users can find web services, individual map sheets, images, reports or any other geospatial product or service. Once users find a resource, links in the product's description can point them to a web site, an online ordering system or download directory. As the supplier, you have total control over these links including how users can access data products or services.

GeoConnections also supports additional access mechanisms, such as those being developed under the Open Geospatial Consortium, Inc.

You, the supplier, control your own data, at your own site

You maintain total control of both the contents of your data and how users interact with it. You hold the individual data products that you make available through remote searches. You must use your password to modify your metadata information.

8.2 What You Need to Make Your Database Searchable

In order to make your database searchable, the GeoConnections Discovery Portal requires that you complete the following two steps before connecting your database:

1. Register as a user (see A2.7, How to Register and Promote Your Data Product, for full details); and

2. Register your data product or collection (again, see A2.7). The data product is the database that becomes searchable when you establish a distributed search connection to your database. Users can find your data product or collection, and, through the distributed search connection, search for individual data products in your database.

Once you have registered as a user and included your data product or collection, you will need a toolkit to connect your databases (or catalogues) to the CGDI. There are several toolkits to choose from, depending on your existing computing environment and your desired method of connection.

8.2.1 Setting Up a Z39.50 FGDC/GEO Search Connection

To set up your Z39.50 FGDC/GEO search connection, follow these 2 steps:

1. **Install a Z39.50 GEO profile server**.

   Currently, you have several options for installing or creating a Z39.50 GEO profile server:

   a. Install the FGDC Metadata Toolkit (MetaManager) by Compusult on your Unix machine or Windows server and configure it to query your database tables. Download a trial copy at: http://www.metadatamanager.com/.

   b. Install the Isite software product from MCNC's Center for Networked Information Discovery and Retrieval (CNIDR ®): www.mcnc.org.

   c. Purchase the MetaStar Server from Blue Angel Technologies and create the Metadata Standards layer of the product with the FGDC Content metadata standard. See: http://www.blueangeltech.com/default.html.

   d. Purchase the SMMS (Spatial Metadata Management System) GeoConnect Metadata Server product from Intergraph. Full FGDC support is provided at: http://imgs.intergraph.com/smms/.

   e. Install ESRI's ArcIMS software product from: http://www.esri.com/software/arcims/index.html).

   f. Discover others by performing a search for Services and Resources in the GeoConnections Discovery Portal: http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&entryType=service&language=en&isNewSearch=true&keywords=services+resources.

2. **Connect your Z39.50 GEO profile server to a discovery mechanism**. The requirements for this connection depend on the individual discovery mechanism. To connect to the GeoConnections Discovery Portal, complete the following 2 steps:

   Step 1 Once you have registered your data product/collection (as described in Appendix A2.7, How to Register and Promote Your Data Product), select Add/Edit Search Service to specify the following details for your Z39.50 GEO

profile server:

- Hostname or IP address of enhanced Z39.50/FGDC search server;
- Port number of enhanced Z39.50/FGDC search server; and
- Database name for the enhanced Z39.50/FGDC search server.

Step 2 Complete the fields and submit the form. Users around the world can now perform an FGDC/GEO search on your database by using the GeoConnections Discovery Portal query form as well as other discovery mechanisms (see Chapter 5)..

SECTION IV

Using CGDI Web Resources

This section describes the different ways you can use CGDI resources to make your organization's applications more "geospatially aware". The CGDI offers a number of standardized services that allow you to access geospatial information that can enhance your online services for your own clients.

Chapter 9 discusses the reasons for using common standards and gives examples of web map services.

Chapter 10 explains how and why the CGDI uses a web service architecture, describes its attributes and provides several examples of "best practices". It also details how you can use several CGDI-endorsed web map services, including gazetteers, mapping services and web map service repositories.

Chapter 11 outlines what you must do to allow users to access your services and data products, and highlights several related firewall issues and CGDI security options.

Ensure interoperability with common standards
Save time and money, and increase flexibility, with web map services and framework data
Consider different options for access to your services or products

CHAPTER 9

Developing Your Application with CGDI-Endorsed Standards and Web Resources

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The Canadian Geospatial Data Infrastructure was envisaged to help organizations enjoy the benefits of having easy access to the geospatial information they need, in a format they can easily integrate into any application they would like to develop. The CGDI can offer this ease of access because it relies on a set of common standards. This chapter:

- Describes why standards are essential to spatial data infrastructures like the CGDI;
- Discusses the approach being taken by the CGDI and Open Geospatial Consortium, Inc. and its partners in implementing standards and specifications;
- Outlines web services;
- Provides an in depth discussion on Metadata; and
- Introduces the OGC Cookbooks reference material.

9.1 The Need for Standards

The CGDI has enormous potential to help a wide range of organizations use and access geospatial information in their daily operations. For an Emergency Management Organization (EMO) for instance, the CGDI could provide Internet-based maps of the country's road network, the location of road construction, and predicted areas of snowfall. The EMO could then develop applications to display all this information, and to plan the best evacuation route.

Furthermore, using the CGDI, this EMO could also integrate traffic congestion information, ferry routes and schedules, road conditions, and accident reports. The EMO could then offer a service to its customers to submit requests for pick-up and delivery of supplies in a given area. This service could allocate the delivery to the most appropriate truck (based on its current location and route), develop a plan of how to alter its route to fulfill the request, estimate pick-up and delivery times based on traffic congestion, road construction and conditions, etc., and respond to customers with a detailed schedule.

For the CGDI to reach its full potential, participants must make two commitments:

1. Data suppliers must provide access to their data through one or more of the specifications endorsed by the CGDI. (This does not require data suppliers to change their existing internal data storage formats.); and

2. Developers must develop applications using a web service architecture.

When you use services based on CGDI-endorsed standards for data delivery, you can integrate data from multiple sources. You can then develop a whole range of applications that have been, until now, cost-prohibitive. Indeed, the CGDI is fostering the development of tools (some open-source) that can efficiently deliver and manipulate data accessible through these standard services.

9.2 CGDI Endorsement of OGC Standards

The need for standards for geospatial data is well known, which is why committees such as the Open Geospatial Consortium, Inc. (OGC) and the ISO Technical Committee 211 on Geographic Information and Geomatics are developing them. Geospatial data infrastructures such as the CGDI, however, require broader standards, since they encompass protocols and web services, e.g. HTTP, Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL), Electronic Business using Extensible Markup Language (ebXML); information technology committees such as the World Wide Web Consortium (W3C) and Oasis are addressing these comprehensive standards.

For its part, OGC is helping GeoConnections implement standards and specifications in order that the CGDI remain an operational and sustainable spatial data infrastructure. Indeed, OGC describes its role in the geospatial domain as follows:

- Because there are so many incompatible standards in the geo-information technology area, geospatial information and geo-processing are not part of most information systems, and sharing geodata between geo-processing systems and between user communities requires considerable time and expertise.
- Most of the standards attempt to normalize one of the following: 1) the encoding of information in software systems (data format standards and data transfer standards), or 2) the naming of features and feature relationships (data dictionaries), or 3) schemas for descriptions of datasets (metadata).
- Uniquely, OGC addresses the confusion of data format and data transfer standards by creating open, common interfaces between software system components, and letting those systems use any data format internally. These Open Geospatial® Interfaces provide access to both information and functionality. OGC also works to develop open software approaches that address inconsistent data dictionaries and metadata schemas (http://opengis.org/).

The Canadian Geospatial Data Infrastructure shares OGC's vision of interoperability. As a sponsor of OGC, GeoConnections is developing a set of standard interfaces and services through which geospatial data can be accessed within the CGDI. These services do not dictate how organizations store their data: rather, each organization can choose what best fits its needs. They do, however, define a standard external interface with which organizations must comply in order to openly share data and services.

OGC describes the advantages of **standard external interfaces** in this way:

- The interface approach has the great advantage of providing "transparent access" between systems. That is, it becomes possible for the data on another system to be as readily available to you as the data on your own system. The Open Geospatial Specification for geo-processing interfaces largely eliminates the need for data format standards and costly batch data conversion. A query returns not a whole data file, but only the "result," or the answer to the query, and thus the network model eliminates the need for users to keep (usually outdated) copies of whole datasets.
- An even greater advantage is that the interface approach enables geo-processing to become an integral part of the new Internet and web-based distributed computing paradigm in which applets, middleware, components, e-commerce tools, online data servers, and object request brokers give any networked computing device real-time access to a huge

> universe of data and processing resources. Any Internet-linked device, even cell phones, will be able to access countless data servers and powerful application servers as if all those terabytes of geodata and sophisticated software were on their own local storage media. Remote servers will upload little GIS applets and geo-enabled software components and will enable ordinary users to make use of smart digital maps in all kinds of desktop documents. Conventional RDBMSs (through advances not related to the Open Geospatial Specification) will soon store complex spatial data and serve it (through Open Geospatial® conformant interfaces) to a wide variety of GIS and non-GIS applications (http://opengis.org/).

With geospatial data available from multiple sources through standard interfaces, organizations like yours can now cost-effectively develop applications that integrate data from these sources. This will lead to a host of new applications that have until now been cost-prohibitive.

9.2.1 CGDI-Endorsed Standards and Specifications

GeoConnections is the program that deploys the Canadian Geospatial Data Infrastructure (CGDI). As the governing body of the CGDI, it identifies and endorses standards to which applications and services must conform to in order to be compliant with the CGDI. Compliance is very important to ensure that CGDI components are interoperable. Standards and specifications that have been endorsed by GeoConnections for the purpose of CGDI-deployed services and applications are called **CGDI-endorsed specifications.**

The GeoConnections program does not develop its own standards and specifications; rather, it adopts international or national standards so that the CGDI can be interoperable with other infrastructures around the world. Services or applications that conform to CGDI-endorsed specifications should be able to operate or interface with other components outside of the CGDI.

This section discusses several geospatial specifications, some of which have been formally endorsed by the CGDI, others of which are widely used within the CGDI, but not yet endorsed by GeoConnections. For each specification, there is a discussion of the purpose of each category of specification; within each category, there is a discussion of why each endorsed specification is important to the CGDI, what it represents, and what services it enables.

You can read more about CGDI-endorsed specifications at: http://www.geoconnections.org/CGDI.cfm/fuseaction/developersCorner.endspecs/gcs.cfm.

You can access high-level catalogue descriptions of these specifications through the GeoConnections Discovery Portal at: http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&entryType=service&serviceType=StandardSpecification.

9.3 CGDI Resources for Developers

The Canadian Geospatial Data Infrastructure has endorsed various standards and specifications and provides several resources for anyone developing applications. Of course, for these resources to help you, your application must have some geospatial association. While this might at first glance rule out many applications, most applications could in fact be improved by becoming more "geographically aware". Any application that is intended to convey information (e.g. municipal tax information or weather information) or deliver a product to the user (i.e. by shipping purchased items) is likely to use geographic information in some way.

The CGDI can help you by providing the following resources:

- Framework data (www.GeoBase.ca). See Section 4.5 of this document for more information.;
- Web services;
- Data licensing guide: The Dissemination of Government Geographic Data in Canada – Guide to best practices (version 1.2). A new version is forthcoming http://www.geoconnections.org/publications/Best_practices_guide/html/summary_e.html.
- CGDI Web Map Service Client Component (CWC2); and
- GeoConnections Discovery Portal application program interfaces (APIs).

Web services include web map services, web feature services, web coverage services, and catalogue service for web. These are described in Chapter 11, Implementing CGDI Web Services.

The **CGDI Web Map Service Client Component (CWC^2)** is an open-source, downloadable web map client development toolkit developed for the CGDI, which consumes OGC web map services. It provides complete programmer configuration capabilities (i.e. template-driven) over the viewer client and WMS interfaces.

With this tool, you or your developer can embed a web map viewer into your web application. You control the access to one or more layers to (a) web map server(s) (either directly or via the use of context documents), and also control the presentation of the map and associated control widgets.

CWC[2] is an instance of Chameleon from http://www.maptools.org/chameleon/

The GeoConnections Discovery Portal's **Application Program Interfaces (APIs)** are the subject of Appendix 3.1, Using GeoConnections Discovery Portal APIs.

The CGDI resources described in the pages that follow are currently available. However, the CGDI is quickly evolving and additional resources will likely be available by the time you read this manual. For the latest information, please refer to the GeoConnections web site at: http://www.geoconnections.org/.

9.3.1 Framework Data

You can incorporate dynamic framework data into your application by retrieving it when you need it, using one of the CGDI-endorsed service interfaces. In this way, you avoid having to maintain the data, and your application always uses the latest version of the data.

Alternatively, you can download framework data into your own GIS or database, for subsequent use in your applications. In this way, your application does not rely on a service provided by another organization. However, it is your responsibility to periodically retrieve the latest version of the framework data.

Each portion of the framework has a specified resolution (normally the resolution at which it was acquired) and a range of scales to which it is suited. Although eventually it might be possible to maintain just a single representation of any particular feature, for ease of use the CGDI framework data is currently stored and maintained at two separate resolutions, as shown in Table 4, Resolutions for Framework Data.

Resolution	Accuracy	Large Scale	Small Scale
National	1 km	750,000	7,500,000
Regional	250 m and better	10,000	750,000

Table 4 Resolutions for Framework Data

These two resolutions have the following characteristics:

National Resolution

The current framework data at a national resolution includes railroads, hydrography, provinces, municipalities and ecological units. The standard reference layers chosen at this resolution are integrated with the 1:1 million hydro/coastline framework maintained by the Atlas of Canada

(http://atlas.nrcan.gc.ca/site/english/index.html). The nominal scale of this data is 1:1,000,000 and the accuracy is approximately 1 km.

These national resolution frameworks feature correct relative positioning, and a consistent national resolution and methodology through partnerships with federal source agencies. Additional linkages (e.g. common feature identifiers) will be developed with the regional-scale frameworks to enhance cross-scale visualization and updates.

Regional Resolution

As of November 2003, the current framework data at a regional resolution became available through the GeoBase Portal (http://www.geobase.ca/). This regional data includes National Road Network, Canadian Digital Elevation Data, Geographical Names of Canada data (toponymy), Canadian Geopolitical Administrative Boundaries, Canadian Geodetic Network and Landsat-7 Ortho-image data.

Framework data at a regional resolution consists of data produced by a wide variety of organizations from federal, provincial, and in some cases, municipal levels. These datasets are maintained at a variety of accuracies, typically ranging from 250 m to 1 m. Normally the resolution used as the standard is the most detailed resolution of mapping available for that area. Horizontal integration is required between adjacent regional datasets.

As with other aspects of the CGDI, additional data such as the hydro network is being made available, so visit GeoBase often.

9.3.2 Web Services

A key attribute of the CGDI is its set of standards-based services that enable access to geospatially-referenced data. The CGDI has endorsed these standards, and encourages all organizations working with geospatial information to adopt them. These standards are introduced in this section and details on the specifications may also be found on the OGC web site under Open Geospatial® Implementation Specifications: http://www.opengis.org/specs/?page=abstract. Details on web services can be found in Appendix 1. These CGDI-endorsed standards include:

Web Map Services (WMS) Specification defines a service to retrieve a map (or image) of geo-referenced data. It has three operations.

Web Feature Services (WFS) Specification defines a set of operations that retrieve and manipulate geographic features. The specification allows for two levels of functionality. A Basic (read-only) WFS supports feature retrieval only,

while a Transaction WFS additionally supports feature manipulation (creation, modification and deletion).

Web Coverage Services (WCS), provides delivery of data coverage such as digital elevation data and other fixed or variable sized matrix data (http://www.opengis.org/docs/03-065r6.pdf).

Web Map Context (WMC) Documents, are an XML application which specifies grouping of one or more maps coming from one or more Web Map Services to display a map composition within a given area of interest. Web Map Context Documents can be generated, saved, reused and exchanged within and between web mapping viewer client applications. Web Map Context Documents are analogous to 'projects' or 'workspaces' in common GIS desktop applications http://www.cgdi.gc.ca/en/communities/developers/standards/web_map_context.

Map styling services, and services access map symbol libraries, to support styling of geographic features in an encoding form passable by a web map service.

The **Styled Layer Descriptor (SLD)** standard defines a language that specifies how features are to be portrayed. It is currently most widely used as an additional parameter in the WMS GetMap operation, allowing the person making the request to define, in detail, how features are to be portrayed in the resulting map (http://www.opengis.org/docs/02-070.pdf).

The **Web Map Context Specification** defines an XML document that contains map metadata and enough information to retrieve a particular map from WMS servers. It can be thought of as a bookmark to a specific map (http://www.opengis.org/docs/03-036r2.pdf).

An optional component of the GetFeature, Transaction, and LockFeature requests is a "filter" that selects the features to operate on. The **Filter Encoding** Specification defines the format of this filter (http://www.opengis.org/docs/02-059.pdf).

The WFS specification specifies that features are to be exchanged using **Geography Markup Language** (GML). GML is a standard system for encoding spatial data in XML. It provides a grammar for encoding the geospatial content (feature properties, location, extent, feature relationships) of features. GML is based on XML Schema (Schema Definition Language-XSD) and can be thought of as a schema-writing language for spatial information that provides a set of standard XML tags or elements for spatial features and geometry types (http://www.opengis.org/docs/02-023r4.pdf).

Sensor Web Enablement (SWE): OGC members are specifying interoperability interfaces and metadata encodings that enable real time integration of

heterogeneous sensor web into the information infrastructure. Developers will use these specifications in creating applications, platforms, and products involving Web-connected devices such as flood gauges, air pollution monitors, stress gauges on bridges, mobile heart monitors, Webcams, and robots as well as space and airborne earth imaging devices.

SWE is a framework of two sets of specifications that define the information and service model for:

1. Discovering sensor systems, observations and observation processes;
2. Determining sensor's capabilities and quality of measurements;
3. Accessing sensor parameters that automatically allow software to process and geo-locate observations;
4. Retrieving real-time or time-series observations and coverages in standard encodings;
5. Tasking sensors to acquire observations of interest; and
6. Providing notifications from sensors or sensor services based upon user-specified criteria.

These functions are being enabled through the establishment of several encodings for describing sensors and sensor observations and through the definition of standard interfaces implemented as web services. Figure 14 illustrates the role of the SWE framework.

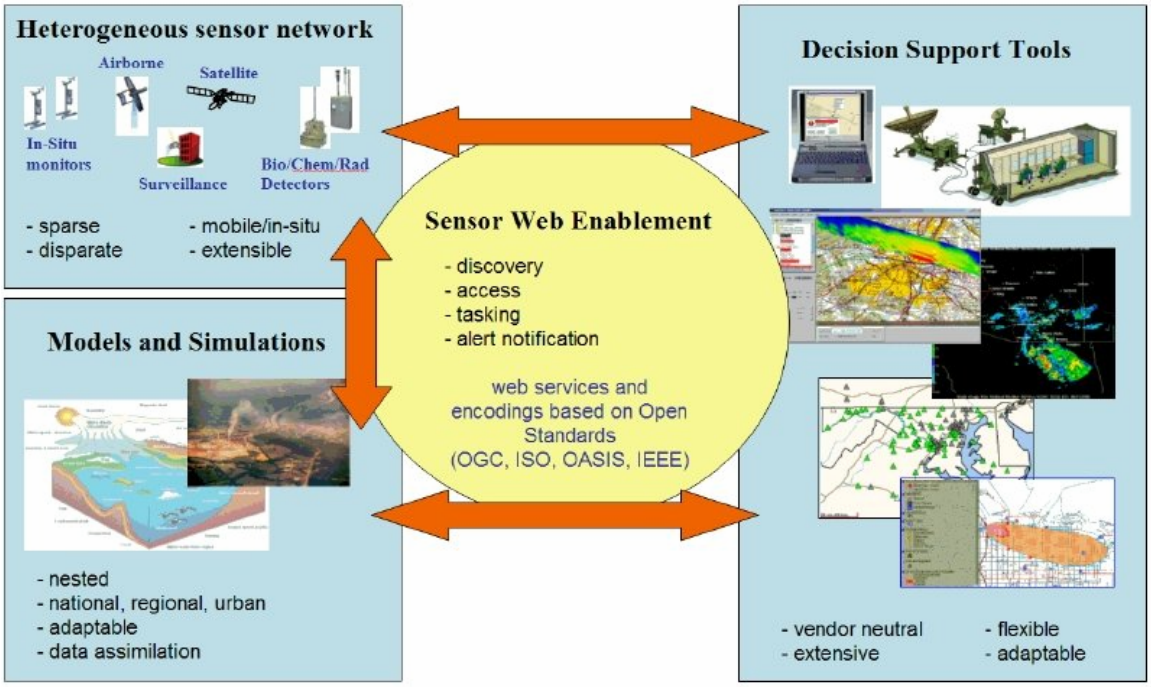


Figure 14 Role of SWE

OGC members have developed and tested the following candidate specifications. Others are planned.

1. Observations & Measurements (O&M) - Standard models and XML Schema for encoding observations and measurements from a sensor, both archived and real-time.
2. Sensor Model Language (SensorML) - Standard models and XML Schema for describing sensors systems and processes; provides information needed for discovery of sensors, location of sensor observations, processing of low-level sensor observations, and listing of taskable properties.
3. Transducer Model Language (TransducerML or TML) - The conceptual model and XML Schema for describing transducers and supporting real-time streaming of data to and from sensor systems.
4. Sensor Observations Service (SOS) - Standard web service interface for requesting, filtering, and retrieving observations and sensor system information. This is the intermediary between a client and an observation repository or near real-time sensor channel.
5. Sensor Planning Service (SPS) - Standard web service interface for requesting user-driven acquisitions and observations. This is the intermediary between a client and a sensor collection management environment.
6. Sensor Alert Service (SAS) - Standard web service interface for publishing and subscribing to alerts from sensors.

9.3.3 Keyhole Markup Language (KML)

The Keyhole Markup Language (KML) is a derivative of XML developed for use with Google Earth and is used to store geographic information including points, lines, polygons, images, and models. KML can be created from scratch using a text or XML editor, or can be created in Google Earth using their interface. In much the same way that web browsers open HTML files, Earth browsers display KML files. All that is needed is a properly configured server and the URL addresses of the KML files. Anyone can then view the KML files using one of the many applications that display them: Google Earth, Google Maps, Google Maps for mobile, NASA WorldWind, ESRI ArcGIS Explorer, Adobe PhotoShop, AutoCAD, and Yahoo! Pipes.

For more information visit: http://code.google.com/apis/kml/documentation/

GeoConnections is monitoring the development of KML. Visit the Developers section of the GeoConnections website for more information, http://www.geoconnections.org/en/communities/developers/standards.

9.4 Using Metadata to Describe Your Resources

Metadata, or 'information about data', answers 'who, what, where, when, why, and how' about every facet of the data or service being documented. This includes details about the data's ownership, quality, time of collection or update, attribute information and how it can be accessed and obtained. To ensure consistency, metadata can be defined by standards that offer a common set of terms, definitions and organization.

9.4.1 What is Metadata?

The concept of metadata is familiar to most people who work with spatial data. A common example of metadata is a library's catalogue of books and periodicals. The information recorded in a catalogue card is the metadata about the book. This metadata provides the name of the book, author or originator, a brief description of the book's subject matter, as well as the number of pages in the book, its publishers, and most importantly, where to find the book in the library. By holding a database of electronic catalogue cards (i.e. metadata), then a particular book or reference can be found by searching by title, author or subject matter. The metadata may invoke other related services, such as searching for other publications by an author, keyword searches, book reservations or inter-library loans.

This type of information can be compiled for many products in the geospatial context. With geospatial data such as digital satellite imagery, where the digital satellite image is the data, the metadata is the descriptive text or values, which outline the characteristic properties of the image such as satellite name and number, date and time of image acquisition, geographical location of the image, applied processing details or distributor.

9.4.2 The Importance of Metadata

Metadata serves many important purposes. It is a vital foundation for understanding, collaborating and sharing resources with others. It allows people to determine what the best resources are for their individual needs by permitting them to see the details of the data itself, and its history. It benefits data-producing organizations by ensuring that data holdings are well documented over time so their value for the data holder and user is maintained. Metadata is important in the creation of a spatial data clearinghouse, where potential users can search, find and compare data in all its detail.

Metadata can be organized into several levels, ranging from a simple listing of basic information about a collection of geospatial data, to a complex and detailed documentation about an individual geospatial data set or service. The key benefit of metadata is that it provides you, the user, with a complete description and history of the data or service. In this way, it is a vital tool for you to evaluate the

data or service. Structured and complete metadata empowers you to seek entries that have specific parameters in your search (for example, specific latitude and longitude positions). This helps you discover resources that are specific to your needs.

9.4.3 CGDI-Endorsed Metadata Content Standards

A **geospatial metadata content standard** is a common set of terms and definitions that describe geospatial data. Conforming to a standard is important to ensure that everyone can find, understand and share data by finding and comparing common details of the data. A metadata standard outlines the characteristic properties to be recorded, as well as the values the properties should have. Such standardization of the vocabulary makes information sharing more reliable and universal.

The CGDI endorses two metadata content standards. First, the United States' **Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM)** were chosen for their quality, popularity of use, established support, as well as for the tools that have been and are continuing to be created.

Second, the new **International Organization for Standardization (ISO) Standard for Geographic Information - Metadata (ISO 19115)** was chosen for its capabilities for internationalization. ISO 19115 is a newer standard that has more configurability to application communities and supports internationalism in terms of languages and character sets.

These two standards have a high degree of alignment; the existing repositories of FGDC-CSDGM metadata can be easily mapped to conform to the ISO 19115 standard.

9.4.3.1 The Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata (FGDC CSDGM)

Organized in 1990, the Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the coordinated use, sharing, and dissemination of geospatial data in the United States.

The Federal Geographic Data Committee Content Standards for Digital Geospatial Metadata (FGDC CSDGM) defines the metadata fields used to describe geospatial data and is used by the GeoConnections Discovery Portal.

The FGDC CSDGM standard enables data users to determine:

- **What** data is available;

- **Whether** the data meet their specific needs;
- **Where** to find the data; and
- **How** to access the data.

The intent is not to centralize all geographic data in one location, but to provide links through the Internet to distributed sites where data is produced or maintained. When you document your data using the metadata standards, you also provide your metadata so that users can easily find your data.

The ISO 19115 Geographic Metadata standard is being used by the GeoConnections Discovery Portal along with the FGDC CSDGM.

You can access the complete specification of the FGDC CSDGM from: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/.

The CGDI **Metadata for GeoData** specification defines the content standards for which peer registries are considered to be compatible with CGDI registries for the purpose of holding descriptions of geospatial data resources. Currently, the CGDI has adopted the U.S. Federal Geographic Data Committee's Content Standard for Digital Geospatial Metadata (FGDC CSDGM) for the Metadata for Geodata, The Federal Geographic Data Committee Content Standard for Digital Geospatial Metadata). It is anticipated that the CGDI will also adopt ISO 19115 as a Metadata for Geodata format.

9.4.3.2 ISO TC 211 Metadata Standard 19115

The **International Organization for Standardization** (ISO) is a worldwide federation of national standards bodies established in 1947. The mission of the ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.

ISO TC 211 is a technical committee tasked with developing standards related to geographical information/geomatics. One of the standards that evolved from this committee is the ISO Geographic Information Metadata standard (ISO 19115), which defines the schema required for describing geographical information and services. It provides information about the identification, extent, quality, spatial and temporal schema, spatial reference, and distribution of digital geographic data. The standard defines:

- Mandatory and conditional metadata sections, metadata entities and metadata elements;

- The minimum set of metadata required to serve the full range of metadata applications;
- Optional metadata elements, to allow for a more extensive standardized description of geographic data, if required; and
- A method for extending metadata to fit specialized needs.

ISO distributes specifications on a cost-recovery basis. You can order the 19115 specification online from:

- http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26020.
- http://webstore.ansi.org/RecordDetail.aspx?sku=INCITS/ISO%2019115-2003.

GeoConnections is moving away from the Z39.50 protocol towards the International Organization for Standardization's ISO 19115 metadata schema for geographic information. Metadata is data about data and through standardization it is used to define the extent, quality, spatial and temporal reference, and the digital distribution of geographic data. With the metadata thoroughly inputted by the author, a user can better identify, evaluate, and acquire the data of interest to them.

This metadata standard was introduced by ISO Technical Committee 211 in May 2003 as the industry standard for capturing metadata of digital geospatial data.

With ISO 19115 over 300 metadata elements are defined including 86 possible classes, 282 possible attributes, and 56 possible relations. The metadata elements are broken into packages with mandatory (M), optional (O), and conditional (C) usage for defining the data. At a basic level, the metadata standard identifies the who, what, where, when characteristics of the data (http://grdc.bafg.de/servlet/is/2376/). The Open Geospatial Consortium (OGC), implements the standard using XML.

The Table 5 lists the core elements of this metadata standard where M is mandatory, C is mandatory under certain condition, and O is optional.

Core metadata for Geographic Datasets	Obligation	UML hierarchy
Dataset title	(M)	(MD_Metadata > MD_DataIdentification.citation > CI_Citation.title)
Dataset topic category	(M)	(MD_Metadata > MD_DataIdentification.topicCategory)
Abstract describing the dataset	(M)	(MD_Metadata > MD_DataIdentification.abstract)

Dataset reference date	(M)	(MD_Metadata > MD_DataIdentification.citation > CI_Citation.date)
Dataset language	(M)	(MD_Metadata > MD_DataIdentification.language)
Metadata point of contact	(M)	(MD_Metadata.contact > CI_ResponsibleParty)
Metadata date stamp	(M)	(MD_Metadata.dateStamp)
Dataset character set	(C)	(MD_Metadata > MD_DataIdentification.characterSet)
Geographic location of the dataset (by four coordinates or by geographic identifier)	(C)	(MD_Metadata > MD_DataIdentification.extent > EX_Extent > EX_GeographicExtent > EX_GeographicBoundingBox or EX_GeographicDescription)
Metadata language	(C)	(MD_Metadata.language)
Metadata character set	(C)	(MD_Metadata.characterSet)
Dataset responsible party	(O)	(MD_Metadata > MD_DataIdentification.pointOfContact > CI_ResponsibleParty)
Additional extent information for the dataset (vertical and temporal)	(O)	(MD_Metadata > MD_DataIdentification.extent > EX_Extent> EX_TemporalExtent or EX_VerticalExtent)
Spatial resolution of the dataset	(O)	(MD_Metadata > MD_DataIdentification.spatialResolution > MD_Resolution.equivalentScale or MD_Resolution.distance)
Spatial representation type	(O)	(MD_Metadata > MD_DataIdentification.spatialRepresentationType)
Reference system	(O)	(MD_Metadata > MD_ReferenceSystem)
Lineage	(O)	(MD_Metadata > DQ_DataQuality.lineage > LI_Lineage)
Distribution format	(O)	(MD_Metadata > MD_Distribution > MD_Format.name and MD_Format.version)
On-line resource	(O)	(MD_Metadata > MD_Distribution > MD_DigitalTransferOption.onLine > CI_OnlineResource)
Metadata file identifier	(O)	(MD_Metadata.fileIdentifier)
Metadata standard name	(O)	(MD_Metadata.metadataStandardName)
Metadata standard version	(O)	(MD_Metadata.metadataStandardVersion)

Table 5 Core Elements of the ISO 19115 Metadata Standard

ISO 19115 functionality includes:

1. multilingual data sharing through
    a. use of numerically coded pick lists and
    b. identifying the language and character set used in the metadata and the dataset,
2. topic categories for high level metadata classification,
3. unique identifier for the metadata,
4. extending the identification of roles and responsibilities in a dataset, and

5. describing geospatial service metadata (http://www.fgdc.gov/metadata/us-national-profile-iso19115)

A metadata community profile implements the core metadata components, those that are mandatory, with the community defining additional elements (see figure 15). Optional metadata elements may be used. Metadata extensions follow their own set of rules in the ISO 19115 standards specification.

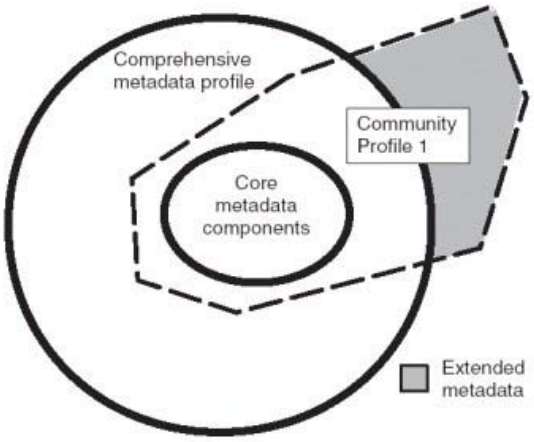


Figure 15 Metadata Community Profile for ISO 19115 (http://grdc.bafg.de/servlet/is/6494/)

For an example of a successfully implemented community metadata profile visit **Land Information New Zealand** (http://www.linz.govt.nz/rcs/linz/pub/web/root/core/Topography/ProjectsAndProgrammes/geospatialmetadata). A cross-agency team led by Land Information New Zealand (LINZ) has developed a geospatial metadata standard to consistently describe geospatial information across New Zealand government agencies. The initiative builds on recent and current e-government work on the New Zealand Government Locator Service (NZGLS) and e-Government Interoperability Framework (e-GIF), which are key components of the e-Government work programme.

For information on the North American Profile of ISO19115:2003, visit http://www.cits.rncan.gc.ca/html/brodeurj/.protege/.napMetadata/napMetadataWebsite/napMetadataProfileV11_20070726.pdf

9.4.4 Comparison of the ISO19115 and FGDC Metadata Fields

The international community, through the International Organization of Standards (ISO), has developed and approved an international metadata standard, ISO 19115. As a member of ISO, the US revised the CSDGM in accord with ISO 19115. A draft North American Profile of the (ISO) international metadata

standard, ISO 19115 has been developed. For more information on the FGDC-ISO harmonization activities see:

http://www.fgdc.gov/metadata/geospatial-metadata-standards.

A "crosswalk" between the FGDC CSDGM and ISO 19115 core profile fields is available at:

http://www.fgdc.gov/metadata/metadata/documents/FGDC_Sections_v40.xls .

In addition, an XSLT profile (19139) is being developed to map FGDC XML files to a equivalent ISO 19115 metadata fields.

9.4.5 CGDI-Recommended Service Metadata - Metadata for Geodata

The CGDI Architecture Working Group developed a set of metadata fields based on ISO 19115 and ISO 19128 standards. Metadata for Geodata was created to describe metadata fields needed to describe Web Map Services. It is posted on the GeoConnections site at:

http://www.geoconnections.org/en/communities/developers/standards/fa=technical.metadata_for_geodata

9.4.6 Metadata and the GeoConnections Discovery Portal

The metadata fields in the GeoConnections Discovery Portal's forms are compatible with the 1998 version of the FGDC Content Standard for Digital Geospatial Metadata (FGDC CSDGM).

The 'Mandatory' form of the geospatial data promotion page has extra fields which do not belong to the FGDC 98 standard. Some of those fields are for GeoConnections Discovery Portal purposes, whereas others bring the metadata into compliance with the Core Profile of the ISO 19115 metadata content standard.

As a result, the GeoConnections Discovery Portal's metadata is compliant with both the FGDC 98 version of the CSDGM and the Core Profile of the ISO 19115 metadata content standard.

The GeoConnections Discovery Portal currently supports the FGDC Content Standard for Digital Geospatial Metadata (CSDGM) as well as the core fields of the ISO TC211-sponsored 19115 geographic metadata standard and the Open Geospatial Consortium standards for web services. Support for the North American profile of the ISO 19115 standard is planned in the next version of the Discovery Portal.

9.4.7 Metadata Cataloguing Tools

Several metadata cataloguing tools exist to help resolve the tedium, complexity and steep learning curve associated with metadata such as Intelec's M3Cat, Multistandard, Multilingual Metadata Cataloguing tool and GeoScope (http://www.intelec.ca/html/fr/technologies/geoscope.html), ESRI's ArcIMS (http://www.esri.com/software/arcgis/arcims/index.html), GeoArctic's MapWraptor (http://www.mapwraptor.com/home.htm), USGS's MetaLite (http://gisdata.usgs.net/metalite/), and Catalogue Service for Web (CSW).

9.5 OGC Cookbooks

OGC Cookbooks are free, online, easy-to-use technical documents for developers, available on the Open Geospatial Consotrium's web site: http://www.opengeospatial.org/resource/cookbooks. Cookbooks typically include three chapters:

1. **Introduction** which describes the implementation and application
2. **Implementations and Applications**
   Experiences:
   - Examples of OGC Members' **Implementations and Applications** of Open Geospatial® Specifications. See the design of software systems that implement open interfaces, schemas etc. See use-case scenarios, WMS/WFS request examples, illustrations, DTD/XML documents, XSL/XSLT style sheet examples and more.
   - **Implementer Experiences**: How and why organizations are building their enterprise solutions around Open Geospatial Specifications, highlighting benefits and challenges.
3. **Recipes:** Step by step "how to" submitted by Web site developers and application developers. Explain how to implement WMS/WFS in existing software on both the server and client side using popular commercial, open source and freeware products.

For a list of current OGC Cookbooks visit http://www.opengeospatial.org/resource/cookbooks:

CHAPTER 10

Implementing CGDI Web Services

You can use web map services from the Canadian Geospatial Data Infrastructure for your own application. These services include gazetteers, geospatial-content servers, geospatial-content clients and standards-based inventories.

This chapter documents the architectures, descriptions, parameter specifications and web service interfaces of these web map services.

10.1 Web Service Architectures

Web service architectures arose from the need for computer-to-computer communication among distributed organizations. While the Internet has vastly increased person-to-person communication, it has also fuelled the demand for computer-to-computer communication. However, progress in this area has lagged due to the lack of a widespread communication mechanism. The mechanism must accommodate all who wish to participate, no matter what computer platform they use. The barriers to participation must be low.

These needs are paramount for business-to-business (B2B) e-commerce to succeed, and it is this B2B market that is spearheading the development of web service architectures. The same needs are also imperative to establish distributed infrastructures such as the Canadian Geospatial Data Infrastructure. The purpose of the CGDI is to increase the online availability of geospatial data and services, and foster new geomatics applications. Access to distributed data and other geomatics services is crucial to meeting this goal.

Web service architectures provide a distributed environment in which you can deploy and invoke services using standard Internet Protocols. In this context, a service is a collection of operations, accessible through one or more interfaces, that allows you to evoke a behaviour of value to you.

10.1.1 Benefits of Web Service Architectures

Web service architectures leverage the pervasive Web, providing a universal distributed computing platform. Applying distributed computing no longer means a heavy financial and training investment in technologies. Many methods exist to publish legacy applications to the Web. A service can be made web-accessible no matter how it is implemented, or what platform it executes on. Applications can be easily built from services running on heterogeneous platforms in any location.

These benefits are vital for large organizations (corporations or governments) whose distributed divisions, running different computing platforms, need to interoperate. Inter-organizational infrastructures, such as the CGDI, and B2B infrastructures can function thanks in part to web service architectures.

Applying web service architectural principles to development yields applications composed of loosely coupled, distributed (or distributable), and reusable services. Complex applications are broken down into simpler entities that can be independently developed. The development adds to the pool of services that become available for use in new, even more sophisticated applications. The cost of application development is reduced, making sophisticated application development more cost effective.

10.1.2 How to Use Web Service Architectures

The following example demonstrates how you can build an application using a web service architecture. This case study develops a web application that accepts place names, and returns a map showing a road route between the two places. This application might be implemented as shown in Figure 16, Traditional Application Design.

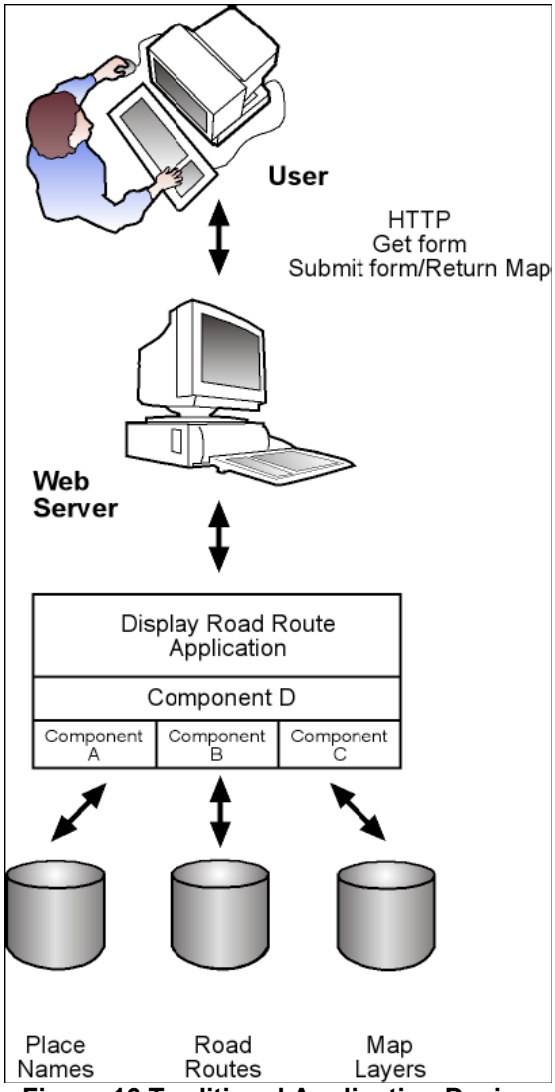


Figure 16 Traditional Application Design

The user invokes the application through a web browser, and then enters the place names. The web server invokes an application, which performs the necessary processing i.e. accessing a database of place names, a road route database, and a database of other map features. The web server then returns a map to the browser as a Graphics Interchange Format (GIF) image. The important aspect of this process is the way in which the application is structured,

particularly the partitioning of the software into components and the interfaces between the components.

Traditional design techniques structure the software into logical units with well-defined interfaces, but deploy the application as a uniform entity, not suitable for distribution.

When you apply web-service based techniques to this application, they break down the application into a number of web service components, which are deployed as stand-alone servers with an HTTP interface. The result of this structure is shown in Figure 17, Application Design Using a Web Service Architecture. (Since the user's access to the web browser, and the browser to web server interaction, are unchanged, they are not shown.) The application has been constructed to make use of the services provided by distinct servers:

- A **gazetteer server** provides services to convert a place name into a geographic location;
- A **route server** provides services to get the road route between two geographic locations;
- A **map server** provides services to get a base map on which the route is displayed;
- An **overlay server** provides a service to overlay the route on the map; and
- A **display route** server makes use of the services above to convert a road route request into a map displaying the route.

The services are deployed in the web service platform and hence can potentially be located anywhere on the Internet, even though they might all reside on a single host computer for the initial deployment.

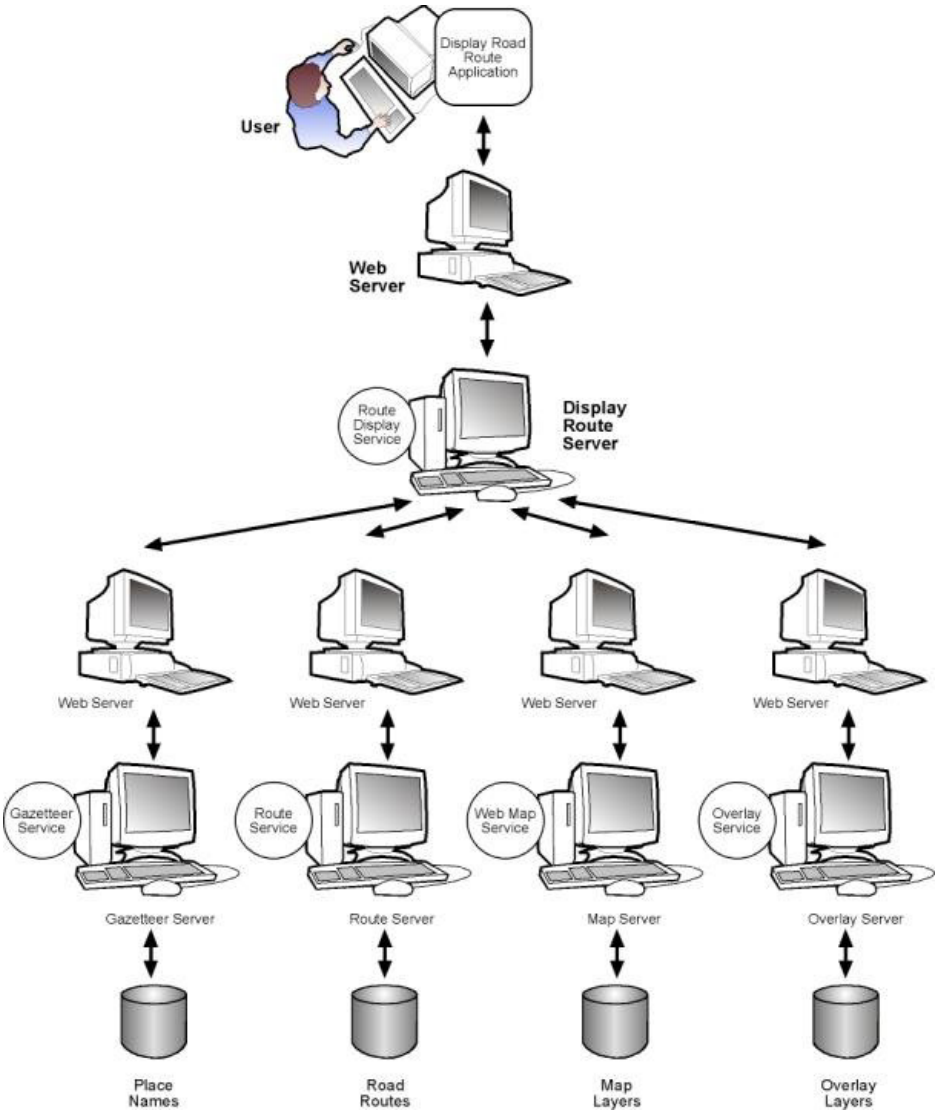


Figure 177 Application Design Using a Web Service Architecture

The benefits of this architecture are not necessarily apparent when this application is considered in isolation. However, when the application is considered as part of a distributed infrastructure such as the CGDI, the benefits of a web service architecture are immediately apparent:

- The development of this application has resulted in the deployment of a number of reusable services that can initiate the development of other applications;
- The architecture is scalable: even if all services were initially deployed on a single computer, if the server is swamped by heavy use, services can easily be migrated to different computers; and
- The most suitable participant can provide the back-end services (e.g. the Atlas of Canada can provide the server that provides the base map).

Additional benefits are realized when the service interfaces become "standards" (formal or de facto), and when there are multiple deployments of the same services. The design allows the application to make use of new and better implementation of the services as they emerge.

10.1.3 Best Practices and Case Studies

One of the focal points of the Canadian Geospatial Data Infrastructure is to implement a distributed set of Open Geospatial® web services that were developed to support user communities of practice. For additional documentation on Web Map Services visit: http://www.geoconnections.org/publications/training_manual/e/06/06_02/06-02-01.htm.

Existing web services now available from the CGDI include:

- National-provincial mapping services such as the Centre for Topographic Information;
- Provincial topographic web map servers from British Columbia, Ontario, and Newfoundland and Labrador;
- National and provincial gazetteers;
- Catalogue servers; and
- Application development tools.

To view a popular web map service, see the **Atlas of Canada**: http://atlas.nrcan.gc.ca/site/index.html.

To see a web map service in action, see **North American Weather Today**: http://cgdi-dev.geoconnections.org/prototypes/owsview/index.html.

For a listing of other web map services, see the **GeoConnections Discovery Portal**: http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&entryType=webService&sortOrder=alphabetic&serviceType=CgdiMapServices

To read more about web map services, see **GeoPlace.com**: http://www.geoplace.com/ME2/Default.asp.

All of these services are based on OGC's implementation specifications, namely: Catalog Services, Web Map Server Interfaces, Geography Markup Language (GML), Web Feature Service (WFS) and Web Map Service (WMS).

Table 6, Web Services Best Practices, and the following case study, provide examples of "best practices" of organizations that have implemented web services.

Organization	CGDI Services Exploited	Applications
Natural Resources Canada/GeoConnections	WMS WFS SLD Gazetteers	GeoConnections Discovery Portal http://geodiscover.cgdi.ca/gdp/index.jsp?language=en
NRCan/ /GeoBase	WMS NTDB feature Catalog	Geobase Portal http://www.geobase.ca/ http://toporama.cits.rncan.gc.ca/toporama_en.html
Agriculture and Agri-Food Canada	WMS WFS SLD Gazeteers	Canadian Soil Information System (CanSIS) http://sis.agr.gc.ca/cansis/intro.html
Environment Canada	WMS Metastar Geospatial Search Interface, XchainJ, Z39.50	Canadian Information System for the Environment (CISE) http://gis.ec.gc.ca/ec-cise/
NRCan/Pacific Forestry Centre	WMS WFS	National Forest Information System (NFIS) http://www.nfis.org/

Table 6 Web Services Best Practices

The **National Forest Information System** (NFIS) (http://www.nfis.org/) provides an example of how an organization can meet its internal needs while at the same time contributing to and using the Canadian Geospatial Data Infrastructure. The National Forest Information System aims to be the key thematic component of the CGDI for forest resources information. The NFIS is being built on the principles that this section has been advocating, namely:

1. **Use of Standards**

   NFIS adopts and promotes the use of international and other appropriate standards as these standards evolve through the work of bodies such as ISO, W3C and OGC, and as these standards become accepted within the CGDI community. Standards are fundamental in achieving interoperability

of information services relating to metadata, web content delivery (both spatial and thematic) and for generic IT services such as user authentication, e-commerce, etc.

2. **Web Services Architecture**

   The NFIS architecture consists of a network of content servers working within a common information and services framework. OGC web map technologies form the basis for vendor-neutral information interoperability in the NFIS network. The common information and services framework allows NFIS member organizations to attach attributes to the shared representations of the landscape and to carry out independent, off-line analyses and compilations for subsequent web delivery through the common framework.

   This distributed architecture allows responsibility for the management of information and implementation of services to reside with the custodian, closest to the data source. This approach ensures that the data are authoritative and current while providing the custodial agency with full control of the data.

10.2 Using CGDI Web Map Services

The advantage of using CGDI web service interfaces is that you receive standards-compliant results from the web services. You can easily integrate these results along with other standards-based mapping components, into your own applications to create more powerful services for your users.

In most cases, the standards are based on definitions ratified by the Open Geospatial Consortium, Inc. and documented at http://www.opengis.org.

Some services have two interfaces: a web service that returns XML and an embedded HTML service in which you can insert the component into a web page.

10.2.1 Viewing Data from Web Map Services

The user requires a Web Map Service viewing client in order to view data submitted with a URL.

For a current list of OGC Registered Products including WMS servers and clients visit http://www.opengeospatial.org/resource/products.

In addition, GeoConnections financially contributed to uDig, a user-friendly desktop internet GIS application produced by Refractions Research. It is free to download at http://udig.refractions.net/confluence/display/UDIG/Home.

Figure 18 depicts the process involved when someone uses a web map service from the CGDI.

Depending on the WMS viewer, the user typically adds a layer, and submits a URL containing the link to the requested service. The following URL links to data in the EcoStratification WMS maintained by Agriculture and Agri-Food Canada:

http://wms1.agr.gc.ca/cgi-bin/mapeco?version=1.1.0&service=wms&request=getCapabilities.

When the WMS is connected, the user sees layers that describe the eco-provinces of Canada displayed in their viewer.

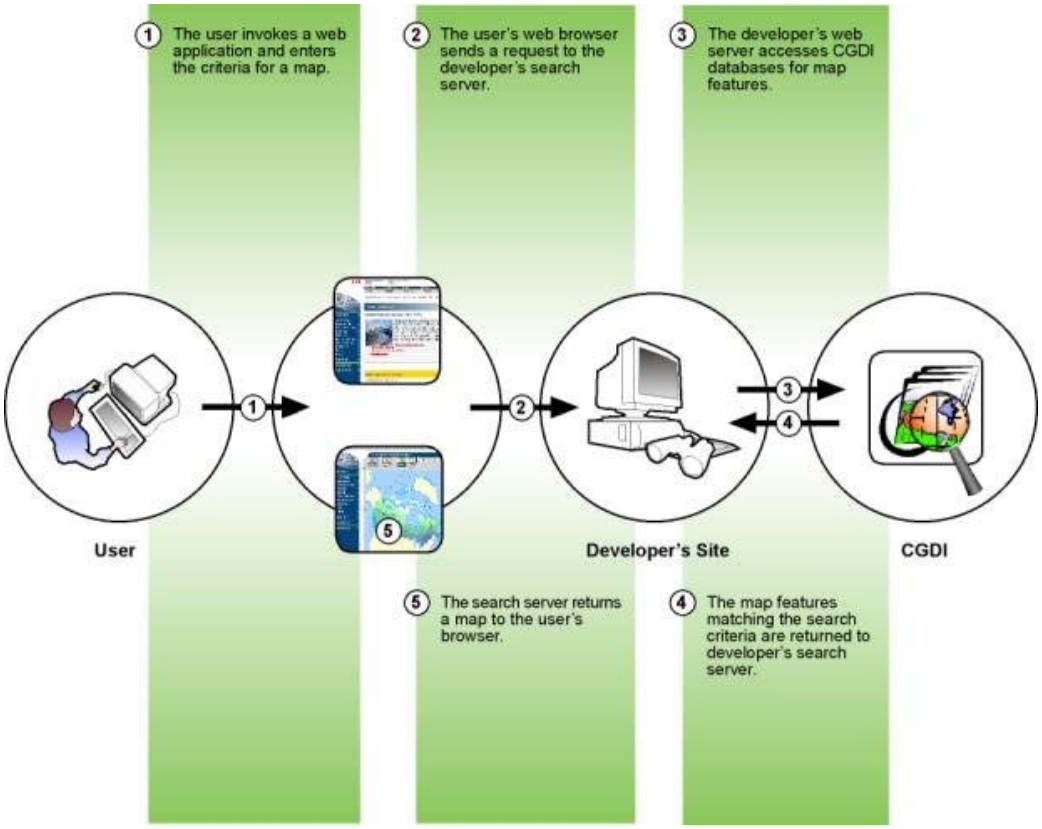


Figure 18 Using a CGDI Web Map Service

10.2.2 Viewing Data from User Communities

User communities within the GeoConnections thematic areas of public health, public safety and security, environment and sustainable development, and Aboriginal matters have contributed to the CGDI by providing data to the following Web Services.

10.2.2.1 Public Health

The New Brunswick Lung Association hosts a Web Map Service (WMS) to facilitate integration and provide visualization of air quality, and human health data. For more information visit: www.gishealthportal.ca.

WMS Link:
http://156.34.150.115/nbla/servlet/FusionServlet?request=GetCapabilities&service=wms

10.2.2.2 Public Safety and Security

The Environmental Emergencies Branch has created a system 'the Environmental Emergency Management System or "E2MS"' that capitalizes on the CGDI's vast reservoir of interoperable geographic data layers. By combining spatial-information management tools and technologies with spatial data and information, E2MS uses the CGDI to enable emergency organizations, federal government departments, and provincial emergency-measures agencies to respond more effectively to oil and chemical spills. For more information, visit: http://www.geoconnections.org/en/aboutGeo/successStories/id=1117.

10.2.2.3 Environment and Sustainable Development

The following is a WFS link for Bird Studies Canada. Bird Studies Canada is the lead NGO in Canada for Citizen Science-based monitoring of avian biodiversity. BSC's BirdMap WMS makes locational information from several national bird monitoring programs available to the conservation community.

For more mnformation see:
http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=service&entryId=3919&entryLang=en

WFS Link:
http://www.bsc-eoc.org/cgi-bin/bsc_ows.asp?version=1.0.0&service=WFS&request=GetCapabilities

10.2.2.4 Aboriginal Matters

The Indian and Northern Affairs Canada (INAC) Spatial Data Infrastructure Project generated this WMS. Within INAC this project is a catalyst to make it easier to access and share geospatial information.

For more information see:
http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=service&entryId=6238&entryLang=en

WMS Link:
http://geoportail-geoportal.ainc-inac.gc.ca/cgi-bin/mapserv.exe?map=inac.map&service=wms&version=1.1.3&request=getcapabilities.

10.3 Gazetteers

Gazetteers are CGDI services that look up geographic regions based on secondary reference systems. These secondary reference systems are a means of making your data mappable or geocoding a point or a region by some means, such as postal code, CGDI place name, the Canadian Geographic Name Service, or the National Topographic System.

10.3.1 Postal Code Lookup Service

The **Postal Code Lookup** service finds geographic regions based on Canadian postal codes. This gazetteer uses the "Forward Sorting Area" (FSA) portion of Canadian postal codes for input; the Forward Sorting Area is the first three characters of the full Canadian postal code. It then returns a point location that contains the latitude-longitude coordinates of the central postal station of the FSA.

Note that at some time in the future, this service may be upgraded to use the full six-character postal code.

Service Type
Gazetteer

Output Format
XML/GML with place name, latitude-longitude point location.

Output Encoding
OGC GML 3.0.0

Further Documentation
http://geoservices.cgdi.ca/postalcode/postalcode_1_0_0-en.doc

Sample Interface
http://geoservices.cgdi.ca/postalcode/sample.html

Capabilities Document
http://geoservices.cgdi.ca/ cgi-bin/postalcode/postalcode.cgi?version=1.0.0&request=GetCapabilities

Base URL
http://geoservices.cgdi.ca/cgi-bin/postalcode/postalcode.cgi?

HTML Encoding
An alternate embedded HTML version of this service is available at:
http://geodiscover.cgdi.ca/gdp/about/en/6.2.html

10.3.1.1 Parameter Specification

Table 7 provides a snapshot of the parameter specifications for the Postal Code Lookup service. Refer to the online documentation for the latest parameter specifications at:
http://geoservices.cgdi.ca/postalcode/postalcode_1_0_0-en.doc.

Parameter	Obligation	Value	Meaning
version	Required		Requested version of the WFS specification. For example, 1.0.0.
request	Required	**GetPostalCode** **GetCapabilities**	Either list the capabilities or do the search. If the selection is GetCapabilities, then no other parameters are required.
sortArea	Conditional		Required when Request=GetPostalCode.
code	Conditional	<a postal code>	Required when Request=GetPostalCode. If the entire six-character postal code is provided with the FSA service, the last three characters are ignored.

Table 7 Postal Code Lookup Service Parameter Specifications

For an example of the results of a Postal Code Lookup service, see:
http://geoservices.cgdi.ca/cgi-bin/postalcode/postalcode.cgi?version=1.0.0&request=GetPostalCode&sortarea=FSA&code=M6M2G4

10.3.2 CGDI Place Name Lookup Service

The **CGDI Place Name Lookup** service finds all places in Canada that match the place name specification in the input string. A repeatable set of the feature description and GML latitude-longitude coordinates is returned within a web feature service (WFS) XML description. The complexity of the geometry that is returned can vary from simple points to complex geometries; this is determined by one of the parameters in the input request.

The place name data used for the CGDI Place Name Lookup service is from the Canadian Geographic Names Service (CGNS).

Service Type
Gazetteer

Output Format
An XML/GML containing one or more features. There may be several features provided in the output if the search criteria match several geographic places.

Output Encoding
OGC GML 2.1.2

Further Documentation

The following document describes the CGDI gazetteer Service which provides an interface/wrapper to Web Feature Services (WFS) allowing users to acquire geometries for known placenames.
http://cgdi-dev.geoconnections.org/prototypes/cgdigaz/

Sample Interface

The following links to a sample interface where you can search for geometries based on placenames and other criteria. The result of the search is an XML output displaying the schema used in this search interface.
http://cgdi-dev.geoconnections.org/prototypes/cgdigaz/sample.htm

Capabilities Document

http://cgdi-dev.geoconnections.org/cgi-bin/prototypes/cgdigaz/cgdigaz.cgi?version=1.0&request=GetCapabilities

Base URL

Access the CGDI Gazetteer Service using the following URL in your web server client.
http://cgdi-dev.geoconnections.org/cgi-bin/prototypes/cgdigaz/cgdigaz.cgi?version=1.0&request=GetCapabilities

For the latest description on the deployment of this service, see:
http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=service&entryId=1825&entryLang=en

10.3.2.1 Parameter Specification

Table 8 provides a snapshot of the parameter specifications for the CGDI Place Name Lookup service. Refer to the online documentation for the latest parameter specifications at: http://cgdi-dev.geoconnections.org/prototypes/cgdigaz/.

Parameter	Obligation	Value	Meaning
version	Required		Requested version of the WFS specification, e.g. 1.0.
request	Required	**GetPlaceNameGeometry** **GetCapabilities**	Either lists the capabilities or does the search. If the selection is GetCapabilities, then no other parameters are required.
placename	Conditional Optional	<free text>	Is optional if the bbox or key parameter is used.
entitytypes	Conditional Optional	See online document. Default: ITY	Specifies the type of geometry to search for (for example, a city or a river). This is a comma-separated list.
provterr	Conditional Optional	See online document. Default: all	Specifies the province or territory to search.
key	Conditional Optional		Searches the Canadian Geographic Names Database (CGNDB) Key; usage of this parameter voids all other parameters.
geomtype	Conditional Optional	**Simple**	Returns complex points.
		Complex	Returns complex geometries (polygon, line) for supported features.
		Bbox	Returns the minimum bounding rectangle for supported features.
wildcards	Conditional Optional	< **true** or **false** > Default: false	If set to true, then place names are not required to be exact matches. Also, if set to true, then all entity types will be returned, unless specific entity types are requested.
format	Conditional Optional	**Xml** Default: xml	Only one output format is currently available; XML.
bbox	Conditional Optional	<real number, real number, real number, real number > The order of the bbox values are: West Bounding Longitude	Defines the bounding area in which to search for place names. Is optional if the place name or key parameter is used.

		North Bounding Latitude East Bounding Longitude South Bounding Latitude The format of the coordinates are: Longitude: < **-180** to **180** > Latitude: < **-90** to **90** >	

Table 8 CGDI Place Name Lookup Service Parameter Specifications

For an example of a CGDI Place Name Lookup service in XML format, see: http://cgdi-dev.geoconnections.org/cgi-bin/prototypes/cgdigaz/cgdigaz.cgi?version=1.0&request=GetPlacenameGeometry&placename=Toronto&bbox=-90,40,-70,50&

Refer to the online documentation for more examples: http://cgdi-dev.geoconnections.org/prototypes/cgdigaz/index.htm

10.3.3 Canadian Geographic Name Service Place Name Gazetteer

The **Canadian Geographic Name Service (CGNS) Place Name** gazetteer returns feature information for specific geographic locations.

Service Type
Gazetteer

Output Format
HTML, XML or CSV

Further Documentation

The following link is to the Geographical Name Search Services provided by Natural Resources Canada. It includes discussion of API parameters, code definitions, and refer functionality.
http://gnss.nrcan.gc.ca/gnss-srt/help_api.jsp#api

Sample Interface

Visit the following link to view the search interface for the Geographical Name Search Service and experiment with data view options.

http://gnss.nrcan.gc.ca/gnss-srt/searchName.jsp

10.3.4 Canadian Geographic Name Service Server

The **Canadian Geographic Name Service (CGNS)** is a web feature service (WFS), with all input requests and output conforming to the WFS specifications. The WFS includes the place name data, which is used to drive some of the CGDI gazetteer services, such as the Canadian Geographic Name Service Place Name Gazetteer. Visit the CGNS at the following link:
http://gnss.nrcan.gc.ca/index_e.html

Service Type
WFS Gazetteer, Web Map Server

Output Format
OGC WFS or WMS

Capabilities Document

Enter the following URL into a Web Feature Service viewing client.
http://cgns.nrcan.gc.ca/wfs/cubeserv.cgi?datastore=cgns&version=1.0.0&service=wfs&request=GetCapabilities

Base URL

There is a web map service (WMS) instance of the place name service, with scale-dependent location names available as layers. The capabilities document for this service is below. Enter the following URL into a Web Map Service viewing client:
http://cgns.nrcan.gc.ca/wfs/cubeserv.cgi?datastore=cgns

10.3.5 Other Place Name Gazetteer Services

The CGDI offers two other place name gazetteer services: the World Place Name gazetteer, and the HTML-encoded gazetteer.

10.3.5.1 World Place Name Gazetteer

Service Type
Gazetteer

Further Documentation

Online documentation is available at:
http://www.geoconnections.org/publications/training_manual/e/08/08_09/08_09_01.htm

Capabilities Document
http://ogc.compusult.nf.ca/cgi-bin/OGC/gazetteers/wfs?request=getCapabilities

Base URL
http://ogc.compusult.nf.ca/cgi-bin/OGC/gazetteers/wfs

10.3.5.2 HTML-Encoded Gazetteer Client

Service Type
An embedded HTML gazetteer client (based on the CGDI gazetteer for Canadian place lookups and the World gazetteer for non-Canadian place lookups).

Further Documentation
http://geodiscover.cgdi.ca/gdp/about/en/6.2.html

10.3.6 National Topographic System Lookup Service

The National Topographic System (NTS) returns geometries for known NTS map sheet identifiers, or it returns NTS map sheet identifiers for given geometries.

Service Type
Gazetteer

Output Format
XML with two regions encoded in GML with latitude-longitude coordinates. One location is the neat line of the map sheet, the other location is the quadrangle of the map sheet. Alternatively, it can return the National Topographic System map sheet number for a given location and scale.

Output Encoding
OGC GML 3.0.0

Further Documentation
http://geoservices.cgdi.ca/NTS/index.jsp

Samples

View samples at the following link: http://geoservices.cgdi.ca/NTS/example.jsp

Capabilities Document
http://geoservices.cgdi.ca/NTS/NTSLookup?request=GetCapabilities&version=1.1.0

Base URL
http://geoservices.cgdi.ca/NTS/NTSLookup?-

10.3.6.1 Parameter Specification

Table 9 provides a snapshot of the parameter specifications for the National Topographic Systems lookup service. Refer to the online documentation under "Further Documentation" above for the latest parameter specifications.

Parameter	Obligation	Value	Meaning
request	Required	**GetMapSheet**	There is only one request type.
Map sheet	Conditional	< an NTS map sheet number >	Provides either a map sheet (to look up the coordinates), or the combination of latitude, longitude and scale (to look up the map sheet).
lat	Conditional	A real number of a latitude within Canada	Provides either a map sheet (to look up the coordinates) or the combination of latitude, longitude and scale (to look up the map sheet).
lon	Conditional	A real number of a latitude within Canada	Provides either a map sheet (to look up the coordinates) or the combination of latitude, longitude and scale (to look up the map sheet).
scale	Conditional	Either **50 000** or **250 000** or **1 000 000**	Provides either a map sheet (to look up the coordinates) or the combination of latitude, longitude and scale (to look up the map sheet).
version	Optional		Requested version of the WFS specification, e.g. 1.1.0.
interval	Optional	A real number in minutes	Point interval to create the neat line geometry.

Table 9 National Topographic Systems Lookup Service Parameter Specifications

For an example of a National Topographic Systems lookup service XML schema, see:

http://geoservices.cgdi.ca/NTS/NTSLookup?request=GetMapsheet&version=1.1.0& mapsheet=31g5

10.4 Other CGDI Mapping Services

The Canadian Geospatial Data Infrastructure has web mapping services of many varieties registered as web services in the GeoConnections Discovery Portal. These include web map servers, web map clients, web feature services, web coverage services, web registry services, and gazetteer clients. With time, the number and breadth of services registered in this directory will grow. Descriptions of the services in this directory include links to capabilities documents for the services and URLs for further descriptions about the services.

You can access the list of CGDI web services from the CGDI web services form of the GeoConnections Discovery Portal at http://geodiscover.cgdi.ca.

For a list of CGDI web services, visit the Discovery Portal at:
http://geodiscover.cgdi.ca/gdp/search?action=searchForm&entryType=service

Each service in the XML response has an entryId. For more information about each entryId using the getEntry interface, see Appendix 3.1, Using GeoConnections Discovery Portal APIs.

You can use the GeoConnections Discovery Portal XML API (described in Appendix 3.2, Programming and Using HTML APIs) to get an XML list of all CGDI web services.

10.5 Web Map Services Repository Interfaces

The CGDI also offers a web map service repository. This repository stores service information (such as web map server instances) and capabilities documents. It enables clients to discover web services such as map servers and layers, at:
http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&
entryType=webService& sortOrder=alphabetic&
serviceType=CgdiAllServicesAndClients

10.5.1 Service Manager

The **Service Manager** is a repository of OGC-compliant services, implemented using OGC's Catalogue Interface Implementation Specification. Queries conforming to this specification may be used to retrieve CGDI services that conform to OGC's specifications.

Further Documentation
http://www.ogc.gov.uk/User_roles_in_the_toolkit_service_manager.asp

Base URL
http://ceomap2.ccrs.nrcan.gc.ca/cgi-bin/cslt/wes/service_manager/catquery
Note: You must make a valid request to it for it to work.

CHAPTER 11

Providing Access to Your Services and Data Products

There are several means by which CGDI users can access your services and data products. This chapter:

- Explains how you can provide access to your services;
- Describes the four ways you can provide access to your data products;
- Highlights several firewall issues you may want to keep in mind;
- Provides information on security options;
- Discusses web services management; and
- Introduces GeoRSS for regularly changing web content.

11.1 Providing Access to Your Services

To provide access to your geospatial services, you must first register your service on the GeoConnections Discovery Portal at: http://geodiscover.cgdi.ca/gdp/help?request=RegisterServices. As part of the process, you will be asked to submit a form which requires you to enter the URL for your service in the appropriate box. When users perform a search for a service, they receive a list of results matching their request criteria. They can then choose to visit any of the services from the list by selecting the Access button associated with that particular site. This launches the web site containing the service.

11.2 Providing Access to Data Products

There are four ways users can access your geospatial data products: by FTP download, HTTP access, order basket or email.

To specify how you would like users to access your data products, you will need to configure the field named "Online Linkage" in the table of FGDC fields.

You can configure this URL to enable FTP downloading of your products, email ordering of your products, order basket services for your products, or any other HTTP service that consumes your products.

11.2.1 FTP Download Access for a Product

When the GeoConnections Discovery Portal encounters a product with an online linkage starting with an "ftp:" scheme, it provides a Download button with the product description. When a user selects the Download button, it initiates a browser FTP connection to the address provided in the online linkage, which starts a session to download the product to the user's computer.

11.2.2 HTTP Access for a Product

When the GeoConnections Discovery Portal encounters a product with an online linkage starting with an "http:" scheme, it provides an Access button along with the product description. When a user selects the Access button, it initiates a browser HTTP connection to the address provided in the online linkage. The HTTP address can point to a service that is related to the product, to a static page with more information about the product, or to the actual product file (which initiates an FTP download if the product has the appropriate file extension).

11.2.3 Remote Order Basket Access for a Product

When the GeoConnections Discovery Portal encounters a product with an online linkage containing the string with "remoteOrder", it provides an 'Order' check-box with the product description, and an Order button next to the database summary.

The user can then select one or more products and press the Order button, which activates your order basket service and pre-populates it with the products that were checked-off.

The mask of the online linkage is as follows:

http://<address>/remoteOrder<...>

where:

- The content between braces “<>” is defined by the user;
- “address” is the address of your HTTP server;
- “remoteOrder” is the required mask that indicates that the product is available for online ordering; and
- <...> is any other text or parameters that you wish to specify for the online order interface. For example, you may wish to add a parameter that passes the database name as a parameter along with the CGI call.

You must have a script on your server that has the phrase "remoteOrder" in its name. In addition, this script must accept the parameter named "PID". This parameter is constructed into a call to your server in the following format:

http://<address>/remoteOrder<...>&PID=id1;id2;...

where **id1** and **id2** are the product IDs of the products that the user has discovered via your Search server, and has requested to order via the GeoConnections Discovery Portal interface.

If more than one product coming back from the same search points to the same order basket address, the user can select more than one product to place into the order basket for a single check-out process.

It is important to remember that the order basket and check-out services reside at your site: the GeoConnections Discovery Portal simply brokers the product discovery and selection of the products to be pushed into the order basket.

11.2.4 Email Order Access for a Product

When the GeoConnections Discovery Portal encounters a product with an online linkage starting with a "mailto:" scheme, it provides an 'Order' check-box with the product description, and an Order button next to the database summary.

The user can then select one or more products and press the Order button, to activate a service to send an email message to your order desk (at the email address defined in the online linkage URL).

The "mailto" URL for an orderable product has the following format:

mailto:<order-desk email address>

Example: mailto:order-desk@sample.com

Mailto is a standard URL scheme (cf. RFC 2368. See http://rfc.net/rfc2368.html for more information).

A default subject is provided to all email orders, unless a subject is provided in the "mailto" URL specification. To provide a subject in a "mailto" URL specification, use the following format:

mailto:<order-desk email address>?subject=<subject>

Example: mailto:order-desk@sample.com?subject=email order referred from the GeoConnections Discovery Portal

If you want the orders to go to more than one email address, simply separate the email addresses by commas.

The GeoConnections Discovery Portal handles the user interface for the user to select which products go into the order. The order will be sent to the email address(es) provided in the full URL.

The GeoConnections Discovery Portal collects the user's email address and adds it in the CC field of the email message. The sender address of the email orders is gdp-order@ccrs.nrcan.gc.ca. The body of the email message contains the descriptions of the products, which the user has selected to order, the user's contact information, and any comments added by the user.

11.3 Firewall Issues

Your server sites must be connected to the Internet via a dedicated, high-speed data connection. If you have firewall or security restrictions on direct Internet connections, you may choose one of the following options:

1. Search server inside the firewall;
2. Search server outside the firewall; and
3. Mirrored copy of database outside the firewall.

11.3.1 Search Server Inside the Firewall

A search server inside the firewall allows restricted Z39.50 traffic through the firewall to the search server. In this case the firewall allows Z39.50 traffic to go through one specific port. Port 6675 is the default port used for the Z39.50 protocol.

The advantage of this option is that the database connection to the server does not have to be exposed to the world. The disadvantage is that it is difficult for external users to access.

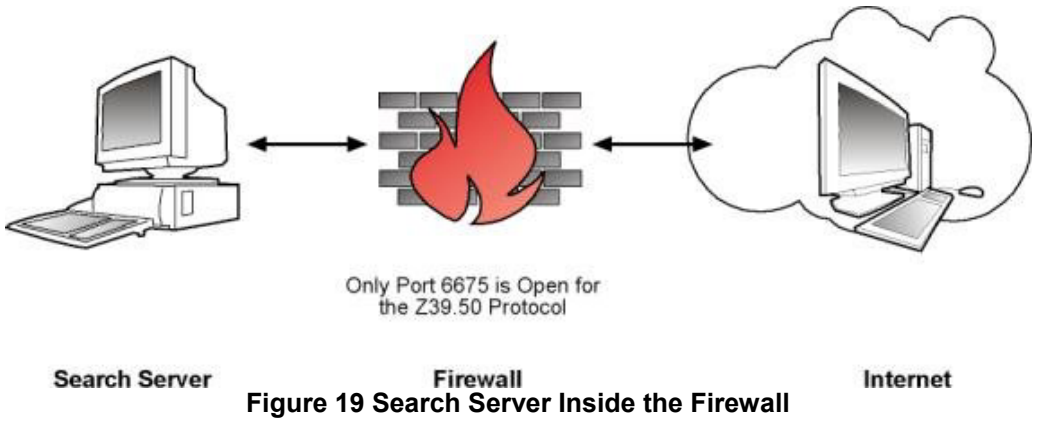


Figure 19 Search Server Inside the Firewall

11.3.2 Search Server Outside the Firewall

A search server outside the firewall allows SQLNet/ODBC access through the firewall. In this case the search server accepts the queries directly from the Internet clients. The firewall allows the search server to communicate with the database located inside the firewall through port 1521 (SQLNet).

The advantage of this option is that it is easy for external users to access. However, the database connection to the search server is exposed to the world.

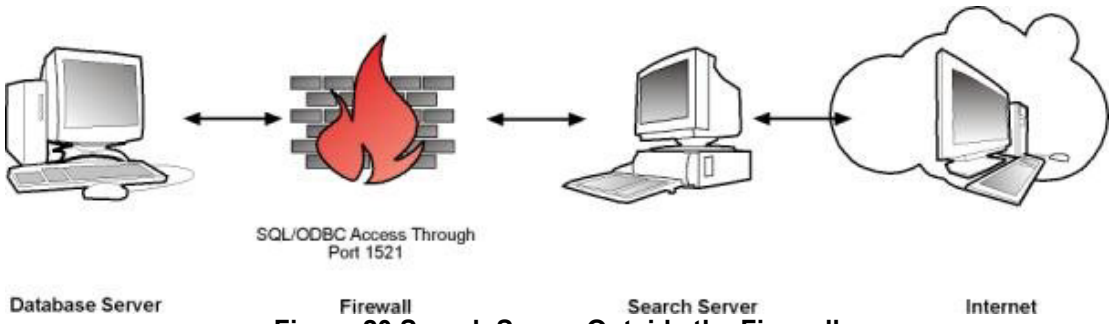


Figure 20 Search Server Outside the Firewall

11.3.3 Mirrored Copy of Database Outside the Firewall

A server containing a mirrored copy of the SQL database (including all metadata, data and GEO Profile data definitions) outside the firewall allows the following:

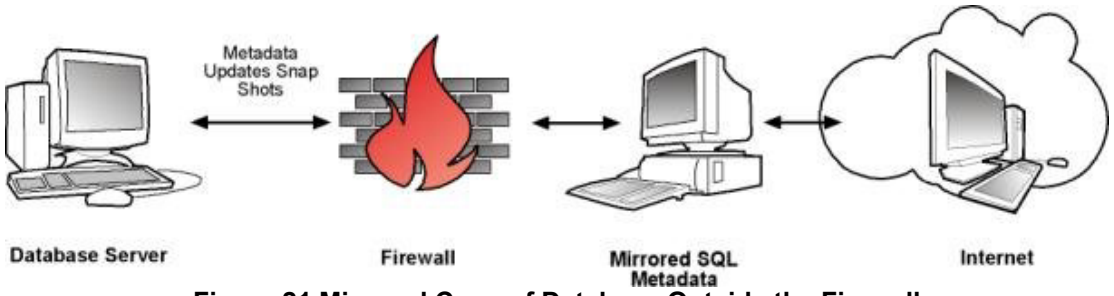


Figure 21 Mirrored Copy of Database Outside the Firewall

11.4 Web Security Options within the CGDI

Web Security is a mechanism for implementing and deploying a secure CGDI service, a mechanism to quickly establish access control rules for OGC services and their data content in response to a more dynamic business environment, and a secure Web environment allowing any CGDI participant to support their own Identity Systems (the ability to authenticate their own users) and still participate into a federated CGDI environment where each organization (data or service provider) can control their own resources.

The Canadian Geospatial Data Infrastructure (CGDI) supports a federated architecture of web resources and moves away from traditional environments maintaining centralized Identity Systems. Until now, service providers have been at the center of Identity Systems, requesting identity information (through a registration process) from each user prior to providing a web service. Web services like those implemented through the Canadian Geospatial Data Infrastructure (CGDI) have been designed to support robust, flexible, and scalable distributed geo-processing capabilities that can be used in collaboration and evolve in response to the requirements of dynamic communities of practice. A federated security mechanism is needed to support such living services and

requirements for loosely coupled and organic CGDI implementations. This is a departure from the paradigm of rigid architecture and centralized identity systems.

CGDI implementation components such as GeoConnections GeoPortal and other applications to be developed by CGDI participants will have to support and integrate well with emerging security models and more specifically Identity Systems implemented using a user-centric model. During the next few years, CGDI participants will need to investigate the use of emerging secure-enabled Identity Systems when implementing their CGDI components. This implies investigating the use of user-centric Identity Systems such as CardSpace and SAML. These Identity systems are based on open specifications from OASIS and implementations already exist. For example, the Oracle Identity Federation solution (part of Oracle Portal Application server) already support SAML v2.0 and the use of X.509 certificates.

One distinguishing aspect of recent identity systems is the fact that users are at the centre of the architecture design and the solution being implemented. In this model both users and service providers have to present identities to each other prior to accessing a service or performing a Web transaction. In addition, the new model introduces more clearly the role of the identity provider in a three tiers relationship. The means by which users interact with service providers about identity information can be described by the following two-way digital conversation between the parties involved:

As presented by Figure 22, this model is user-centric. The service provider is no longer central to the model but the user is now fulfilling that role.

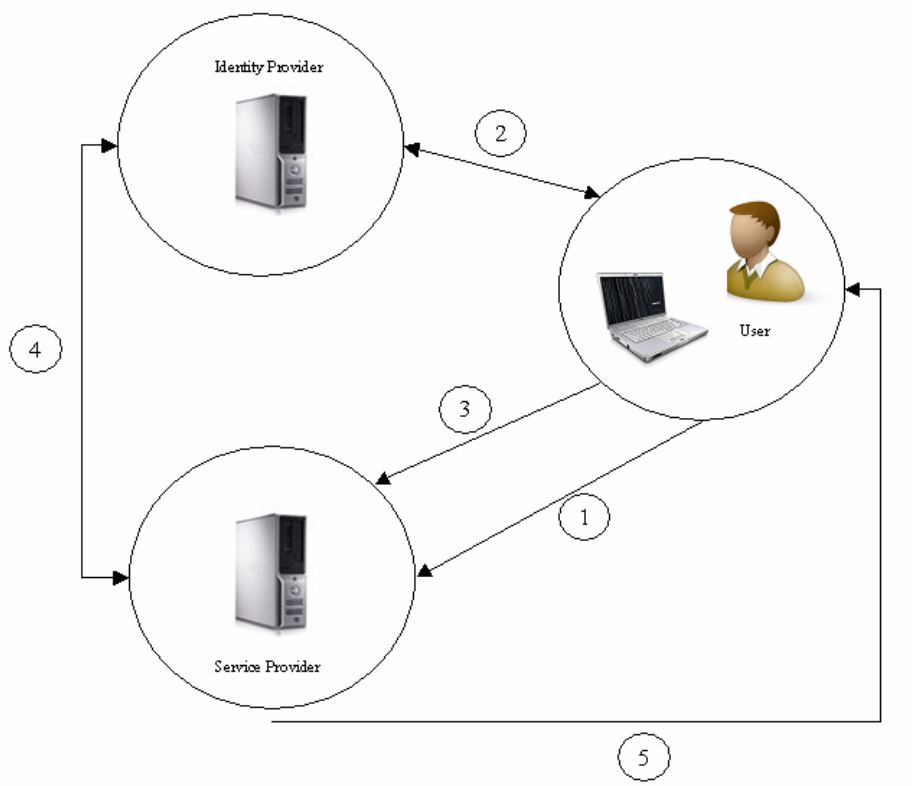


Figure 22 User-Centric Identity Systems

1. A user connects to a service provider about service “A”.
2. The service provider requires identity attribute “X” and indicates which identity provider can provide identity attribute “X”.
3. The user connects to the identity provider and requests identity attribute “X”. The user connects to the service provider and provides identity attribute “X”.
4. The service provider connects to the identity provider and confirms/ validates identity attribute “X” of the user.
5. The service provider provides service “A” to the user.

For GeoConnections and CGDI participants this implies implementing new software applications accepting identity information such as identity attributes from third party Identity Providers without having to register all users connecting to an application or a service.

The intention of web services is to encourage data sharing and interoperability between the service and the customer. Security in this context therefore requires attention in the following areas of communications security: authentication, authorization, integrity, confidentiality, and non-repudiation. The following section focuses on how the OGC addresses these common security issues. For more information refer to *Security for GeoWeb Services: From Problem Statement to Implementation*, 2007.

11.4.1 Communications Security

In its broader sense, communications security ensures the protection of information being transmitted over a network. The subcategories are outlined below although they are further describedin chapter 11.4.2 Geospatial Digital Rights Management.

11.4.1.2 Authentication

Authentication identifies the mutual understanding of credentials and identification between the user (requestor of information), and the provider.

Solutions: Authentication can be accomplished by requiring a username and password, or through the use of encryption certificates; X.509, Kerberos, SAML, WS-Security, etc.

11.4.1.3 Authorization

Authorization grants a user access to information that they have subscribed to. This is achieved using permission protocols.

Solutions: XACML, GeoXACML, proprietary solutions.

11.4.1.4 Integrity

Integrity refers to the reliability that the data is from a trusted source, that it has not been tampered with, and that the exchange of information is legitimate. Solutions available may impact performance, but the customer relies on the integrity of the system and exchange of information.

Solutions: Digital Signatures/Encryption (SSL, XML-DS, WS-Security).

11.4.1.5 Confidentiality

Confidentiality pertains to the treatment of information that an individual has disclosed in a relationship of trust and with the expectation that it will not be divulged to others in ways that are inconsistent with the understanding of the original disclosure without permission. Another understanding of Confidentiality is in terms of confidential business information. Confidentiality is sometimes confused with privacy which is addressed in chapter 11.5.3.

Confidentiality ensures that data is protected and not accessible to unauthorized users. Data can be protected by law for reasons of privacy to individuals and communities. This is closely linked to authorization, limiting access to data.

Solutions: Encryption (SSL, XML-ENC, WS-Security).

11.4.1.6 Non-Repudiation

Non-Repudiation ensures validation for communication (requesting, sending, and receiving information) between the service and the customer. It is a proof of transaction and confirmation of the services rendered. This instills trust in the customer knowing that responsibility within the transaction is maintained.

Solutions: This can be achieved using user accounts and passports that keep track of all requests and transactions.

Digital Signatures (XML-DS, WS-Security, etc).

11.4.2 Geospatial Digital Right Management (GeoDRM)

The OGC initiated the Geospatial Digital Rights management (GeoDRM) Working Group in April, 2004. This working group guides the development of OGC specifications and standards building on the OGC technical baseline. The security working group was established in June, 2006, to establish an interoperable security framework for Open Geospatial Web Services to enable protected geospatial information processing with focus on authentication, authorization, and encryption.

The Security Working Group has identified common security environments including integrity, confidentiality, and authenticity.

Relevant Standards Include:

- Security Assertion Markup Language (OASIS)
  - Exchange of Identity Information using Assertions
  - Single-Sign-On/Single-Logoff
- eXtensible Access Control Markup Language (OASIS)
  - Access Control for XML structured data
- WS-Security (OASIS)
  - Toolkit for (SOAP) message based security
- XML-Digital Signature (W3C)
  - Authenticity for XML structured data
- XML-Encryption (W3C)
  - Confidentiality for XML structured data.

The OGC relies on the security standards developed by the following organizations:

OASIS (Organization for the Advancement of Structured Information Standards): www.oasis-open.org.

IETF (Internet Engineering Task Force): www.ietf.org.

W3C (World Wide Consortium): www.w3c.org

Figure 23 illustrates the OGC Web services and the existing security protocols that are OGC compliant. The sections that follow provide a description of the security solutions discussed in the previous sections including DACS, GeoXACML, HTTPS, HTTP Cookies, Kerberos, SAML, WSS, SOAP, and X.509.

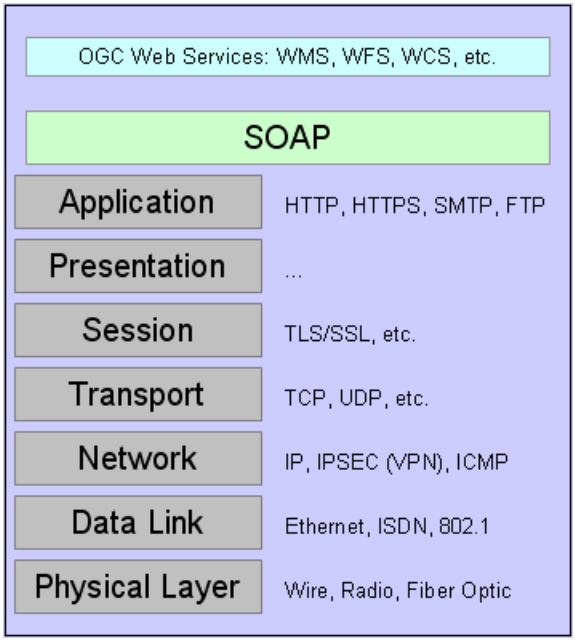


Figure 23 OGC Web Services and Existing Security Protocols

11.4.2.1 Distributed Access Control System (DACS)

DACS was developed by a small Canadian company for the Canadian National Forest Information System (NFIS). Used in authentication, DACS allows controlled access to web services irrespective of what the services are or in what language they were programmed in. DACS is installed on the server and configured to restrict access through a set of defined rules. A user account is usually the defining credential which is based on a user name and password as a basic requirement. If the username and password are correct, a cookie gets sent to the user's computer with credentials that will identify the user each time they make a request from the server.

DACS is an open source web component that meets CGDI requirements. It is not an identity system in itself but interoperates with an identity system and applies access control rules for access to any web resources. Essentially DACS connects to a number of identity systems currently in place within organizations and based on the result of the authentication, generates a credential that can be exchanged in a distributed environment. This credential is then used by service

providers to apply access control rules for any web resources. The key differentiator of DACS, in addition to its capability to support a federated secure model, is its capability to transform business rules into access control rules using an Access Control Language (ACL). Like other relying parties such as SAML, DACS can be integrated into a CardSpace architecture as the architecture diagram in Figure 24 illustrates. The Apache Authentication Module for CardSpace (available as an open source module) allows applications using an Apache server to use the Information Cards as an additional authentication mechanism, facilitating the integration of DACS with CardSpace.

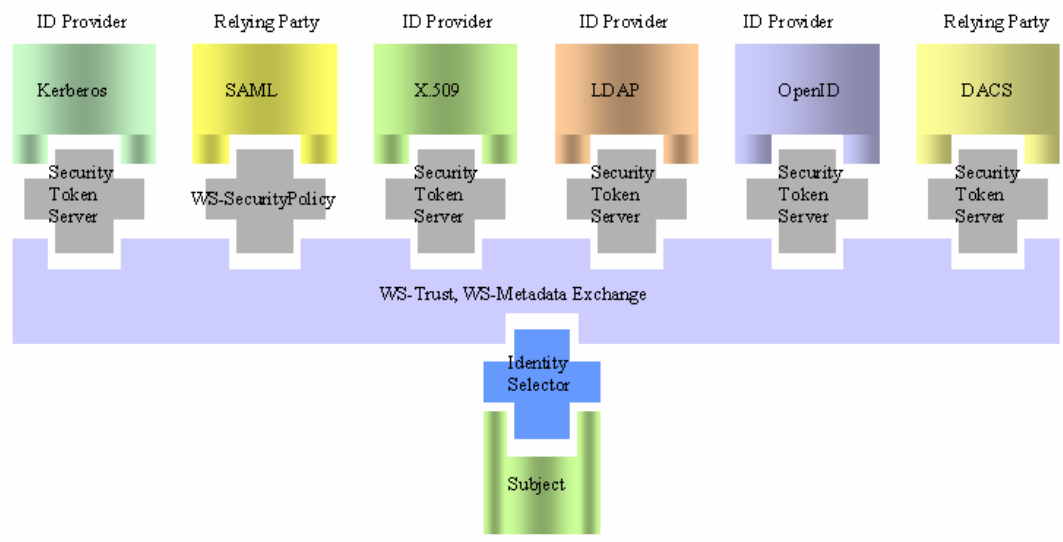


Figure 24 Architecture Illustrating the Integration of DACS into a CardSpace Security Framework

The ‘single sign-on’ feature is significant for DACS, allowing users to have a single account where the credentials are recognized through multiple web servers. Figure 25 illustrates the request path made by the user Bob across multiple web servers protected by DACS. ‘Single sign-on’ is demonstrated here where Bob’s requests and credentials are passed to each site automatically rather than creating a new account for Bob at each site or having Bob resubmit his username and password manually each time.

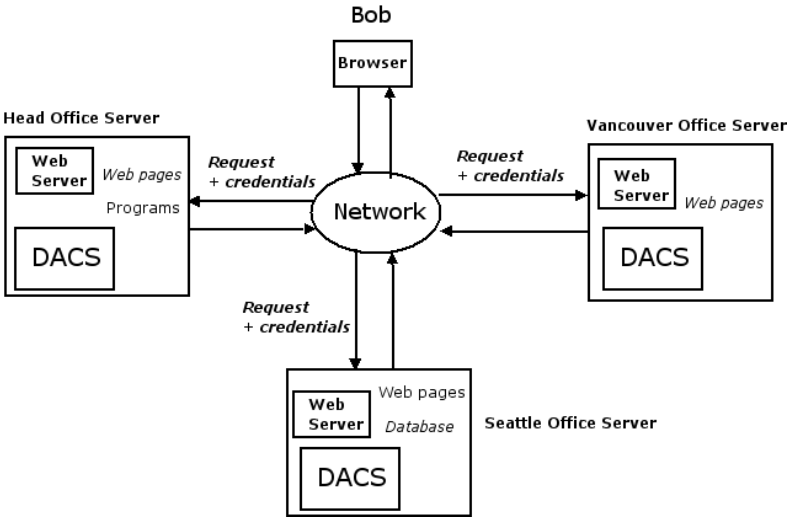


Figure 25 Request Path using Single Sign-On
http://dacs.dss.ca/what_is_dacs2.html

Typically, DACS is used to restrict access to specific web pages. Once it is installed, Apache must be configured to allow DACS to control authentication for the web site. The following is an example of establishing a DACS access control rule:

1. Directives are added to the Apache configuration file for each web site area that DACS should be implemented:

```
<Location /restricted>
        AuthType DACS
        AuthDACS dacs-acs
        Require valid-user
</Location>
```

2. An access control rule is added. The example below is a simple authentication control rule. In this case, all URLs with '/restricted/' as a prefix will be secured by DACS. Following this, users are denied access unless they are authenticated users:

```
<acl_rule>
  <services>
        <service url_pattern="/restricted/*"/>
  </services>

  <rule order="allow,deny">
        <allow>
        user("auth")
        </allow>
  </rule>
</acl_rule>
```

User (“auth”) can be replaced with ‘user(“:Bob”) to be more specific about the user name, or ‘from(“10.0.0.123”)’ to restrict based on the IP address of the user, or by ‘user(“%:staff”)’ to restrict access to only staff members based on the attributes of the user.

It is important to understand that DACS can only be used for authentication of the user in terms of establishing an identity. It cannot restrict what the user does once they enter the site or monitor their ‘rights’.

For more information about DACS visit: http://dacs.dss.ca

For more information about CardSpace visit: http://msdn2.microsoft.com/en-us/library/aa480189.aspx

11.4.2.2 Geo eXtensible Access Control Markup Language (GeoXACML)

OASIS eXtensible Access Control Markup Language (XACML) is an XML schema for authorization and entitlement policies.

For more information visit: http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=xacml

GeoXACML is a geospatial extension of XACML. It enables the interoperable use of protected geodata and is a standards based extension for:

- enabling Access Control to existing service-based Spatial Data Infrastructures (SDI) with no modification of the existing SDI services infrastructure
- harmonizing access rights across different geodata providers to ensure combined use of protected geodata
- potentially increasing business by getting additional customers, by providing protected geodata

For more information visit: http://www.geoxacml.org/

11.4.2.3 Hypertext Transfer Protocol over Secure Socket Layer (HTTPS)

The Hypertext Transfer Protocol over Secure Socket Layer (HTTPS) was developed by Netscape as an encryption web protocol built into the Netscape browser. The protocol encrypts information based on user page requests and offers windows-based security.

For more information visit:
http://searchsoftwarequality.techtarget.com/sDefinition/0,,sid92_gci214006,00.html

Secure Socket Layer (SSL) also fits under HTTPS as an industry standard ensuring that the link between a web server and browser is encrypted.

For more information visit: http://info.ssl.com/article.aspx?id=10241

11.4.2.4 Hypertext Transfer Protocol (HTTP) *Cookies*

RFC 2965 – HTTP State Management Mechanism describes the cookie headers that carry state information between participating origin servers and user agents.

For more information visit: http://www.faqs.org/rfcs/rfc2965.html

11.4.2.5 Kerberos

Kerberos is a network authentication protocol within the WSS standard which uses secret-key cryptography to client/server applications.

For more information visit:

- http://web.mit.edu/kerberos/www/
- http://www.oasis-open.org/committees/download.php/16788/wss-v1.1-spec-os-KerberosTokenProfile.pdf

11.4.2.6 Security Assertion Markup Language (SAML)

OASIS Security Services (SAML) is based on the WSS standard and is used to communicate security and identity information using an XML-based framework to aid in user authentication.

For more information visit:

- http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security
- http://www.oasis-open.org/committees/download.php/16768/wss-v1.1-spec-os-SAMLTokenProfile.pdf

11.4.2.7 Web Services Security (WSS)

OASIS Web Services Security (WSS) is a security standard incorporating X.509, SAML, Kerberos, REL, and SOAP.

For more information visit:
http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wss#overview

11.4.2.8 Simple Object Access Protocol *(SOAP)*

Simple Object Access Protocol (SOAP) is a lightweight protocol for exchange of information in a decentralized, distributed environment. It is an XML based protocol that consists of three parts: an envelope that defines a framework for describing what is in a message and how to process it, a set of encoding rules for expressing instances of application-defined datatypes, and a convention for representing remote procedure calls and responses. SOAP can be used in combination with HTTP and HTTP Extension Framework.

For more information visit:

- http://www.w3.org/TR/soap/
- http://www.w3.org/TR/2000/NOTE-SOAP-20000508/.

XML Encoding (XML-Enc) is required along with XML-DS to wrap security information inside SOAP messages and fits within the WSS standard specification.

For more information visit:
http://www.xml.com/pub/a/ws/2003/04/01/security.html?page=3

11.4.2.9 X.509

X.509 Encryption Certificates encrypts XML data so that it cannot be easily read. It falls under the WSS standard as well.

For more information visit:

- http://msdn2.microsoft.com/en-us/library/ms229744.aspx
- http://www.oasis-open.org/committees/download.php/16785/wss-v1.1-spec-os-x509TokenProfile.pdf

11.5 Web Services Management

In addition to the above security options, the sections below describe auditing, identity management, privacy, delegation, availability, accounting, and rights management GeoRSS is also presented as a means of delivering regularly changing web content.

11.5.1 Auditing

Audits keep track of requested data. They are also useful in detecting trends that could help improve the service.

Solution: Log files

11.5.2 Identity Management

Similar to authentication, identity management identifies administrative information that is tagged to a user of the service. This can include passwords, certificates, name, address, etc.

Solution: Identity management System: Lightweight Directory Access Protocol (LDAP): an application used for managing directory services that support Transmission Control Protocol/Internet Protocol (TCP/IP).

Single Sign On: SAML, Microsoft .NET Passport

11.5.3 Privacy

Privacy is the ability of an individual or group to stop information about themselves from becoming known to people other than those they choose to give the information to. Privacy is sometimes related to anonymity.

Maintaining privacy of individuals and communities is of significant concern to the CGDI. For example, cadastre information should not be freely accessible. It is protected by encryption so that only authorized users can gain access.

11.5.4 Delegation

Delegation requires authentication so that a requestor can delegate a subset of his/her rights to a service which cascades the request to another server in order to fulfill the request.

Solutions: SAML, XACML, WS-Security

11.5.5 Availability

This refers to the proper functioning of the service such that it is available on request with solid performance irrespective of the volume of requests or other administrative factors that can contribute to Denial of Service (DoS).

Solutions: Good administration, redundancy, etc.

11.5.6 Accounting for Web Services

This measures the use of the service and can be useful in determining statistics or performing trend analysis and capacity planning, but is also necessary for billing.

Solutions: Work describing price and business models:

- MICUS Study: www.micus.de
- Web Pricing & Ordering (Discussion Paper OGC): http://portal.opengeospatial.org/files/index.php?artifact_id=11500

11.5.7 Rights Management

Rights management is:

1. A mechanism to specify, manage, control and track geodata distribution within secure, open and trusted environments;
2. A system of operating agreements and interoperable technologies needed to enable broader distribution and use of geodata while protecting the rights of producers and users; and
3. A system that is dependant on Information Security technologies to provide the trusted infrastructure for Rights Management including e-commerce to address the financial transactions necessary to procure rights for geospatial content.

Digital Rights management is a popular term for a field that emerged in the mid-1990s when content providers, technology organizations and policy makers began to address the imbalance of technology and laws caused by the effect of the Web infrastructure on the distribution of copyrighted material in digital form.

A fair amount of work has been done in the industry regarding data ownership and rights management. The main objective of the Open Geospatial Consortium GeoRM Working Group is to coordinate and mature the development and validation of work being done on rights management as they apply to the geospatial community.

The goal of the GeoRM effort in the OGC is to make sure that a larger market has access to geospatial resources through a well understood and common mechanism that enables more than today's "all or nothing" protection. A major motivation for this effort is the need to manage the "ownership obstacle to data sharing" in spatial data infrastructure scenarios.

The GeoDM Reference Model defines the framework for web service mechanisms and rights languages to articulate, manage and protect the rights of all participants in the geographic information marketplace, including the owners of intellectual property and the users who wish to use it. A key aspect of the GeoRM Reference Model is that it is abstract, or general, rather than specifying implementation details about types of agreements. Such agreements might range from an open content sharing model to a cost-recovery program of a public or government organization or a full commercial vendor license model.

The OGC membership will use the GeoRM RM in developing Open Geospatial Implementation Specifications for open interfaces and encodings that will enable

SDI and diverse systems to participate in transactions involving data, services and intellectual property protection.

For more information about GeoRM activities visit:

- http://www.opengeospatial.org/ogc/programs/spec
- http://www.opengeospatial.org/projects/groups/geormwg
- http://portal.opengeospatial.org/files/?artifact_id=17802

11.6 Geo-Enabling Really Simple Syndication (GeoRSS)

Geo-Enabling Really Simple Syndication (GeoRSS) from OGC has been endorsed by the GeoConnections CGDI Architecture Advisory Committee as a Recommendation Specification. GeoRSS is:

1. An information feed mechanism used for delivering regularly changing web content;
2. A feed that represents a summary of uniquely identified, time-stamped data items with metadata including fields such as title, dates, categories, etc; and
3. An information feed that can be referenced in-line or referenced via URI.

Data items, or the content of the feed, can be of any type: text, HTML or binary. Feeds have traditionally been used as a notification mechanism for news stories but their use has expanded rapidly. Feeds are currently used to summarize many types of content such as search results, geographic features, events, podcasts and vidcasts (video clip designed to be viewed in a portable device) to name a few.

The following listing illustrates the GeoRSS GML encoding:

```
<georss:where>
   <gml:Point>
      <gml:pos>45.256 -71.92</gml:pos>
   </gml:Point>
</georss:where>
```

There are three specifications for encoding Geospatial content into feeds:

- A GeoRSS specification from the World Wide Web Consortium (W3C);
- A GeoRSS simple from OGC; and
- A GeoRSS GML from OGC.

Both the GeoRSS from W3C and the OGC GeoRSS simple have known constraints/limitations regarding the use of spatial reference systems. However, the CGDI Architecture Advisory Committee has endorsed the OGC GeoRSS GML as a Recommendation Specification although currently all GeoRSS specifications are White Papers and not formal standard specifications. GeoRSS was endorsed because of its use in public safety and security, among others

For more information visit:

http://portal.opengeospatial.org/files/index.php?artifact_id=15755

Appendix 1

Geospatial Web Services Specifications

The interoperability of the CGDI depends on compliance with the endorsed specifications for web-based geographic information systems, among others. This appendix:

- Discusses the role of the Open Geospatial Consortium, Inc. (OGC) and its registered specifications and implementations;
- Describes how using CGDI-endorsed specifications results in open, transparent, cooperative and sustainable web applications, thereby reducing costs and increasing access and usability, which in turn leads to increased growth;
- Details the Web Map Server (WMS) Interface specification;
- Provides a description, the implementation specification, the benefits and several examples of the Styled Layer Descriptor (SLD);
- Describes Geography Markup Language (GML), its implementation, models and schemas and several examples;
- Describes the Web Feature Service (WFS), its basic and transactional interfaces, and several WFS examples;
- Describes Metadata for Geodata;
- Describes Geodata Discovery Service;
- Provides a description and the implementation specification for Filter Encoding;
- Provides a description and the implementation specification for the Web Coverage Service;
- Describes the Simple Features specification for SQL, CORBA®, OLE/COM; and
- Describes Coordinate Transformation Services.

A1.1 GeoConnections and OGC

GeoConnections is a sponsor of the **Open Geospatial Consortium, Inc. (OGC)**, an international cooperative effort between industry, academia and government to promote and develop open standards based on distributed spatial computing solutions.

OGC began in 1994 in an effort to create a technical committee that would agree on open interfaces for network interoperability of geospatial systems. Since then, vendors have participated in specification development programs to promote interoperability in geospatial data access and applications. OGC's specification program promotes distributed geospatial computing, making web Geographic Information System (GIS) applications as open as the very Web on which it resides.

As a sponsor, GeoConnections contributes to the development of specifications by OGC members. In return, GeoConnections endorses OGC's specifications to provide the CGDI with a comprehensive set of GIS specifications that can act as a foundation for interoperable services within the CGDI.

You can learn more about the OGC by visiting http://www.opengeospatial.org.

A1.2 Registered Specifications and Implementations

OCG publishes ratified specifications on its public web site at: http://www.opengeospatial.org/specs/?page=specs.

All specifications are derived from OGC's **Abstract Specifications**, which are very important to read for a good understanding of the fundamental concepts used in OGC. You can find the Abstract Specifications at: http://www.opengeospatial.org/specs/?page=abstract.

The CGDI has an open test-bed called the **Development Network**. Test implementations of services that conform to CGDI and OGC specifications are cited there for the purpose for testing by the developer community. Those test services are available from the CGDI Development Network site at: http://www.geoconnections.org/en/newsmedia/articles/id=819. An index of the status of all OGC specifications regarding their adoption by the CGDI can be found on the GeoConnections web site under the Developers corner at:

http://www.geoconnections.org/en/communities/developers/standards/indexToSpecs.

A1.3 Web Map Server (WMS) Interface Specification

A **Web Map Server (WMS)** is an Internet-based service that is compliant with the OGC Web Map Server Interface specification. This specification is designed to enable clients (WMS clients) to display maps and/or images possessing a geographic component and whose raw spatial data files reside on one or more remote WMS servers.
A web map server provides online spatial data and maps to disparate Internet clients. A WMS client can aid in the visualization of and access to spatial data and services.

A WMS client can:

- List the contents of a map-based catalogue;
- Select map layers, viewing regions and scales;
- Compose and display maps constructed from data coming from one or more remote servers;
- Query through the Web for attribute information of a map feature selected from a map displayed in a client; and
- Support applications, based on visualization of map data obtained in real time from disparate data sources.

WMS services are useful to organizations that wish to enable Internet-based services of their maps or image products, services and data using a spatial element. Many areas benefit from using maps, such as policy decision-making, environmental monitoring, climate change and military surveillance.

Using online maps and map data is also useful when integrating a common, accessible medium, such as the Internet, to provide map-based services. When compared to the traditional mapping process, online mapping results in a quicker, more customizable rendering of a map. Data management is maintained “closest to the source”, which ensures that WMS applications always have access to the most current and accurate data.

A compliant WMS client does not require any special software viewer other than a Web browser, such as Netscape Communicator or Microsoft Internet Explorer. For spatial data viewing, this is a substantial difference and advantage in terms of software requirements. Traditionally, spatial data visualization required vendor specific software (i.e. “thick clients”) to recognize common formats and definitions. These packages typically required advanced processing capabilities of the user’s computer and/or workstation. In addition, expensive, ongoing licensing and support agreements between the user and/or organization and the

vendor were also required. The use of common Internet standards and practices leverages a wide base of spatial data users, from policy advisors searching for nation-wide base maps, to organizations searching for satellite imagery.

The WMS concept opens opportunities for a variety of users and providers to visualize and provide spatial data using open and documented standards. These standards are in continuous development, and are free to the public to access, input, provide suggestions, implement and exploit.

The WMS specification is applicable to both free and fee-type spatial Internet services. Organizations can publish this type of data and service at no cost to the user as well as charge user fees (e.g. nuisance, cost of maintenance, value-added) in order for users to view and/or access spatial data provided through a WMS client.

There are many benefits to enabling WMS services within the CGDI to provide visualization, access and discovery services through a WMS framework. This facilitates the seamless integration of maps and map data to provide custom maps for visualization. The WMS framework enables the CGDI to use up-to-date map data, from the source, with its various services, which in turns provides the CGDI community with improved quality spatial data.

The WMS specification is of interest to the geospatial community at large, due to its close ties and interoperability with the Internet. This has revolutionized the way in which the global community communicates, allowing very few technical and monetary constraints in comparison to the past.

A1.3.1 Non-Interoperable Web Map Services

Traditionally, a variety of commercial and application-specific web mapping services have existed across the Internet. Due to various issues, however, the majority of these mapping systems have not been compatible in terms of hybrid communication, i.e. between different viewing systems, operating systems and protocols.

When some organizations and vendors chose to develop Internet mapping systems with very specific operational requirements, for example, these may or may not have been applicable to all environments. This resulted in a lack of interoperability. Some vendors conceal source code to keep users dependent on further production and upgrades. Others have developed systems on a specific computer platform environment, not taking into account possible errors or issues when applied to a different platform, while yet other vendors have required plug-in extensions to the web browser.

As a result, these services have been similar to stovepipes or silos, functioning as expected, specific to their requirement, but with no possibility of interaction or interoperability with other Internet mapping systems and services.

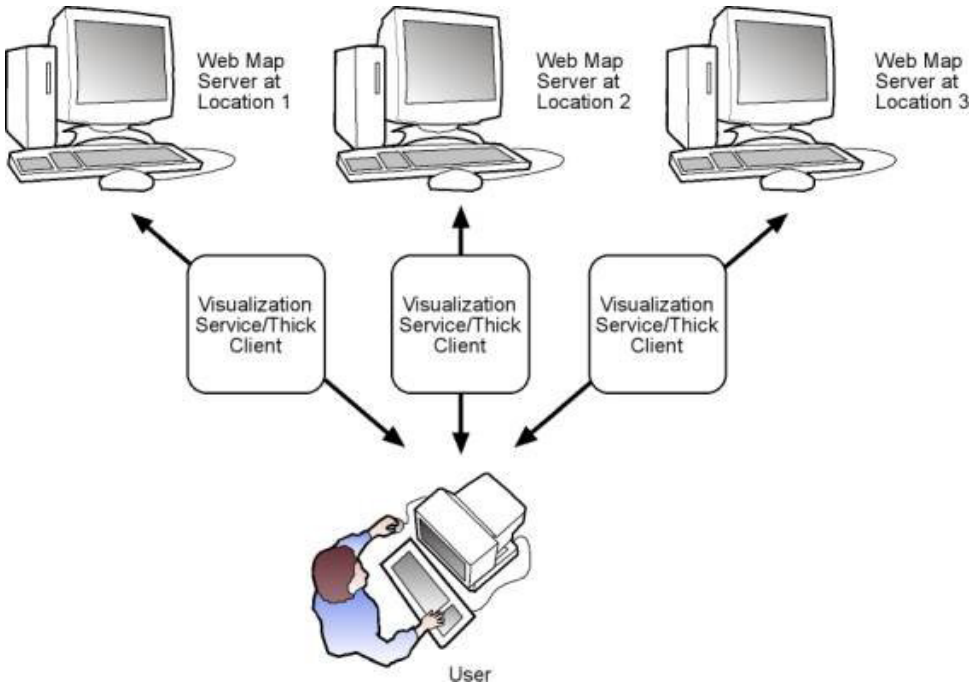


Figure 26 Using Non-Interoperable Web Mapping Services

Figure 26, Using Non-Interoperable Web Mapping Services, shows a typical user searching for spatial data on the Internet. The user finds three different map servers with data of interest, but all three are operating independently of each other. The user cannot find a way to overlay all the maps from the three mapping systems into one combined map.

A1.3.2 Interoperable WMS

In order for the CGDI to be able to deploy a series of interoperable web map services, the GeoConnections Technology Advisory Panel has endorsed OGC's Web Map Server Interface specification for the CGDI. For full details, please see both:

- http://www.opengeospatial.org/specs/?page=specs
- http://www.geoplace.com

By utilizing the Internet as the gateway, you and other organizations have the power to interoperate and benefit from each other's services, as well as to provide your users and consumers with a richer spatial Internet platform and environment.

In Figure 27, Using Interoperable Web Map Servers, a user discovers a web map client, which acts as a gateway to various map servers. The map-viewing client has the ability to combine map layers from remote locations on the Internet. The client, as well as the map servers, are all modelled on OGC's approach. The user makes a spatial request, the three layers are combined with the colours and styles requested into one final map, which is then displayed in the user's browser.

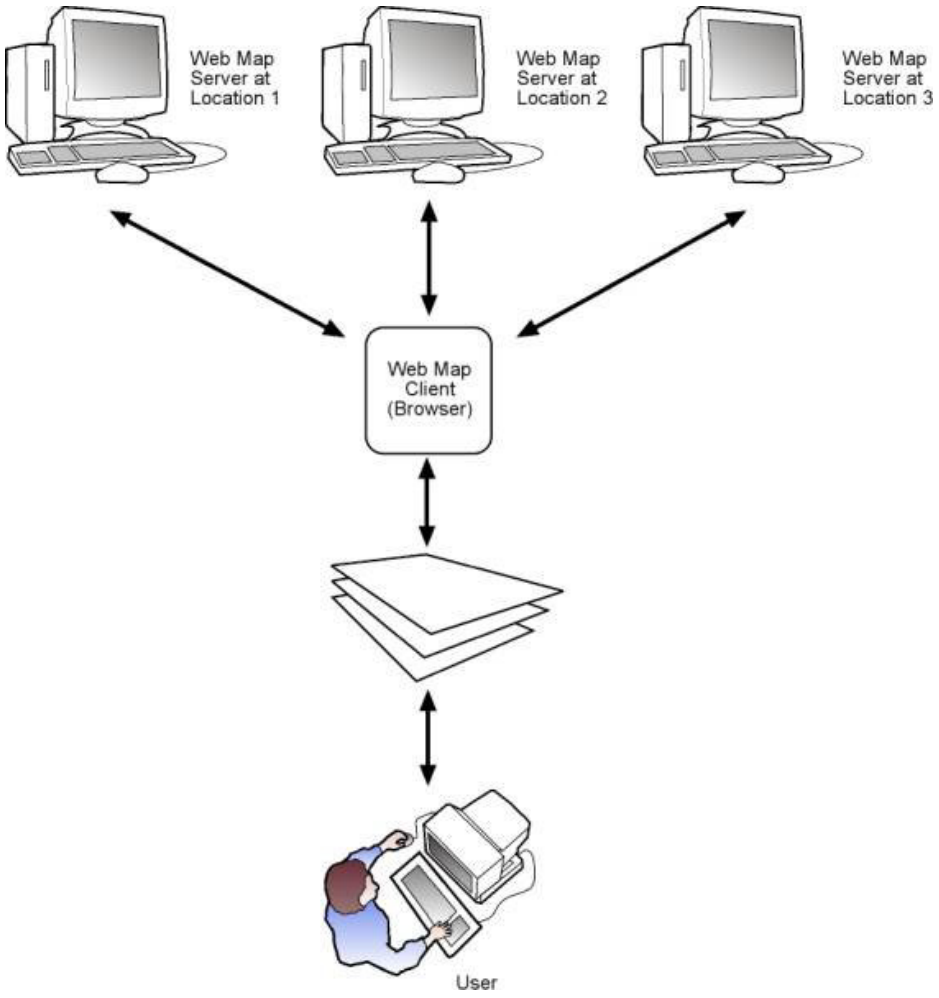


Figure 27 Using Interoperable Web Map Servers

A1.3.3 OGC's WMS vs. Other Desktop and Web-Based Mapping

OGC's WMS mapping differs from traditional desktops and workstations, and previous Internet-based mapping applications in a number of key ways.

Traditional desktop mapping applications:

- Use local data;
- Lack network support and connectivity;
- Have fewer restrictions on bandwidth for data access;
- Operate in a local computing environment;
- Are unable to provide and access disparate spatial data seamlessly into applications; and
- Are typically Central-Processing Unit (CPU)-intensive for geospatial analysis.

Other Internet mapping applications:

- Often require vendor specific plug-ins;
- Lack standards compliance;
- Lack control and/or user customizable;
- Are often centred around vendor-based spatial data and desktop applications; and
- Make it difficult to integrate disparate data sources.

Web Map Servers:

- **Are based on standards**: OGC's WMS standards are documented and freely available. This approach leads to more involvement and interaction from the geospatial community. This results in services and technology that are not dependent on budgetary issues; it also encourages collaboration among a wide range of individuals who strive for the advancement of GIS through free-sourced Internet methods.
- **Use a try-first, announce-after approach**: OGC implements a "test bed" approach where supporting organizations participate in applications and demonstrations where standards and specifications are collectively augmented and agreed upon. This "vendor participation" approach ensures the most interoperability and conformance to open standard-based technologies and protocols. This method creates well-tested working prototypes of interfaces.

  OGC provides a product testing service to assess vendors' products against the specification program. For more detail on compliance testing guidelines, see:

  http://www.opengeospatial.org/resources/?page=testing&view=testdocs#ctpdoc

A1.3.4 OGC's WMS Interfaces

The WMS specification defines three interfaces:

1. **GetCapabilities:** Produces information about the service;
2. **GetMap:** Generates map images or vector data; and
3. **GetFeatureInfo:** Answers basic queries about the content of the map.

A1.3.4.1 GetCapabilities

A WMS server is required to respond to **GetCapabilities** requests from clients. In response, it must provide a listing of which interfaces are supported by the WMS server and the properties of those interfaces (i.e. layers, formats, exceptions, etc.). This listing is useful to users who wish to use the WMS. For example, a developer searching for base-layer data of South Africa can query the WMS via capabilities. The interface's spatial extent, keyword and projection parameters are useful in spatial searches by service registries and other discovery-type infrastructures.

This response covers what kind of data is available on a given WMS, whether it can be queried to find out more information about it, and whether the data is available in a single or multiple geographic projections for the user to work with.

A1.3.4.2 GetMap

When a WMS client invokes a **GetMap** request to a WMS server, the WMS server provides a map (raster and/or vector) based on the spatial and aspatial (i.e. data without a geometric property) queries given by the user through the client. Providers of WMS servers have the option of enabling multiple output types for various applications.

A1.3.4.3 GetFeatureInfo

The **GetFeatureInfo** request returns textual and attribute information about a given point or region requested by the consumer. Often, this returns attribute data associated with the graphic element, such as population density information, elevation, or socio-economic data. This feature is optional for a compliant WMS server.

A1.3.5 Functionality of OGC's WMS

Figure 28 is a high-level diagram of the functionality provided by an OGC-compliant WMS.

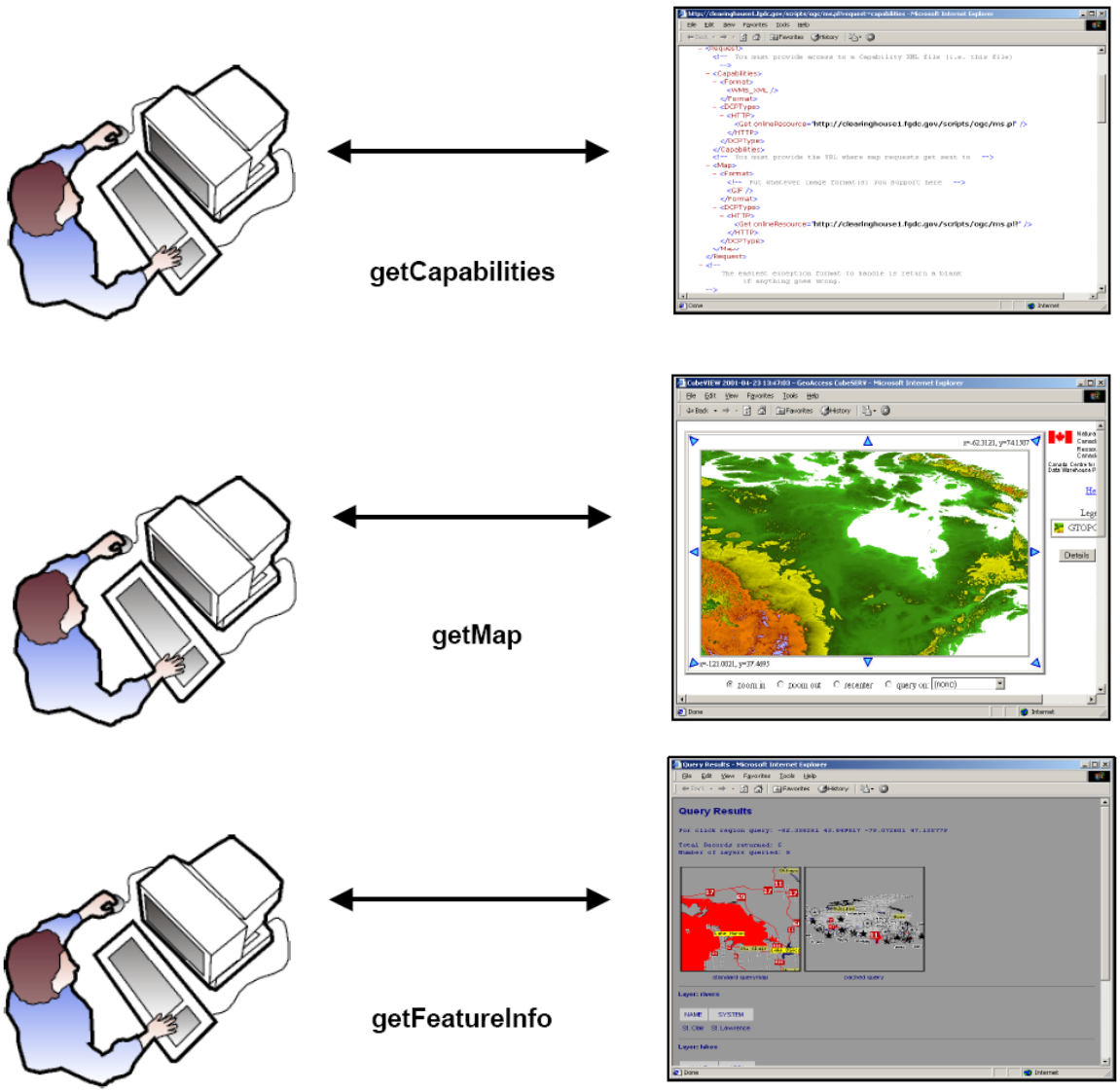


Figure 28 OGC's WMS Functionality

This illustration outlines the three interfaces of a WMS server (on the left side), and what they return to the client (on the right side). Querying a WMS server about its capabilities (getCapabilities) returns a text listing and description of what to expect from the service. A GetMap request provides a map image on a web browser. A GetFeatureInfo request provides a listing of records found within the area of interest and their properties.

Note that there is a fourth request type called **DescribeLayer**, which is part of the optional Styled Layer Descriptor specification (see A1.4, Styled Layer Descriptor).

A1.3.6 Simple WMS Client Example: HTML and Cascading Style Sheets

The following example uses OGC-compliant (http://www.opengeospatial.org/) and WMS-style spatial data requests to quickly render distributed spatial data. There are four layers from three different spatial map servers.

1. The **base layer** is GTOPO30 (http://edcdaac.usgs.gov/gtopo30/gtopo30.html);

2. The **elevation** data is served from OGC's web map service;

3. The **boundary** and **elevation point layers** are accessed through a local OGC architecture; and

4. The **lat/long graticule** and **airport location layers** are served from the Cubewerx (http://www.cubewerx.com/main/demo_centre.html) Cascading Map Server on the FGDC's Clearinghouse (http://clearinghouse1.fgdc.gov/).

When you use Cascading Style Sheets (CSS) (http://www.w3.org/Style/CSS/)with image transparency, you receive a layered output map image. Each layer object in itself can be manipulated individually.

The HTML is as follows:

```
<HTML>
<HEAD>
<TITLE>OGC Data Layering</TITLE>
<STYLE TYPE="text/css">
#OGCLayer_fgdc_clearinghouse { position: absolute; top:100; left:70; }
#OGCLayer_kralidis { position: absolute; top:100; left:70; }
#OGCLayer_cubewerx_usl { position: absolute; top:100; left:70; }
#OGCLayer_cubewerx { position: absolute; top:100; left:70; }
</STYLE>
</HEAD>
<BODY BGCOLOR="silver">
<H2>OGC Data Layering</H2>
<HR NOSHADE>
<DIV ID="OGCLayer_fgdc_clearinghouse">
<IMG
SRC="http://clearinghouse1.fgdc.gov/scripts/ogc/ms.pl?WMTVER=1.0.0&REQUEST=ma
p&LAYERS=coastline,boundary,elevation,roads,lakes,rivers,cities&STYLES=POINT&SR
S=EPSG:4326&BBOX=-120,65,-73,30&WIDTH=500&HEIGHT=300&FORMAT=GIF">
</DIV>
<DIV ID="OGCLayer_from an organization">
<IMG SRC="http://www.organization.ca/cgi-bin/mapserv/ms-
ogc.cgi?WMTVER=1.0.0&REQUEST=map&LAYERS=gcdb_allpts&STYLES=PO
INT&SRS=EPSG:4326&BBOX=-120,65,-
73,30&WIDTH=500&HEIGHT=300&FORMAT=GIF">
</DIV>
<DIV ID="OGCLayer_cubewerx_usl">
```

```
<IMG
SRC="http://usl.cubewerx.com/cubestor/cubeserv/cubeserv.cgi?WMTVER=1.0.0&REQU
EST=map&LAYERS=wmt%5Fgraticule&STYLES=10&SRS=EPSG:4326&BBOX=-
120,50,-
73,65&WIDTH=500&HEIGHT=300&FORMAT=GIF&TRANSPARENT=TRUE&EXCEPTI
ONS=WMS_XML">
</DIV>
<DIV ID="OGCLayer_cubewerx">
<IMG
SRC="http://www.cubewerx.com/demo/cubeserv/cubeserv.cgi?WMTVER=1.0.0&REQUE
ST=map&LAYERS=AEROFACP_1M:CubeWerx&STYLES=10&SRS=EPSG:4326&BBO
X=-120,50,-
73,65&WIDTH=500&HEIGHT=300&FORMAT=GIF&TRANSPARENT=TRUE&EXCEPTI
ONS=WMS_XML" ALT="[Cascading Output Image]">
</DIV>
</BODY>
</HTML>
```

This script gives the following HTML output:

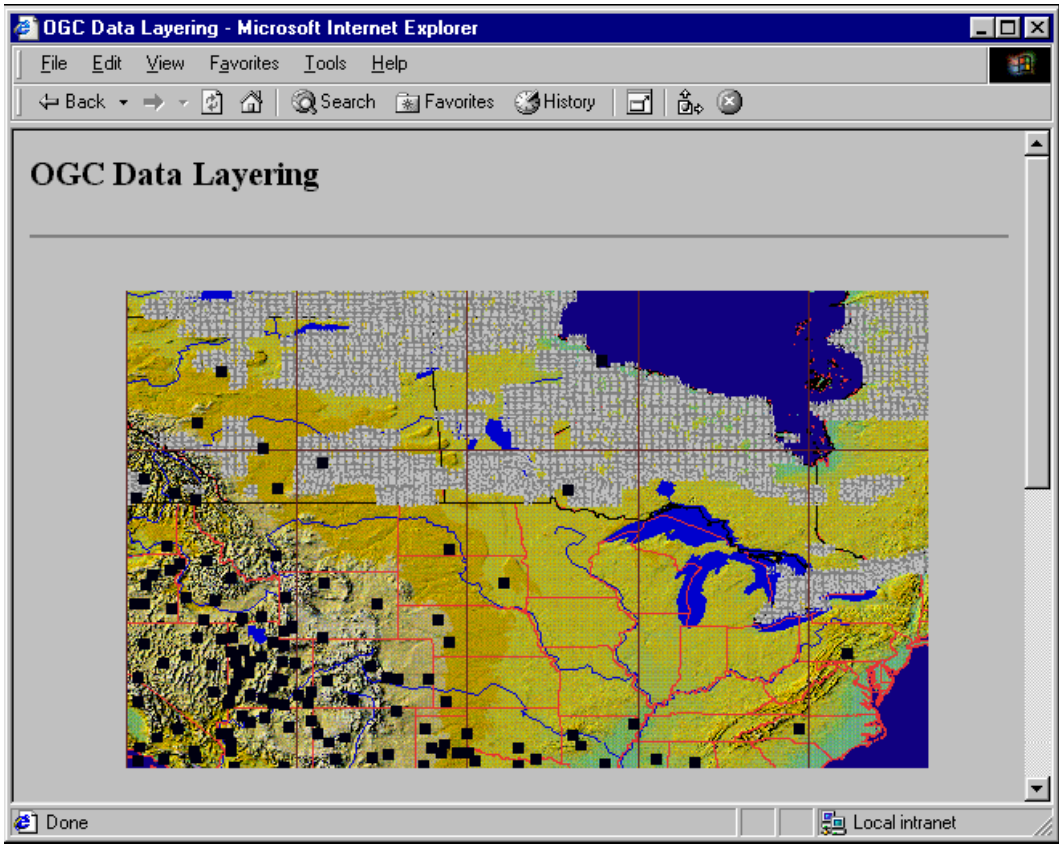


Figure 29 Example of WMS Client with HTML Output

Figure 29 illustrates client applications wishing to display changing data on a fixed area, i.e. satellite imagery of a major city to visualize weather patterns.

A1.3.7 Supplier Advantages

You may host a WMS server for your own application requirements related to map-based visualization, discovery, access and other needs. Registering your WMS server with the CGDI Discovery Portal enables the CGDI application community to develop applications using the registered map server.

The WMS specification is seamless and transparent to the CGDI user community, yet also provides the functionality to visualize and integrate diverse and various spatial and aspatial data.

A1.3.8 Supplier Control Mechanisms

The WMS specification allows you to enable **vendor-specific parameters**; these properties display parameters or properties specific to your organization's WMS service, which may not be part of the WMS specification version to which it is applied. Your organization can provide additional functionality to your WMS, which returns GetMap requests to produce image formats specific to your users' requirements. Your WMS can offer other various format outputs; for a request for data about rainfall for a specific region of Saskatchewan, charts, graphs and plain text records, in addition to simple maps can be provided.

You can also provide vendor-specific parameters for accessing the data layers themselves. Though this is covered in WMS under "Access Constraints", you can define, in detail, the properties of accessing and visualizing spatial data which you wish to have more control over, such as time of day or pricing mechanisms.

The vendor-specific parameters allow you to customize the WMS servers to your general application requirements, as well as to maintain an OGC-compliant and interoperable WMS service.

A1.4 Styled Layer Descriptor

The **Styled Layer Descriptor (SLD)** is a companion specification to the web map server (WMS) interface specification.

The SLD is a means of controlling the portrayal of data that is rendered from a WMS server. For example, if a water-bodies layer on a WMS server portrays the water features with a default colour of black, then adding SLD support on the server allows the WMS client to specify that it wants the water features returned as blue.

The benefit of the SLD is as follows. Since a WMS client is the visualization tool, it should have as much control as possible over the portrayal of the map, since it is the tool that the user interacts with to define the viewing parameters of the map. The SLD gives the WMS client some control over the visual appearance of the map, as well as the existing control over the combination of layers and viewing geometry. If a client is displaying layers from more than one WMS server, then SLD support from one or more of those servers allows the WMS client to resolve conflicts in styling of layers between servers. It is even possible

for a client to pass off the control of the layer styling to the user, thus giving the user complete control over the portrayal of the map.

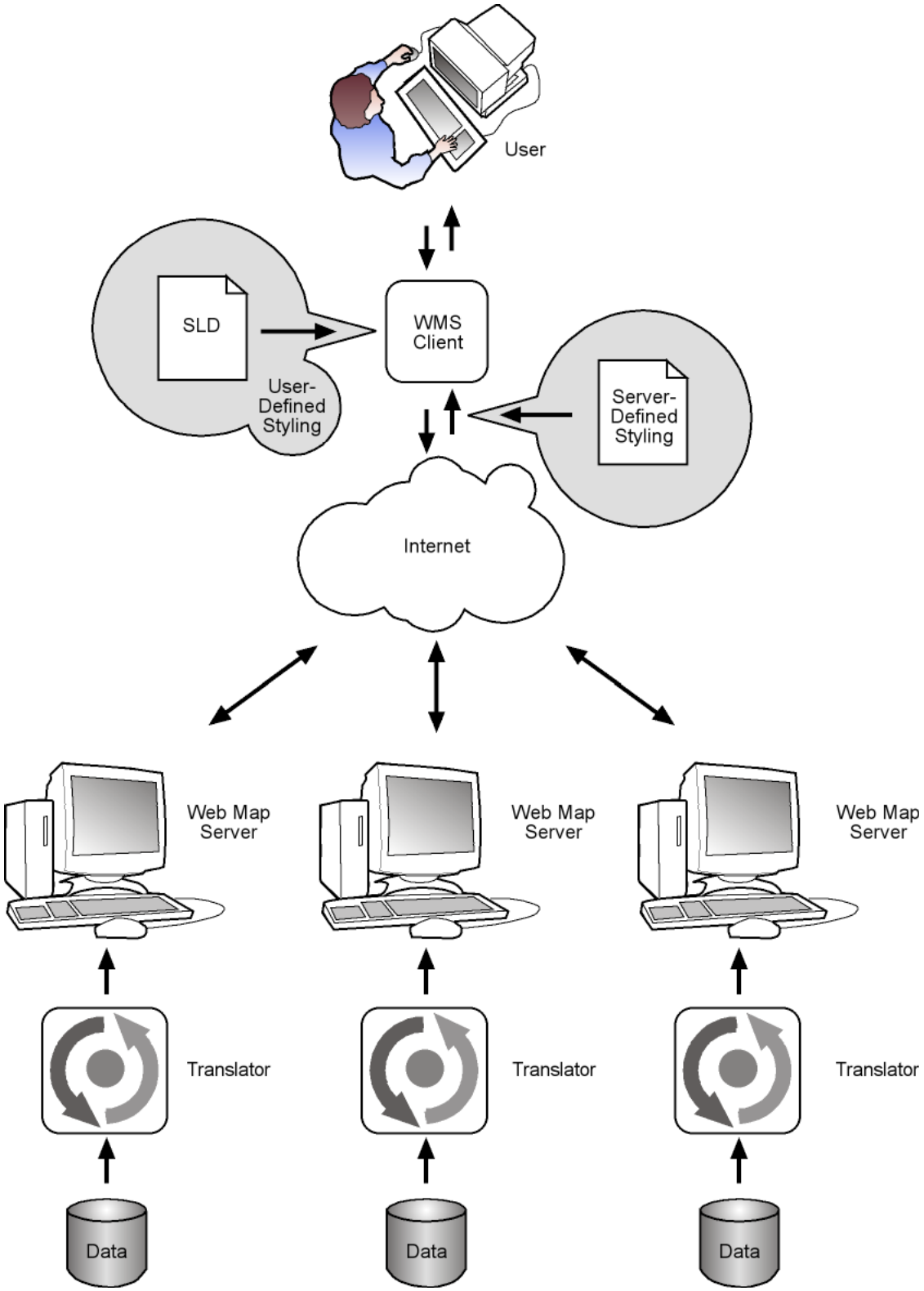


Figure 30 User vs. Server-Defined Styling

A1.4.1 Implementation Specification

Styled Layer Descriptors (SLDs) are implemented for server-side styling using an extension of the WMS GetMap request. A list of layers to style is provided with the **layers** parameter of the request, and the corresponding (requested) styles for those layers are provided in the **styles** parameter of the request.

Alternatively, for client-side styling, the client-specified SLD XML document is specified as a URL in the SLD parameter of the GetMap request, or the contents of the SLD XML document may be provided in the GetMap URL by specifying it as the contents for the SLD_BODY parameter. You can obtain the specification for the SLD XML document from http://www.opengeospatial.org/docs/02-070.pdf. If a user does not have access to a web server to make his or her SLD document visible to the Internet, then the SLD_BODY parameter specification would be advantageous, otherwise the SLD parameter makes for a more compact URL.

The following extensions to the WMS server specification are defined to support the use of styled-layer descriptors:

Capabilities

The WMS capabilities specification has extensions to indicate if a server supports SLDs, and if so, whether it supports user-defined layers, user-defined styles, remote WFS servers or remote WMS servers.

DescribeLayer

This is an optional interface for WMS servers to list which layers come from feature data, and if so, to identify the WFS server or WCS server for the layer.

User-Defined Layers

A user-defined layer is a collection of objects of mixed feature-types coming from one or more WFS or WCS servers. User-defined layers must have user-defined styles applied to them.

User-Defined Styles

Styles can be defined outside of the WMS server. They are passed into the WMS server for portrayal of either server-defined layers or for user-defined layers. The specification of the user-defined styles is part of the XML styled layer descriptor document that is passed from the WMS client to the WMS server.

A1.4.2 SLD Examples

Figure 31 shows a North American topography map of Earth Observation System (EOS) distribution stations (EOSDIS) across North America.

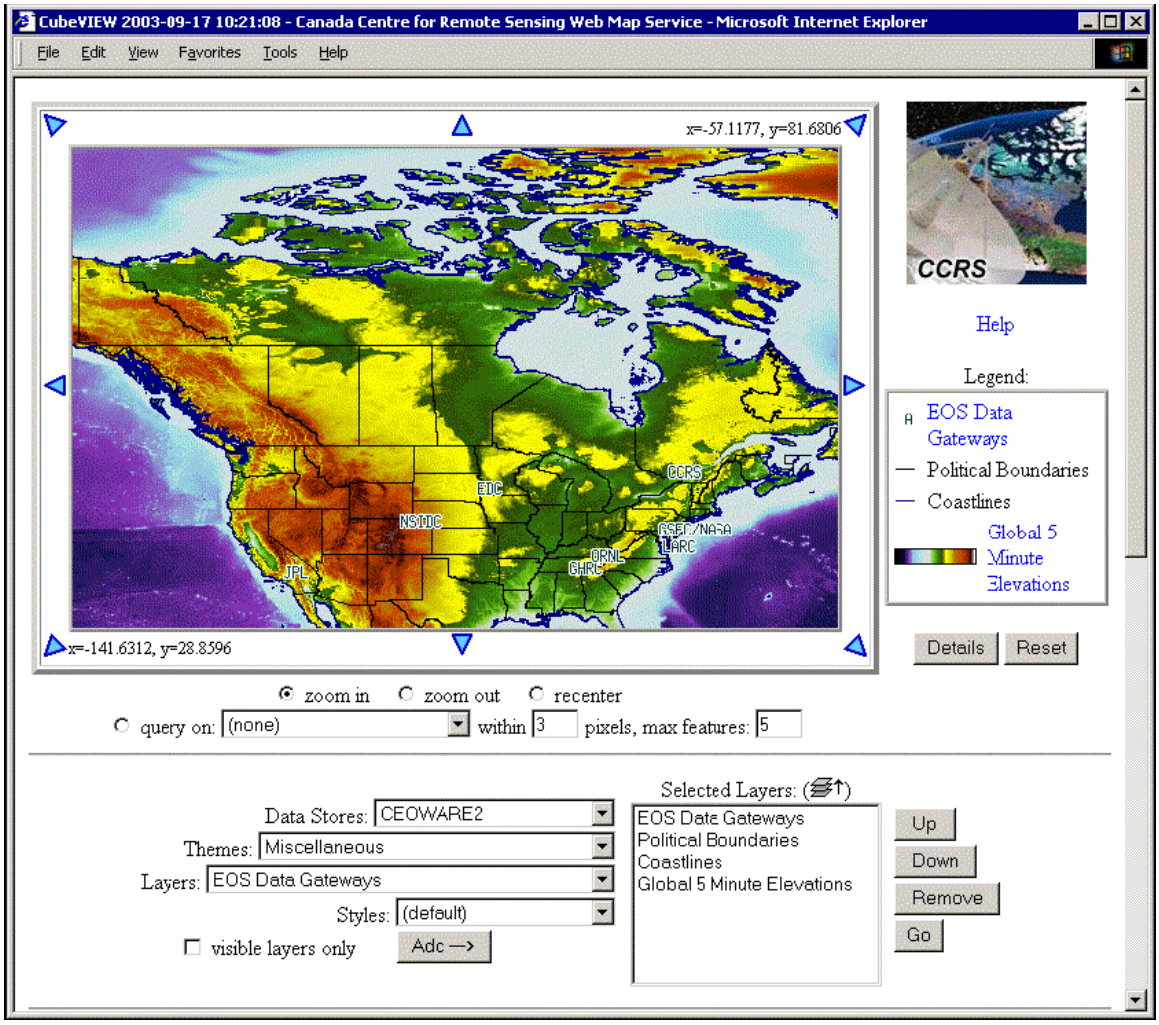


Figure 31 North American Topography Map of
Earth Observation System Distribution Stations across North America

The WMS client URL for this request is as follows. Note there is no data given for the SLD parameter:

http://ceoware2.ccrs.nrcan.gc.ca/cubewerx/cubeview/cubeview.cgi?clickMode=zoom+in&layerToQuery=%28none%29&pixelSensitivity=3&featureCount=5&dataStores=CEOWARE2&themes=Miscellaneous&layers=EOS+Data+Gateways&styles=%28default%29&action=+Go+&newScale=60M&newX=-99.374433&newY=55.27010487&predefinedLocations=%28choose%29&newImageWidth=560&newImageHeight=350&newImageType=image%2Fpng&newQuality=MEDIUM&zoomFactor=2&newSrs=4326+%28WGS+84%29&fromTime=1950-01-01+00%3A00%3A00&toTime=2049-12-31+23%3A59%3A59&layerToMultiband=%28none%29&redChannel=0&redGamma=1.00&greenChannel=0&greenGamma=1.00&blueChannel=0&blueGamma=1.00&postGamma=1.00&whereClauses=&serverUrl=http%3A%2F%2Fceoware2.ccrs.nrcan.gc.ca%2Fcubewerx%2Fcubeserv%2Fcubeserv.cgi&sldUrl=&layersToPlot=EOS+Data+Gateways%2CPolitical+Boundaries%2CCoastlines%2CGlobal+5

+Minute+Elevations&password=bob&currentY=59&currentX=-7&currentScale=60M&currentImageWidth=560&currentImageHeight=350&currentSrs=EPSG%3A4326&currentImageType=image%2Fpng&currentQuality=MEDIUM

When a user-provided Styled Layer Descriptor is passed into the client-side GetMap request, user-supplied icons can replace the default labels that are shown at the EOSDIS sites, as shown in Figure 32.

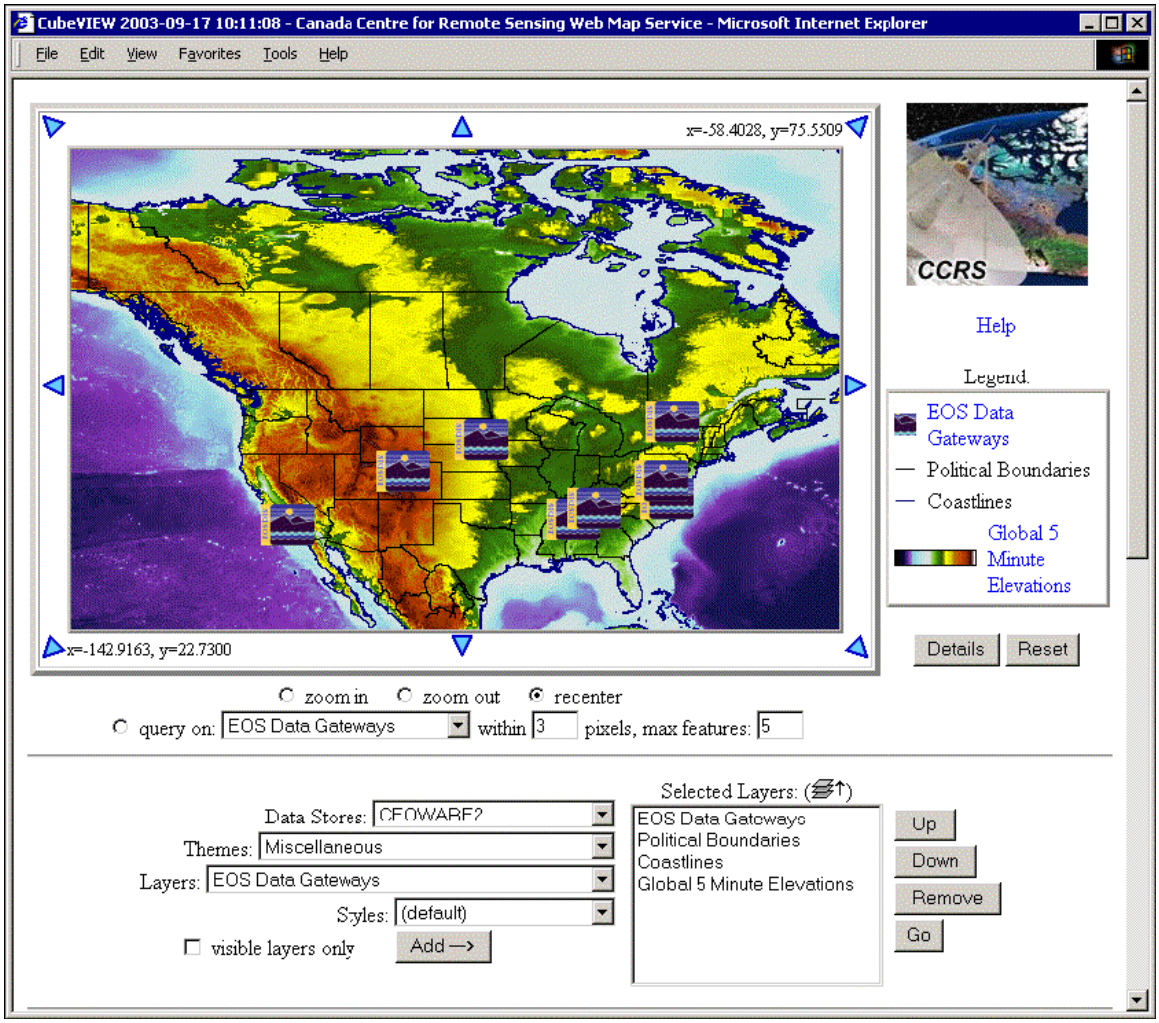


Figure 32 Using a SLD to Supply Icons, Replacing the Default Labels

In the following WMS client URL for this second request, note that the SLD parameter points to a client-side SLD document:

http://ceoware2.ccrs.nrcan.gc.ca/cubewerx/cubeview/cubeview.cgi?imageClick.x=271&imageClick.y=215&clickMode=recenter&layerToQuery=EOS+Data+Gateways&pixelSensitivity=3&featureCount=5&dataStores=CEOWARE2&themes=Miscellaneous&layers=EOS+Data+Gateways&styles=%28default%29&newScale=60M&newX=-99.374433&newY=55.27010487&predefinedLocations=%28choose%29&newImageWidth=560&newImageHeight=350&newImageType=image%2Fpng&newQuality=MEDIUM&z

oomFactor=2&newSrs=4326+%28WGS+84%29&fromTime=1950-01-01+00%3A00%3A00&toTime=2049-12-31+23%3A59%3A59&layerToMultiband=%28none%29&redChannel=0&redGamma=1.00&greenChannel=0&greenGamma=1.00&blueChannel=0&blueGamma=1.00&postGamma=1.00&whereClauses=&serverUrl=http%3A%2F%2Fceoware2.ccrs.nrcan.gc.ca%2Fcubewerx%2Fcubeserv%2Fcubeserv.cgi&sldUrl=http%3A%2F%2Fceoware2.ccrs.nrcan.gc.ca%2Ftkralidi%2Feosdis_eg.sld&layersToPlot=EOS+Data+Gateways%2CPolitical+Boundaries%2CCoastlines%2CGlobal+5+Minute+Elevations&password=bob&currentY=55.2701048695176&currentX=-99.3744330047655&currentScale=60M&currentImageWidth=560&currentImageHeight=350&currentSrs=EPSG%3A4326&currentImageType=image%2Fpng&currentQuality=MEDIUM

A1.5 Web Map Context Documents

Web Map Context (WMC) Documents is a companion specification to the web map server interface (WMS) specification.

Consider a situation where a user is interacting with a web map client, which is displaying several layers from one or more WMS servers. The user has selected a geographic region, a scale, a set of layers and the order in which those layers are displayed. Now, supposing the user wants to use the same viewing parameters the next day, but will not be able to keep the browser window that has that map displayed alive.

It is not practical for the user to rediscover the layers, reorder them, and to re-specify the scale and geographic region that was used to display the map. A web map context document is a means of recording a map view in an XML document. When a user loads a web map context document into a WMS client, the client will load the map based on a predefined set of viewing parameters. (Note that not all WMS clients currently support web map context documents).

A Web map context document is a client-side specification. The web map context document is not sent to the server; the client must interpret the document and translate it into WMS requests.

A user may create a web map context document by hand. WMS clients may have built-in functionality to save the current map view as a web map context document on the user's computer.

The true power of web map context documents is that favourite maps may be saved and archived, much like browser bookmarks. Users may share web map context documents or create a catalogue of web map context documents that can be searched.

There are several possible uses for Context documents:

1. The Context document can provide default startup views for particular classes of user. Such a document would have a long lifetime and public accessibility.

2. The Context document can save the state of a viewer client as the user navigates and modifies map layers.

3. The Context document can store not only the current settings but also additional information about each layer (e.g., available styles, formats, SRS, etc.) to avoid having to query the map server again once the user has selected a layer.

4. The Context document could be saved from one client session and transferred to a different client application to start up with the same context.

This specification is designed to work with the Web Map Service, but can be used by a broad range of services providing content in the form of a catalogue, for WMS layers. Context documents can also be catalogued and discovered, and are analogous to 'projects' in common desktop GIS applications.

For more information visit:
http://www.cgdi.gc.ca/en/communities/developers/standards/web_map_context.

For examples, read Section A1.5.2 below.

A1.5.1 Implementation Specification

You can obtain XML schema for web map context documents in OGC's web map context documents specification at http://www.opengeospatial.org/docs/03-036r2.pdf.

The components of web map context documents are:

- Viewing geometry (the screen resolution of the displayed map);
- Geographic extent of the region to be displayed;
- Contact information of the person who defined the web map context document; and
- An ordered list of layers indicating the server URL, layer name, indications of whether each layer is hidden or queryable, and styling information.

The web map context document is a client-side service. Since there is no common specification for WMS client interfaces (in the case of a user using a client-supplied application), there is no standard means of specifying a web map context document to a WMS client. It is up to the user to learn and understand the client's capabilities, and to determine if and how the client accepts web map context documents.

There are three potential methods of specifying a web map context document to a client:

1. First, the URL of a web map context document can be passed to a client, but this is only acceptable if a user has access to a web server under which he or she can place the web map context document.

2. Secondly, the user can specify a local file on his or her computer (which can be coded in URL notation), but the URL is not very portable.

3. Third, the body of the web map context document can be included in the URL, which creates a long and complex URL. Once again, there are no specifications or guidelines for doing this, so the user must learn the WMS client capabilities.

Figure 33, Interacting with a Web Map Client, shows the sequence that users must follow to interact with a web map client in order to configure a map to their liking. To configure a map, the user must perform a series of transactions, each of which will cascade to one or more WMS servers, to define the display settings and viewing regions for the layers. If the user terminates the interaction with the WMS client, to get the same map back in a future session, he or she must repeat the complex interaction sequence with the client.

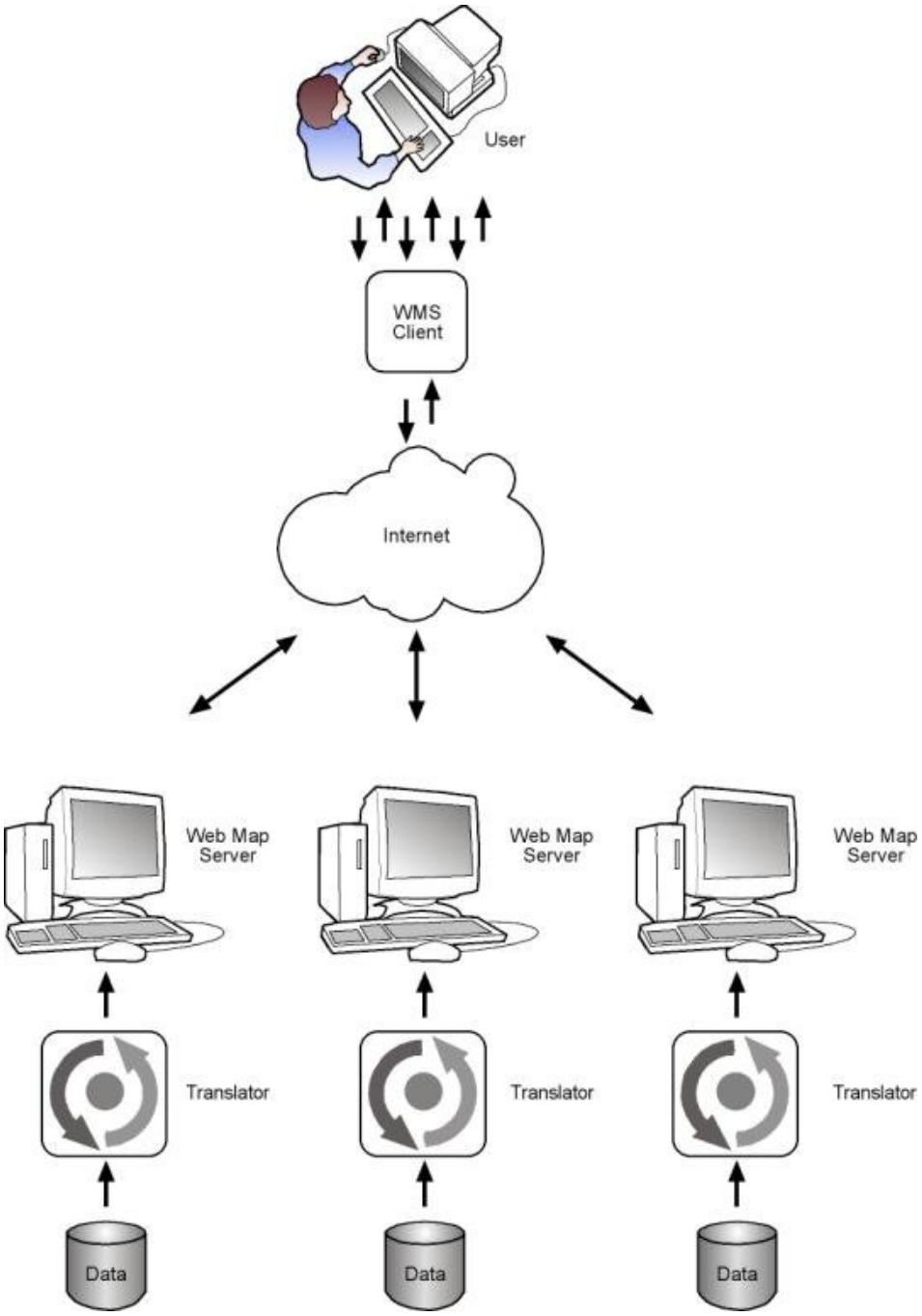


Figure 33 Interacting with a Web Map Client

As in Figure 34, Using a Web Map Context Document, the user can configure the map once, and save it as a web map context document which can be reloaded at any time. Users or user communities can build up libraries of web map context documents, which are essentially pre-configured maps that can be recalled at any time using a web map context-enabled browser.

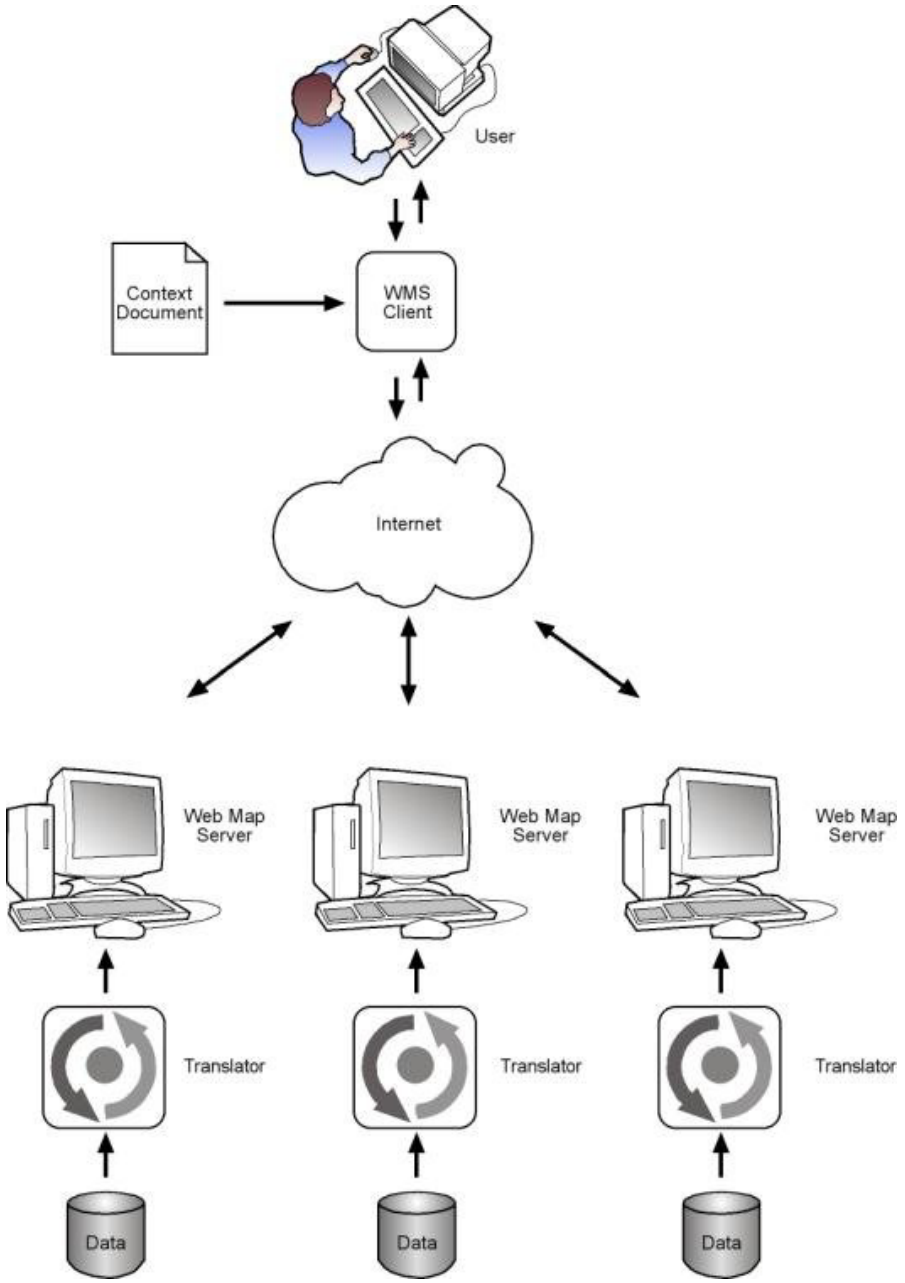


Figure 34 Using a Web Map Context Document

A1.5.2 Web Map Context Document Examples

Figure 35 uses a CGDI viewer client with a web map context document that loads a world image and shows different EOS (Earth Observation System) gateways.

http://cgdi-dev.geoconnections.org/prototypes/owsview/index.html?context=http://cgdi-dev.geoconnections.org/prototypes/contexts/eos_data_gateways.xml

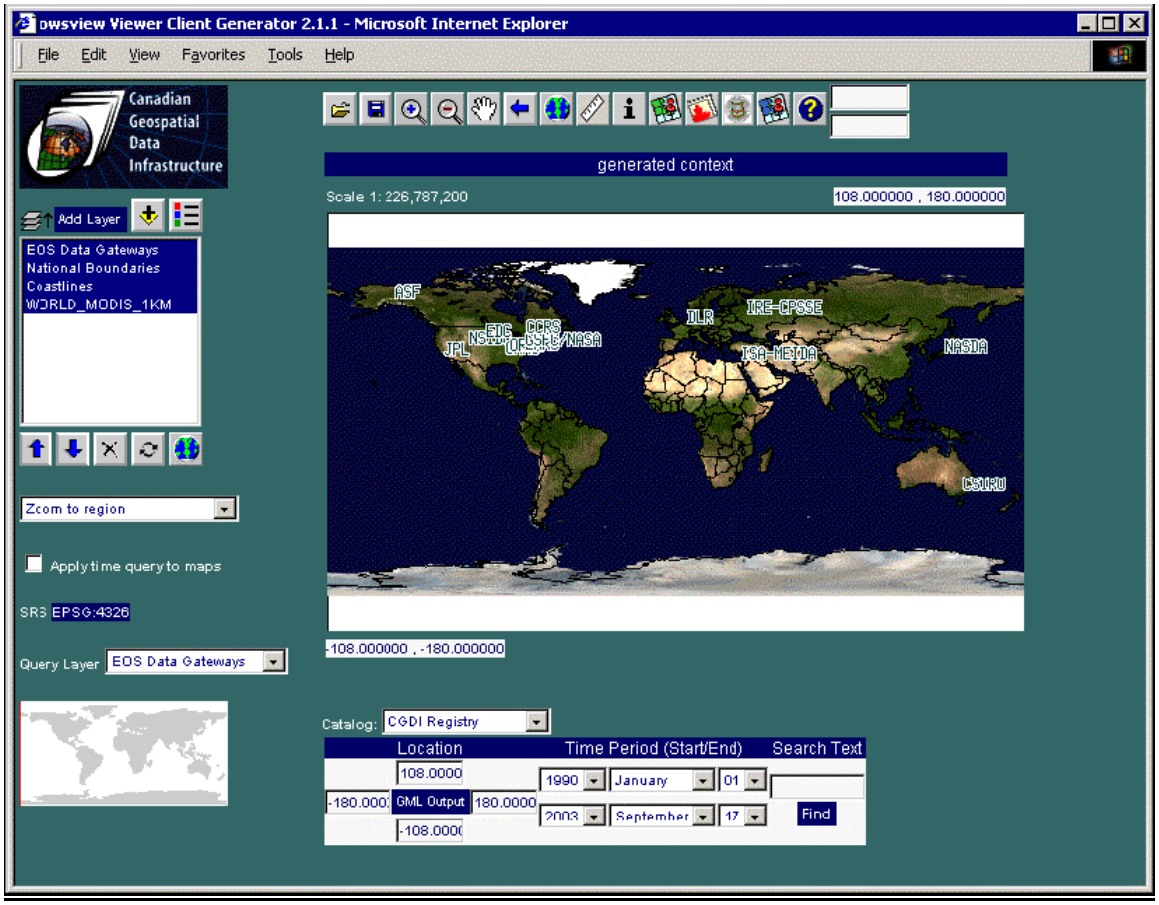


Figure 35 CGDI Viewer Client with a Web Map Context Document

Figure 36 uses the same web map context document as Figure 35, CGDI Viewer Client with a Web Map Context Document, except it loads the map in a different (NASA) viewer client.

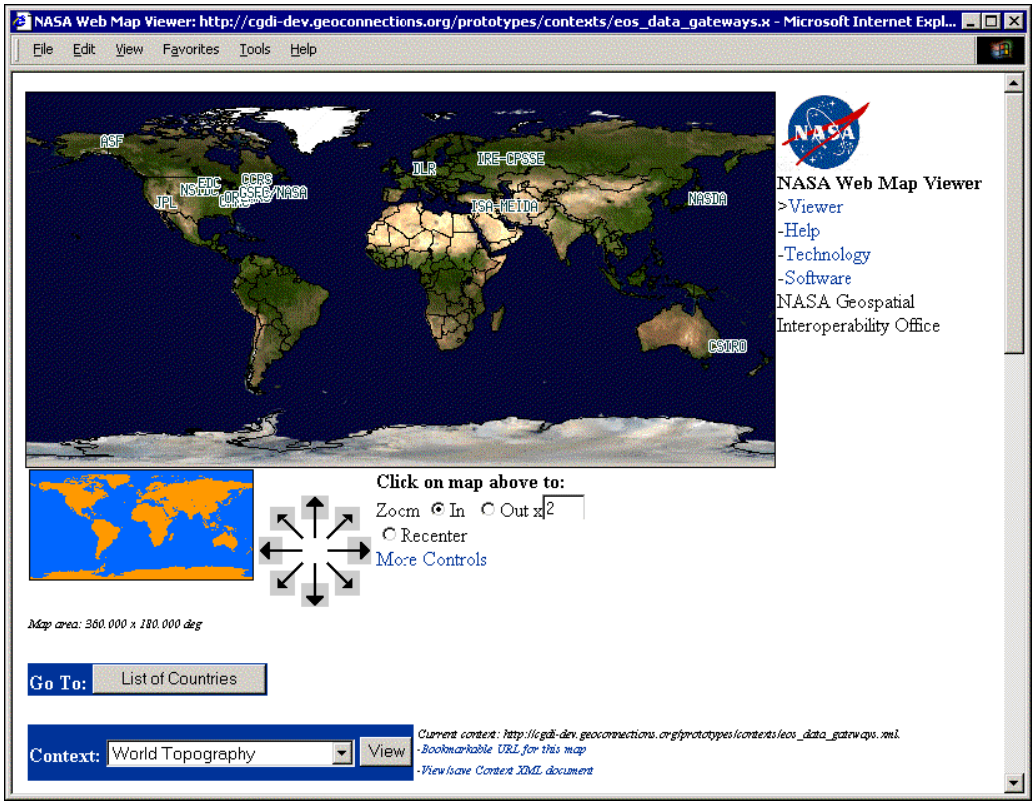


Figure 36 Using the Same Web Map Context Document as Figure 35 But Loading the Map in a Different Viewer Client

Figure 37 uses the same viewer as Figure 35, CGDI Viewer Client with a Web Map Context Document, except it loads a web map context document to display global topography and bathymetry.

http://cgdi-dev.geoconnections.org/prototypes/owsview/index.html?context=http://viewer.digitalearth.gov/context_perm/world_topo_0_1_2.xml

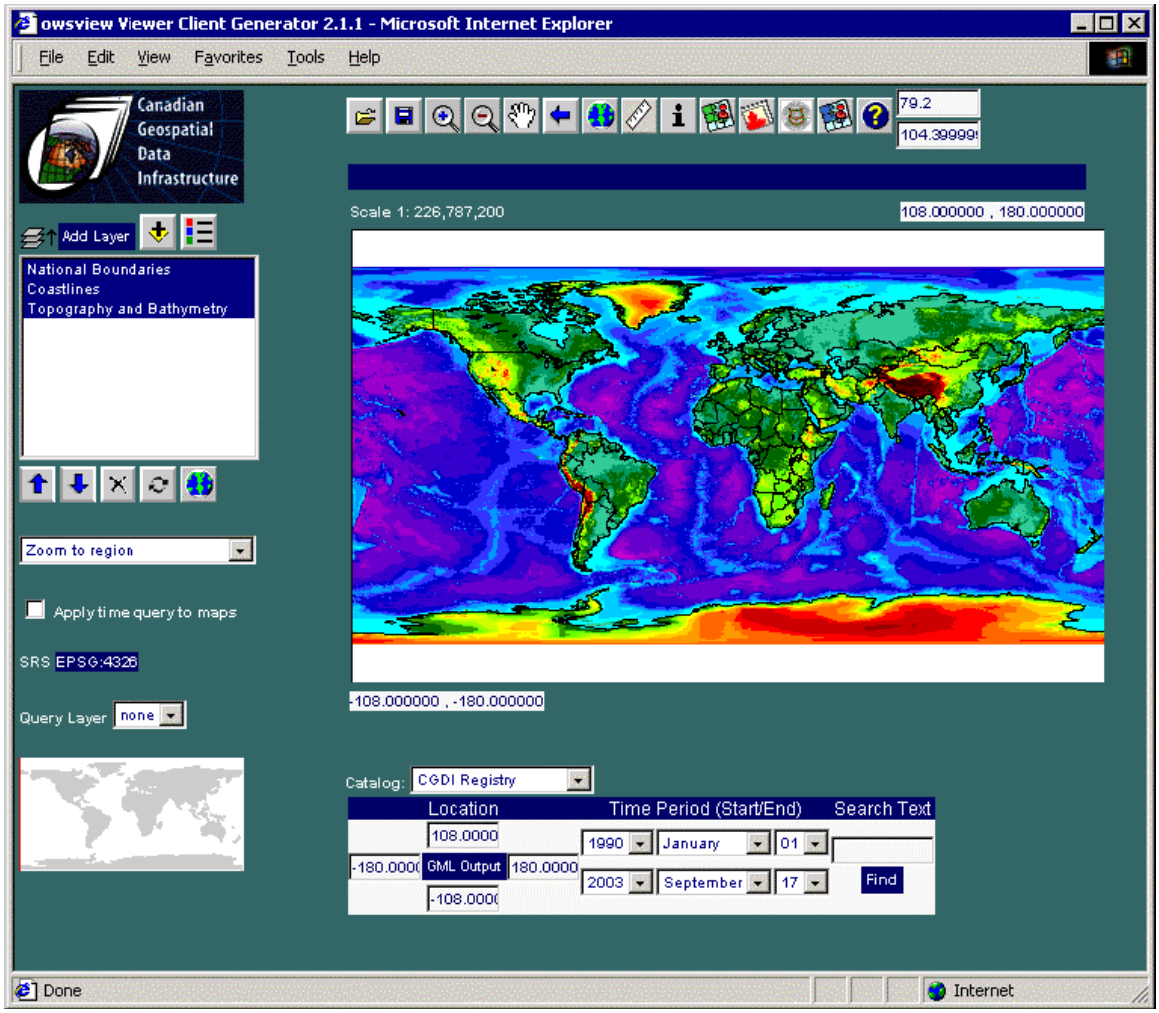


Figure 37 Using the Same Viewer as Figure 35 but Loading a Web Map Context Document to Display Global Topography and Bathymetry

The XML content of the web map context document is as follows:

```
<?xml version="1.0" encoding="UTF-8" standalone="no" ?>
<!DOCTYPE WMS_Viewer_Context SYSTEM
"http://www.digitalearth.gov/wmt/xml/context/context_0_1_2.dtd">
<WMS_Viewer_Context version="0.1.2">
<General>
<BoundingBox SRS="EPSG:4326" minx="-180" miny="-90" maxx="180"
maxy="90" />
<Window width="512" height="256" />
</General>
<LayerList>
<Layer level="0" queryable="0" hidden="0">
<Server wmtver="1.0.7"
title="The GLOBE Program Visualization Server" onlineResource=
"http://globe.digitalearth.gov/viz-bin/wmt.cgi" />
```

<Name>RTOPO</Name>
<Title>Topography and Bathymetry</Title>
<Abstract>Topography and Bathymetry. Availability:
special,19941231. Units: m.
</Abstract>
<SRS>EPSG:4326</SRS>
<LatLonBoundingBox minx="-180" miny="-90" maxx="180" maxy="90" />
<Style current="1">
<Name>REFERENCE</Name>
<Title>Color map</Title>
<Abstract>Color on map indicates data value.</Abstract>
<LegendURL width="180" format="GIF" height="50">
http://globe.digitalearth.gov/globe/en/icons/colorbars/topo.h.gif
</LegendURL>
</Style>
<Format current="1">GIF</Format>
</Layer>
<Layer level="1" queryable="0" hidden="0">
<Server wmtver="1.0.7"
title="The GLOBE Program Visualization Server"
onlineResource=
"http://globe.digitalearth.gov/viz-bin/wmt.cgi" />
<Name>COASTLINES</Name>
<Title>Coastlines</Title>
<Abstract>Context layer: Coastlines</Abstract>
<SRS>EPSG:4326</SRS>
<LatLonBoundingBox minx="-180" miny="-90" maxx="180" maxy="90" />
<Style current="1">
<Name>default</Name>
<Title>Default</Title>
<LegendURL width="180" format="GIF" height="50">
http://globe.digitalearth.gov/globe/en/icons/colorbars/COASTLINES.gif
</LegendURL>
</Style>
<Format current="1">GIF</Format>
</Layer>
<Layer level="2" queryable="0" hidden="0">
<Server wmtver="1.0.7"
title="The GLOBE Program Visualization Server" onlineResource=
"http://globe.digitalearth.gov/viz-bin/wmt.cgi" />
<Name>NATIONAL</Name>
<Title>National Boundaries</Title>
<Abstract>Context layer: National Boundaries</Abstract>
<SRS>EPSG:4326</SRS>
<LatLonBoundingBox minx="-180" miny="-90" maxx="180" maxy="90" />
<Style current="1">
<Name>default</Name>
<Title>Default</Title>
<LegendURL width="180" format="GIF" height="50">
http://globe.digitalearth.gov/globe/en/icons/colorbars/NATIONAL.gif
</LegendURL>
</Style>
<Format current="1">GIF</Format>
</Layer>
</LayerList>
</WMS_Viewer_Context>

A1.6 Geography Markup Language

Geography Markup Language (GML) is a vendor-neutral means of transferring geographic features through the Internet. It allows the client to have the actual raw data that a feature is composed of, such as points, lines, polygons, attribute descriptions, temporal objects and coverages.

The difference between a GML feature and a vector feature which is returned from a web map server interface (WMS) request is that WMS returns only the rendering of the feature in a graphics format such as Scalable Vector Graphics (SVG), while GML provides the actual data values in an XML format that any client can easily put into its own data structures. In other words, it delivers the actual data, as opposed to a visualization of the data.

GML is based on the general geographic model defined in OGC's Abstract Specification (http://www.opengeospatial.org/docs/02-023r4.pdf).

GML is not an interface: it is an XML grammar, written in XML schema. Applications can define "GML application schema" within this grammar, and use that syntax to transfer geographic features through the Internet.

GML does not have any predefinitions about the service in which it is used. Although it is an important element of OGC's web feature service (see A1.7, Web Feature Service), it can be used as a component of any open or proprietary interface specification. It can be used in both "transactional" and "explain" services (i.e. to upload to, or download from a server).

It is intended that OGC response types that include actual geographic features provide those features as GML notations (e.g. with WFS responses). These are called "GML Feature Instances". Figure 38, Using Geography Markup Language, provides an example of a GML Feature Instance: it shows a representation of a WFS response from a WFS server to a client. The WFS response format is determined by the WFS specification. Since the WFS specification allows for the embedding of GML features, GML feature instances are included in appropriate points in the WFS response.

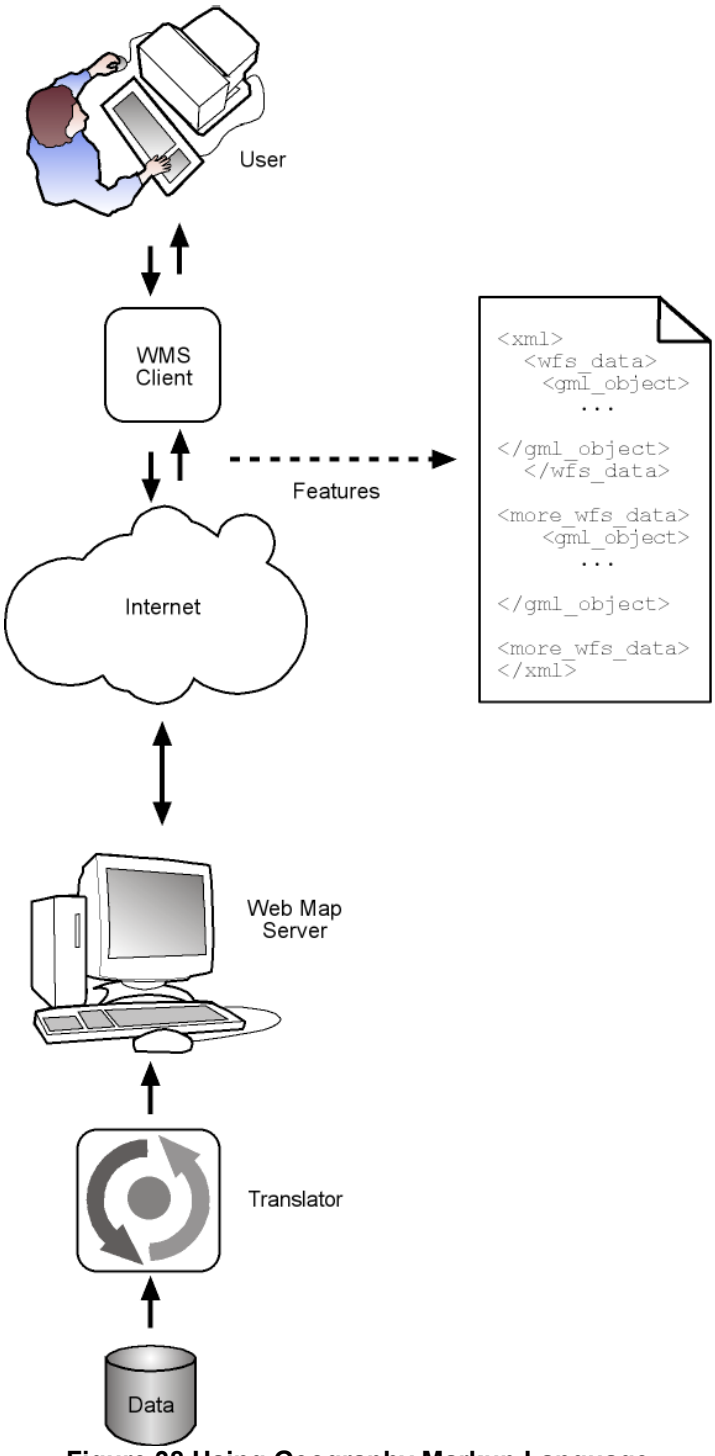


Figure 38 Using Geography Markup Language

A1.6.1 Implementation Specification for GML

As an XML grammar, encoded in XML schema, GML does not really "do" anything. What GML provides are object definitions, all of which are derived from a base abstract GML object type.

The intention is that application schemas, written in XML, define which GML object types are to be used in the application's data structures which are available through public interfaces. This is accomplished in the application schema by importing as many GML schemas as are required for the application.

When the application's public XML data structure is created, it contains XML elements that describe geometric features (one element per feature). The elements are defined by the GML schema for the feature type being described. Note that these elements, or GML feature instances, may form only parts of the content of the data structure as there may be many more elements that are defined by schema outside of GML feature instances. The GML feature instances would only be used to describe the geometric properties of objects contained in the XML data structure.

A1.6.2 GML Models and Schemas

The GML model enables the encoding of geographic features. There is a broad range of geometric object types that can be encoded in GML, and a comprehensive set of properties that are defined for each object type. For example, in addition to the obvious geometric properties of objects, temporal sequences can be encoded. As another example, a coordinate reference system or a coverage can be encoded.

There are three categories of objects for which GML schema exist: features (and feature collections), coverages, and observations. As mentioned previously, the GML feature instances are instances of geographic object types, which may constitute only a part of the full description of the object being represented in the XML structure. The object may have many sub-properties, some of which are GML feature instances, some of which may be other object instances defined by external schema. The application must define how the objects are described in terms of GML feature instances.

A1.6.3 GML Examples

The following XML is a WFS response from the CGDI place name gazetteer from a query for all places in Canada called Toronto (for brevity, only the first two feature members in the feature collection are included in this example, although there are actually several more returned). The response object uses GML to define the point coordinates as the geometry of the returned features.

```
<?xml version="1.0" encoding="utf-8" standalone="no"?>

<featureCollection xmlns:xlink="http://www.w3.org/TR/xlink"
   xmlns:xsi=http://www.w3.org/2001/XMLSchema-instance
   xsi:noNamespaceSchemaLocation=
   "http://cgdi-dev.geoconnections.org/prototypes/schemas/cgdi/cgdigaz/cgdigaz_1_0.xsd"
   xmlns:gml="http://www.opengeospatial.net/gml">
  <queryInfo>
    <nameEntered>TORONTO</nameEntered>
    <wildcards>TRUE</wildcards>
    <bbox>-90,40,-70,50</bbox>
    <key>FALSE</key>
    <numberOfResults>7</numberOfResults>
  </queryInfo>
  <featureMember>
    <GazetteerEntry>
      <Geometry>
       <gml:Point srsName="EPSG:4326">
         <gml:coordinates decimal="." cs="," ts=" ">
           -79.5,43.6
         </gml:coordinates>
       </gml:Point>
      </Geometry>
     <feature_na>New Toronto</feature_na>
     <entity>UNP/LNO</entity>
     <location1>ON</location1>
     <map_chart>30 M/1</map_chart>
     <unique_key>FCFSV</unique_key>
     <lon>-79.5</lon>
     <lat>43.6</lat>
     <nameSource>CGNDB Names Source Concise Gazetteer</nameSource>
     <featureLayer>G_CCSD962</featureLayer>
     <GetFeatureURL xlink:type="simple"
 xlink:href="http://ceoware2.ccrs.nrcan.gc.ca/cubewerx/cwwfs/cubeserv.cg
 i?service=wfs&version=0.0.13&datastore=CEOWARE2&request=GET
 FEATURE&typename=G_CCSD962&filter=<Filter><PropertyIsE
 qualTo><PropertyName>NAME_KEY</PropertyName><Literal&
 gt;FCFSV</Literal></PropertyIsEqualTo></Filter>" />
   </GazetteerEntry>
 </featureMember>
 <featureMember>
   <GazetteerEntry>
     <Geometry>
      <gml:Point srsName="EPSG:4326">
        <gml:coordinates decimal="." cs="," ts=" ">
          -79.4667,43.6667
        </gml:coordinates>
       </gml:Point>
     </Geometry>
    <feature_na>West Toronto</feature_na>
    <entity>VILG/VILG</entity>
    <location1>ON</location1>
    <map_chart>30 M/1</map_chart>
    <unique_key>FEGSC</unique_key>
    <lon>-79.4667</lon>
```

```
    <lat>43.6667</lat>
    <nameSource>CGNDB Names Source Concise Gazetteer</nameSource>
    <featureLayer>G_CCSD962</featureLayer>
    <GetFeatureURL xlink:type="simple"
xlink:href="http://ceoware2.ccrs.nrcan.gc.ca/cubewerx/cwwfs/cubeserv.cg
i?service=wfs&version=0.0.13&datastore=CEOWARE2&request=GET
FEATURE&typename=G_CCSD962&filter=<Filter><PropertyIsE
qualTo><PropertyName>NAME_KEY</PropertyName><Literal&
gt;FEGSC</Literal></PropertyIsEqualTo></Filter>" />
   </GazetteerEntry>
  </featureMember>
</featureCollection>
```

A1.7 Web Feature Service

Web Feature Service (WFS) is a specification that defines data manipulation operations on geographic "features." The data manipulation operations allow for querying, retrieval and transactional (i.e. add, update or delete) operations.

Features consist of geospatial data containing attribute descriptions and geometric descriptions. The geometric descriptions of features in the WFS specification are encoded in Geography Markup Language (GML), and are the actual raw data of the spatial description of the feature. The OGC Abstract Specification provides the exact definition of a feature within the WFS specification (http://www.opengeospatial.org/docs/02-058.pdf). Note that features do not necessarily have to contain geometric properties.

There are many advantages of the WFS. It enables raw data to be served to any client in a vendor-neutral format. The raw data can contain the geometric descriptions of features as well as other accompanying information about the features. With the WFS, the client can also manipulate features through its transactional operations.

However, if a WFS implementation allows clients to manipulate (i.e. add or edit) features, then it must ensure that the client has authority to do the manipulation. It is up to the site that implements the WFS service to manage user-access controls for the upload of new or edited features. This would likely be implemented using a user-authentication mechanism that would verify the identity and the role of the user.

Consider the following hypothetical example. A provincial environment official is visiting a lake, and is carrying a hand-held computer device. The official connects the device to a wireless network via cell phone or satellite, and asks for the lake feature to be returned to the hand-held device. Plotted on the device's browser are the outline of the lake, a depth chart, a list of fish species and populations in the lake, and the position of a control point for measuring the lake's water level. The official then goes to the control point, measures the water level, uploads it from the hand-held computer to the server, and receives a new feature

containing the calculated outline of the lake and a plot of hazardous navigation features given the new water level.

This scenario is hypothetical, although many similar applications are being planned for the near future.

Since the WFS is transactional, the set of interfaces that it supports is much more comprehensive than with the WMS. The following sections describe the basic and transactional interfaces that are supported by the WFS.

A1.7.1 Implementation Specification for Basic WFS Interfaces

There are three basic WFS interfaces: GetCapabilities, DescribeFeatureType, and GetFeature.

A1.7.1.1 GetCapabilities

Just as with WMS, the server must respond to a GetCapabilities request to list which operations it supports, which feature types it supports, and which operations act on which feature types. GetCapabilities must respond with an XML record conforming to the capabilities response schema.

A1.7.1.2 DescribeFeatureType

DescribeFeatureType is an operation where the client can request the server to detail the feature types that it supports, and to list the properties of those feature types. The client can request the server to describe all the feature types that it supports, or it can specify one or more specific feature types that it wishes the server to describe. The server response must be an XML document that conforms to the DescribeFeatureType schema as defined by the specification.

A1.7.1.3 GetFeature

The **GetFeature** operation is a request to retrieve the contents of a single feature from the server. The response is an XML document that must conform to the feature XML schema as defined by the specification.

A1.7.2 Implementation Specification for Transactional WFS Interfaces

There are two transactional WFS interfaces: the transaction operation and the LockFeature operation.

A1.7.2.1 Transaction Operation

The transaction operation will upload data from the client to the data store that holds the data. Of course, it requires the necessary transactional interfaces between the WFS server and the back-end data store, using whatever software component manages the data. Transactional interfaces include the following operation types:

- InsertElement, to add a new feature to the data store;
- DeleteElement, to remove a feature from the data store; and
- UpdateElement, to modify a feature in the data store.

All transactions are encoded in XML, conforming to the schema provided in the specification.

Any geometric properties in transactions must be encoded in GML.

A1.7.2.2 LockFeature Operation

Since the WFS is transactional, the server risks losing data integrity if several requests are made at once to update the same feature. The LockFeature operation enables one user to lock out other users from updating a specified feature. The user may manually unlock the feature (using this operation) once the transaction is complete, or may add a timeout to the initial lock. A timeout to the initial lock is a specified period of time after which the feature will be automatically unlocked.

A1.7.3 WFS Example

The following response is from a WFS service (the Canadian Geographic Names Database Gazetteer service) to a query for any feature within a specified bounding box. Simple geometries are returned, although it is possible to return complex geometries, with a large number of coordinates representing the vertices of regions, in GML.

The second feature in this example has a feature name of Monkland, and a national topographic system (NTS) location of 031G02. There is further geographic information about the feature members that can be referenced from the WFS server.

Note that, for brevity, only two of the dozens of features are included in this sample response.

```
<?xml version="1.0" encoding="ISO-8859-1" ?>
<FeatureCollection
scope="http://cgns.nrcan.gc.ca/wfs/cubeserv.cgi?SERVICE=wfs&DATASTORE=c
gns" xmlns="http://www.cubewerx.com/cw"
```

```
xmlns:gml="http://www.opengeospatial.net/gml"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.cubewerx.com/cw
http://cgns.nrcan.gc.ca/wfs/cubeserv.cgi?SERVICE=wfs&DATASTORE=cgns&REQ
UEST=DESCRIBEFEATURETYPE&TYPENAME=geonames http://www.opengeospatial.net/gml
http://schemas.cubewerx.com/schemas/gml/2.1/feature.xsd">
 <gml:boundedBy>
 <gml:Box srsName="EPSG:4267">
 <gml:coordinates>-75.000000,45.000000 -74.000000,46.000000</gml:coordinates>
 </gml:Box>
 </gml:boundedBy>
 <gml:featureMember>
  <geonames fid="geonames.105469:7088B048F9A9B963D62324020000">
   <geonames.CGNDB_KEY>FDVMP</geonames.CGNDB_KEY>
   <geonames.GEONAME>Monkland Drain</geonames.GEONAME>
   <geonames.FEATURE_ID />
   <geonames.STATUS_CODE>A1</geonames.STATUS_CODE>
   <geonames.CONCISE_CODE>MISC</geonames.CONCISE_CODE>
   <geonames.GENERIC_CODE>4510</geonames.GENERIC_CODE>
   <geonames.REGION_CODE>35</geonames.REGION_CODE>
   <geonames.GEOMETRY>
    <gml:Point gid="ID1" srsName="EPSG:4267">
     <gml:coordinates decimal="." cs="," ts="">
      -74.8667000015848,45.2000000022235</gml:coordinates>
    </gml:Point>
   </geonames.GEOMETRY>
   <geonames.LOCATION>Stormont</geonames.LOCATION>
   <geonames.NTS_MAP>031G02</geonames.NTS_MAP>
   <geonames.ORIGINAL_APPROVAL_DATE />
   <geonames.DECISION_DATE>04-SEP-69</geonames.DECISION_DATE>
   <geonames.EFFECTIVE_DATE />
   <geonames.NAME_KEY>MONKLANDDRAIN</geonames.NAME_KEY>
   <geonames.RS_VALUE />
   <geonames.PC_NAME_LANG />
   <geonames.SOURCE_RECORD_ID />
   <geonames.SOURCE_FEATURE_ID />
   <geonames.HYPER_LINK />
   <geonames.DATE_CREATED>12-DEC-02</geonames.DATE_CREATED>
   <geonames.SOURCE_CREATED>CGNDB</geonames.SOURCE_CREATED>
   <geonames.DATE_MODIFIED />
   <geonames.SOURCE_MODIFIED />
  </geonames>
 </gml:featureMember>
 <gml:featureMember>
  <geonames fid="geonames.117353:7088B048F9A9B963D62324020000">
   <geonames.CGNDB_KEY>FDVMO</geonames.CGNDB_KEY>
   <geonames.GEONAME>Monkland</geonames.GEONAME>
   <geonames.FEATURE_ID />
   <geonames.STATUS_CODE>A4</geonames.STATUS_CODE>
   <geonames.CONCISE_CODE>UNP</geonames.CONCISE_CODE>
   <geonames.GENERIC_CODE>108</geonames.GENERIC_CODE>
   <geonames.REGION_CODE>35</geonames.REGION_CODE>
   <geonames.GEOMETRY>
    <gml:Point gid="ID2" srsName="EPSG:4267">
     <gml:coordinates decimal="." cs="," ts="">
      -74.8667000015848,45.2000000022235</gml:coordinates>
```

```
      </gml:Point>
    </geonames.GEOMETRY>
    <geonames.LOCATION>Stormont</geonames.LOCATION>
    <geonames.NTS_MAP>031G02</geonames.NTS_MAP>
    <geonames.ORIGINAL_APPROVAL_DATE>
      01-DEC-32
    </geonames.ORIGINAL_APPROVAL_DATE>
    <geonames.DECISION_DATE>01-JAN-98</geonames.DECISION_DATE>
    <geonames.EFFECTIVE_DATE />
    <geonames.NAME_KEY>MONKLAND</geonames.NAME_KEY>
    <geonames.RS_VALUE>1000000</geonames.RS_VALUE>
    <geonames.PC_NAME_LANG />
    <geonames.SOURCE_RECORD_ID />
    <geonames.SOURCE_FEATURE_ID />
    <geonames.HYPER_LINK />
    <geonames.DATE_CREATED>12-DEC-02</geonames.DATE_CREATED>
    <geonames.SOURCE_CREATED>CGNDB</geonames.SOURCE_CREATED>
    <geonames.DATE_MODIFIED />
    <geonames.SOURCE_MODIFIED />
   </geonames>
  </gml:featureMember>
</FeatureCollection>
```

A1.8 Geodata Discovery Service

The **Geodata Discovery Service** is a CGDI specification to search Geodata Resource Registries and to retrieve metadata about geospatial data.

A1.8.1 Geodata Discovery Service Implementation Specification

There are two profiles of the Geodata Discovery Service: **stateful** and **stateless**.

A1.8.1.1 Stateful Specification

The **stateful** specification of the Geodata Discovery Service is based on the Z39.50 search and retrieval protocol. Z39.50 is ratified by the United States' national standards body, ANSI, but it is widely used in many application areas around the world.

Z39.50 is a search and retrieval protocol: it enables clients to search catalogues of information through the Internet, and to retrieve details about the catalogue records that match the search criteria. While HTTP is an Internet protocol for hypertext transfer based on URL-encoded requests for information, Z39.50 is an Internet protocol for metadata retrieval based on a set of detailed search specifications in the request. Just as an HTTP-based application may have its own specification for URL parameters to request and retrieve services though HTTP, there are many "profiles" for information search and retrieval through Z39.50.

The advantages that Z39.50 has over HTTP include the fact that these search profiles may be very specific to application communities. For example, the BIB-1 profile was created for the library community to search through distributed library catalogues and retrieve the catalogue information for the records that match the search. There is also a GEO profile that facilitates spatial, temporal and textual searching for geodata, and for the retrieval of the catalogue information (metadata) for the resulting records.

Another advantage is that Z30.50 is stateful. This is unlike HTTP, where a client sends a request to a server, the server processes the request, returns the result to the client, then goes back to its initial state. In Z39.50, a client can send a search query to the server, and then terminate the connection. The Z39.50 server continues to process the request, and the client may connect back to the same session to check the status of the request, or to do a secondary query within the result set that was returned from the initial search.

In addition, the client does not have to request that all results are returned to it in the same connection to the server. For example, it can ask for the first 50 results, then go off and do its own processing or interactions with the user, then go back to the Z39.50 server and ask for the next 50 results. Alternatively, the client may send several different searches, but may refer back to the results of any one of the searches at any time. This is called persistent result set management. The whole advantage of the stateful model is that it allows the client software component to interact with the user, without having to go back and redo the search if more information is required from the results of the previous search. It also permits the client to resume its own services while it is waiting for the server to complete the search.

The GEO profile of Z39.50 is widely used in geospatial applications for searching many inventory catalogues distributed throughout the Internet at the same time. It is a means of searching for geospatial content, using a single set of search criteria, which are held at the source of the data (i.e. at the supplier's site) and are described by metadata inside the supplier's databases. The GEO search profile is based on the FGDC CSDGM attribute set. It can be considered to be equivalent to a filter encoding specification for inventory metadata though the Z39.50 protocol.

Figure 39 shows how Z39.50 can be used by a consumer who connects to a Geodata Discovery Service, which then cascades simultaneously to several suppliers' inventory catalogues to search for individual data products.

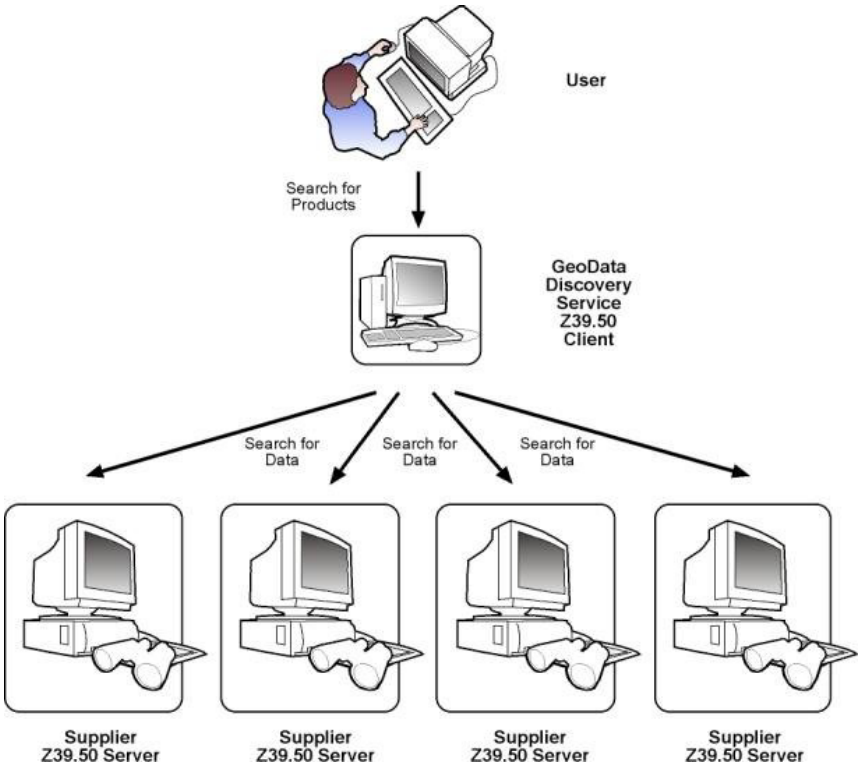


Figure 39 Using Z39.50 with the Geodata Discovery Service

See Section 7.2, CGDI Search Protocols, for the three basic Z39.50 operations.

A1.8.1.2 Stateless Specification

The stateless specification is intended to serve the same goals as Z39.50, to search geospatial inventory catalogues through the Internet, but without the requirement to deploy specialized Z39.50 components on the client and the server.

This specification is currently under development. The draft documented specification is available from the GeoConnections GeoData Discovery Service description page at: http://www.geoconnections.org/CGDI.cfm/fuseaction/technical.geodata_discovery_service/gcs.cfm.

The specification should align with OGC's Stateless Catalogue Interface Implementation specification. Interfaces in this specification are aligned with Open Geospatial®-style interfaces, which consist of the following operations:

GetCapabilities

As with most Open Geospatial®-specified services, the server must respond to a GetCapabilities request with an XML document that conforms to the

schema defined by the specification. The capabilities statement must respond with a list of operations that are supported by the server, the supported query languages, the type of geodata schema used with the results (e.g. FGDC-CSDGM or ISO 19115) and other specific information regarding the functionality of the query service.

DescribeCollectionSchema

When an entry identifier is specified with this request (where the entry identifier comes from the same GeoData Discovery Service), the server must respond with the XML schema for the record in which that entry is encoded. If identifier 0 is provided, the server must respond with the schema for the metadata directory.

GetRecords

This operation is used to retrieve the actual metadata in XML for the requested entry. The XML must conform to the schema for the metadata content standard (or geodata type) in which the record is stored.

A1.9 Filter Encoding

To find geographic content on the Internet, users must be able to issue an Internet-wide search. There must be a common means for those searches to be specified so that servers will understand them. OGC is developing specifications that define services that must be supported by geographic search servers. This will enable users to find geographic objects that have similar properties.

The **Filter Encoding** specification is a means of defining what those properties are; it is used to filter the objects out of geospatial servers. In technical terms, it is an XML encoding of OGC's Common Query Language, or simply put, an XML schema for specifying a geographic query.

Filter encoding is a CGDI-endorsed specification.

A1.9.1 Implementation Specification for Filter Encoding

The Filter Encoding specification is an XML notation for specifying queries for spatial objects. There is no requirement in this specification on the formulation or contents of the response.

Search servers may describe geographic objects using a set of attributes (or descriptors). The filter will constrain those attributes using the following query properties:

- Spatial measures (for example, any matching object must be contained within a specified bounding box), encoded in GML;
- Comparison of numerical values or date/time descriptors;
- Matching of text descriptors or feature identifiers;
- Logical operators for Boolean comparisons;
- One or more of the attributes from the catalogue may be used in expressions or functions defined by the filter. The filter may then apply comparison or matching operators to the outcome of those expressions or functions.

A1.10 Web Coverage Service

Web Coverage Service (WCS) provides access to intact, raw data such as imagery, digital elevation matrix (DEM) and other types of gridded data. Unlike the Web Map Service (WMS), which returns static maps, the Web Coverage Service provides only data access. Typically client-side applications will model, analyze and render the data.

WCS is an implementation specification from OGC; and is endorsed by the CGDI. See http://www.opengeospatial.org/standards/wcs

A **coverage** is a special type of a feature. It is essentially an irregular multi-dimensional grid that describes many types of Earth phenomena at every point in the grid. The advantage of coverages is that relationships between different geographic entities can be represented and derived. Spatial and/or temporal relationships may be modeled between different entity types. Many different types of phenomena may be represented by coverages, including lines, images, surfaces, geometries, vectors and points.

Interoperable implementations will eventually provide for powerful applications that can perform GIS-like analyses through the Internet.

A1.10.1 Implementation Specification for Web Coverage Service

Web Coverage Service (WCS) servers support the following operations:

GetCapabilities

A WCS server must respond to a capabilities request with an XML document that conforms to the capabilities XMS schema defined by the WCS interface specification. The capabilities must indicate which WCS operations the server supports, which vendor-specific operations are supported, details of the data types supported by the services (including

interface specifications), and server access constraints. Finally, the server must return links to external catalogues that contain and describe metadata for coverages used by the service.

DescribeCoverage

This operation will retrieve a full description of one or more coverages available through the WCS server. The response must be an XML document conforming to the XML schema defined in the specification. This is a way for the client to find out which coverages are available on the server, and for each coverage, to retrieve the spatial extent, coordinate reference system, supported formats, and types of information contained in the coverage.

GetCoverage

A client may retrieve a full coverage, a coverage constrained by geographical area and/or a temporal range, or a subset of the coverage types. This can be considered analogous to a "data download" capability, where the user gets the data (GeoTIFF, Shapefile, etc.) instead of GML or an image.

A1.11 Simple Features Specification for SQL, CORBA®, OLE/COM

Simple Features is an OGC implementation specification. They are basically two-dimensional features in which the vertices are connected by straight lines. This specification has interfaces for representing and manipulating points, lines, polygons, curves, surfaces, geometries etc. See
http://www.opengeospatial.org/standards/sfs,
http://www.opengeospatial.org/standards/sfo,
http://www.opengeospatial.org/standards/sfc.

Recognizing that different communication and database architectures require different implementation architectures, the OGC publishes specifications for the storage and retrieval of simple features using various platform specifications. These implementation architectures are developed for:

- The **Structured Query Language (SQL)**, which is an industry-wide interface for relational database interactions;
- **Microsoft's Common Object Model (COM)**, which is a software architecture that enables applications to be built from a series of underlying stand-alone services. Specifically, this OGC specification is targeted towards the use of the database implementation of Microsoft's

Object Linking and Embedding (OLE db) COM-based technology. This technology provides COM interfaces to a wide range of underlying types of database implementations; and

- The **Common Object Request Broker Architecture (CORBA®)**, which is an architecture that enables applications from multiple vendors to interact with each other through the Internet. CORBA® transactions are communicated through the Internet using the Internet Inter-Orb Protocol (IIOP), which in turn interacts with HTTP services using HTTP to IIOP gateways.

For example, the SQL specification provides SQL schema for the management of simple features via an ODBC (object database connectivity interface). ODBC is a platform-independent interface to enable an application (in this case a web service) to interact with any type of relational database, using SQL.

Figure 40, SQL, CORBA and OLE Architectures, shows the nature of these architectures for the purpose of supporting OGC-type services as platform-independent system architectures.

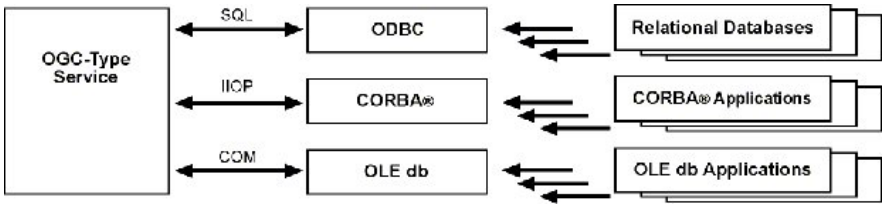


Figure 40 SQL, CORBA® and OLE Architectures

A1.12 Coordinate Transformation Services

Coordinate Transformation is an OGC implementation specification but is not yet a CGDI-endorsed specification (http://www.opengeospatial.org/standards/ct).

Coordinate Transformation Services can be considered to be a superset of the Simple Features services. The specification has separate sets of interfaces for positioning, for coordinate systems, and for coordinate transformations. It has interfaces for creating, managing, transforming and describing multi-dimensional coordinate systems. The profile can handle all coordinate systems from the European Petroleum Survey Group (EPSG), plus it can handle multi-dimensional and coordinate systems that are not georeferenced. This specification has profiles for COM, CORBA® and Java.

Appendix 2

The GeoConnections Discovery Portal

One of the functions of the GeoConnections Discovery Portal is to allow suppliers to promote their geospatial resources online, for free. If you or your organization has geospatial services or information to offer to users around the world, you can easily register with the GeoConnections Discovery Portal and increase your exposure instantly. This appendix:

- Describes the objectives of the GeoConnections Discovery Portal, its stakeholders, components and client support services;
- Outlines the benefits of registering and promoting your geospatial resources in the GeoConnections Discovery Portal;
- Defines metadata and explains its importance to describing geospatial resources;
- Explains the GeoConnections Discovery Portal's registration process for services, data products and organizations; and
- Explains the processes involved when users of the GeoConnections Discovery Portal search both a single database and multiple databases.

Join one of the largest online geomatics communities
Increase your organization's revenues and/or visibility

Enjoy flexible options for access and delivery of your resources
Maintain control of your data

A2.1 What is the GeoConnections Discovery Portal?

The **GeoConnections Discovery Portal** is a free online service that allows you and your organization to find geospatial data products, services and resources from Canada and around the world. Deployed in 1997, the GeoConnections Discovery Portal (formerly CEONet) is part of the CGDI and links to other spatial data infrastructures, giving Canadian businesses, government agencies, non-governmental organizations and individuals access to geospatial data products, services and organizations.

In Canada, the GeoConnections Discovery Portal is connected to catalogues and services that are reused by **peer infrastructures** or **access portals.** These peer infrastructures include the Canadian Geoscience Knowledge Network (CGKN), the National Forestry Information System (NFIS), and the Environmental Monitoring and Assessment Network (EMAN). The GeoConnections Discovery Portal's services are also connected to provincial geospatial infrastructures such as Land Information Ontario (LIO). See chapter 5 for other examples.

Internationally, the CGDI cooperates, interacts and shares its information with spatial data infrastructures and clearinghouses from around the world; in return, it receives geospatial data from them. The Canada Centre for Remote Sensing through the GeoConnections Discovery Portal is the Canadian node of the Committee on earth Observation Systems (CEOS) International Directory Network (IDN). The CEOS IDN describes its organization as follows:

> The CEOS International Directory Network (CEOS IDN) is an international effort developed to assist researchers in locating information on available data sets. The CEOS IDN is sponsored by the Access Subgroup of the Committee on earth Observation Satellites (CEOS) as a service to both the Earth and space science communities. The CEOS IDN provides free, online access to information on worldwide scientific data in the Earth sciences: geoscience, hydrospheric, biospheric, satellite remote sensing, and atmospheric sciences. The CEOS IDN describes data held by university departments, government agencies, and other organizations.

There are five coordinating nodes of the CEOS IDN for the Asian, American, European, and African continents, and another coordinating node for those countries participating in Antarctic research. Each coordinating node has affiliated sites with which they cooperate. These sites, called cooperating nodes, provide a path for researchers within a country or region to participate in the CEOS IDN. Cooperating nodes may support directories specializing in a specific

object, or, although not required, may maintain the complete IDN database (http://idn.ceos.org/IDN/AboutUs).

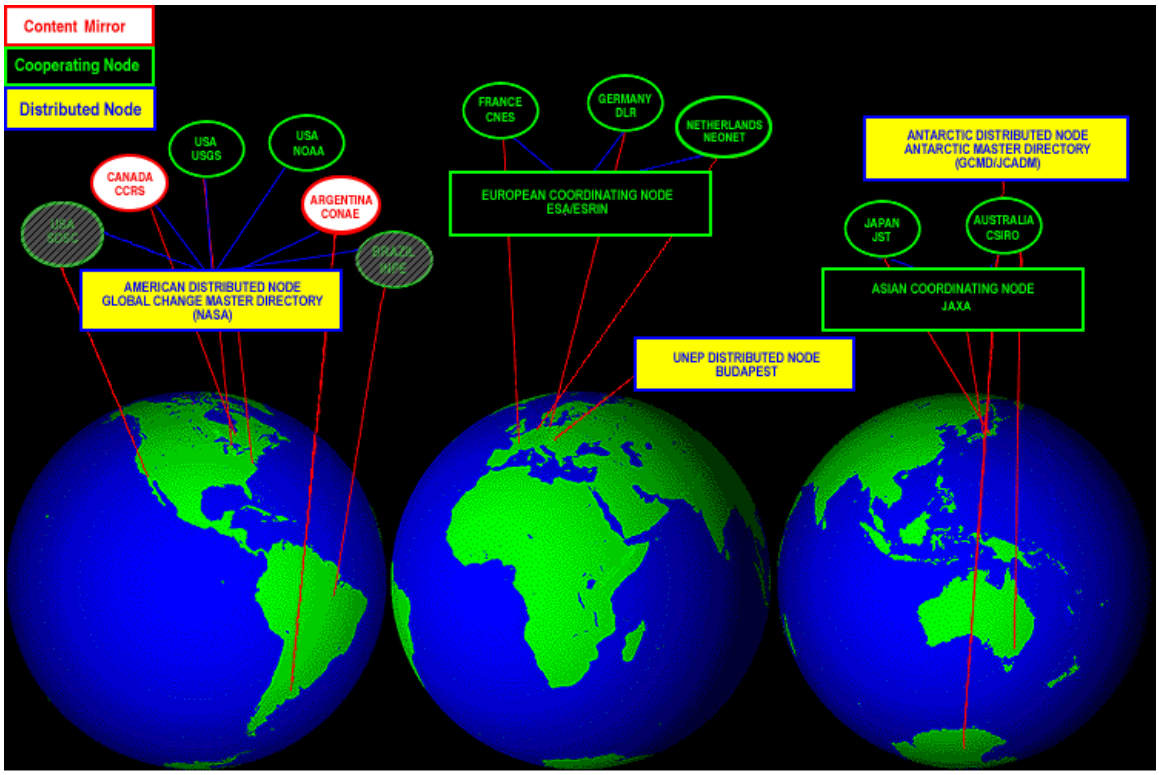


Figure 41 Committee on Earth Observation Systems International Directory Network Sites

Under this arrangement, metadata about Canadian databases is made available through an international network of directory systems. In return, descriptions of international databases are made available to all CGDI users. GeoConnections also cooperates with the United States Federal Geographic Data Committee (FGDC) Geospatial Data Clearinghouse in making databases and catalogues commonly searchable.

A2.2 Objectives and Stakeholders

The GeoConnections Discovery Portal supports a broad range of stakeholders:

- Users: People who wish to find, evaluate and access geospatial resources through the Web;
- Suppliers and Developers: Organizations that wish to make themselves and their data and services available through the Web; and
- Peers: Other spatial data infrastructures with varying levels of interoperability with the CGDI.
- Accordingly, the GeoConnections Discovery Portal's primary objectives are to:

- Provide users with a powerful spatial and keyword search engine to find, evaluate and access Canadian and global data products, services and organizations;
- Enable suppliers to freely promote Canadian geospatial organizations, and to distribute data products and services from base data to value-added services; and
- Enable web site developers requiring geospatial tools to reuse and embed interactive maps and place name gazetteers, and to define geographic boundaries.

A2.3 Components of the GeoConnections Discovery Portal

The GeoConnections Discovery Portal offers several free services for you to promote, find, and access geospatial resources within the CGDI. It also provides tools to help you connect your database to the CGDI.

These services further enable the development of other geospatial data infrastructures by providing a framework of core reusable services and components for resource discovery, evaluation, access and monitoring. The GeoConnections Discovery Portal is designed in an open manner that permits integration of third-party services, therefore allowing the integration of the larger geospatial community. It also provides a sufficient level of autonomy for users and suppliers to connect and use the available services at their desired level.

A2.3.1 Promoting Geospatial Resources

You can promote (or register) your organization's geospatial resources online as a supplier in the GeoConnections Discovery Portal. When you register with the GeoConnections Discovery Portal, you can create or modify a description of your data products, databases, services, resources and organization. Access to entries is password protected.

Registering with the GeoConnections Discovery Portal takes just 10 minutes, and gives you:

- Free promotion for your geospatial data, services or organization to a national and international market;
- The capability to make your web services searchable and accessible over the Internet;
- Access to software tools and Internet-accessible services to make your organization's geospatial data remotely searchable; and
- Free technical help and support.

You can conveniently post and update information about your data products, services or organization within the GeoConnections Discovery Portal by simply using your web browser.

A2.3.2 Finding Geospatial Resources

You can find (or discover) resources within the CGDI by performing a search in the GeoConnections Discovery Portal. The GeoConnections Discovery Portal contains descriptions of geospatial data and services (software applications, online services, business and consultancy services, web services, and resources such as libraries) as well as the organizations that provide them.

The GeoConnections Discovery Portal offers you several ways to search for data, services or organizations:

- Search for services and organizations based on keywords and text;
- Search for data products based on location, time, keywords or text; and
- Discover data collections, services (including web services) and organizations by browsing.

You can search multiple databases in different locations simultaneously for individual data products with a distributed search of external organizations' databases and/or catalogue systems. The GeoConnections Discovery Portal supports the Z39.50/GEO search and retrieval protocol. You can make your database searchable by installing a tool kit for the Z39.50 protocol.

For more details about connecting your geospatial resources to the CGDI, please see Section III, Searching Databases and Making Your Database Searchable.

A2.3.3 Accessing Geospatial Resources

Once you have found the geospatial data or services you need, the GeoConnections Discovery Portal offers you access to connected items. For data, this access may be via an order form, or, if the data is freely available, via direct FTP or HTTP access. For services, you can invoke the discovered service directly over HTTP, FTP and client-based transaction services including e-commerce, if the service is made available this way, or through association with browser helper applications. Services may also include links to downloadable tools or other peer directories.

For more information about integrating geospatial resources into your web site or applications, please refer to Section IV, Using CGDI Web Resources, and Appendix 3, Building Your Application with GeoConnections Discovery Portal APIs.

A2.4 Promoting Your Resources within the GeoConnections Discovery Portal

Once you have decided to promote your resources within the CGDI, there are many discovery mechanisms and directories to choose from. As a national portal, the GeoConnections Discovery Portal offers many benefits to a wide range of Canadians.

World-wide visibility

By registering and promoting your resources with the GeoConnections Discovery Portal, you make your services, geospatial data and organization visible to the world through the Internet via the CGDI. Users can then quickly and easily find your services, geospatial data and/or organization.

The GeoConnections Discovery Portal interoperates with the International Directory Network (IDN). Datasets that are registered with the GeoConnections Discovery Portal are shared with the IDN in a monthly import/export process with NASA's Global Change Master Directory (http://gcmd.nasa.gov/).

The import/export process adds international content to the GeoConnections Discovery Portal directory, and copies Canadian content to international directories. Specific international directories that are involved include: U.S.A. (FGDC Clearinghouse); Australia (ASDI Clearinghouse); and the International Directory Network (IDN) including: Argentina, Australia, Brazil, Canada, France, Germany, Italy, Japan, the Netherlands, New Zealand, the United Nations and the United States of America.

Free and flexible

Your registration and promotion page can be created or updated for free at any time over the Internet; all you need is a web browser and Internet access.

Targeted audience

Registering and advertising with the GeoConnections Discovery Portal reaches a targeted audience because of its geospatial emphasis. Internet users who are interested in geospatial organizations, data and services come to the CGDI to find them.

Total control over content

Because you, as the supplier, complete the registration, you have complete control over what is promoted to users. You can target your information to the specific community you are trying to reach.

Quality control

A dedicated and qualified staff maintains the GeoConnections Discovery Portal and provides quality control of its content and metadata.

A2.4.1 What Can You Promote within the GeoConnections Discovery Portal?

You can promote **geospatial resources**. Within the GeoConnections Discovery Portal, a resource refers to services (including web services and tools), geospatial data and organizations.

Geospatial data includes all kinds of data, maps, satellite images, aerial photography, publications, reports, studies, research data, measurements, etc. Data includes both individual data (e.g. a map) and collections of data (e.g. a map series).

An **organization** may include federal, provincial, territorial and municipal government departments and agencies, associations, private companies, international institutions, or academic institutions.

A **service** or tool may be anything that is provided by your organization-as long as it has a geospatial component-except for data and the description of your organization. There are many types and themes of geospatial services.

You may register and promote your service at any time by completing and submitting an online form in the GeoConnections Discovery Portal. See A2.4, Promoting Your Resources within the GeoConnections Discovery Portal, for complete details.

A2.4.1.1 Directory Services

The purpose of a **directory service** is to store a repository of resources so that public users can discover the resource and access it. You can register and promote your directory service for a specific geospatial theme or application in the GeoConnections Discovery Portal.

To help guide you, please refer to the following examples of "best practices" of directory services that are promoted in the GeoConnections Discovery Portal.

- The **Kativik Community GeoPortal** is a dynamic and interactive Web application for the efficient management of land use and development of the territory and the monitoring of its use. Its main focus is land use planning and supporting the sustainable development of the territory and its resources.

http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=service&entryId=4657&entryLang=en

- The **Ontario Land Information Directory** (OLID) is a provincial directory with services that feature a search capability for provincial geospatial data and a topographic mapping capability. It is promoted as a service in the GeoConnections Discovery Portal as:

  http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=service&entryId=179&entryLang=en

A2.4.1.2 Web Services

You can register and promote your **geospatial web services** in the GeoConnections Discovery Portal and identify them as conforming to CGDI-endorsed standards. In addition, when you register a web map server within the CGDI, the GeoConnections Discovery Portal registry will harvest the capabilities of the server, thereby making the individual layers discoverable from the GeoConnections Discovery Portal. This allows users to find layers based on a theme name or subject within a given geographical area, and to view all the resulting layers in a web map client.

Future initiatives will define common metadata frameworks or keyword thesauri for layers; a common interpretation of the search keywords will then result in consistency in the layer themes that are returned from a layer search.

You can register and promote your geospatial web services in the GeoConnections Discovery Portal and identify them as conforming to CGDI-endorsed standards.

A2.4.1.3 Web Service Client Applications

In addition to providing CGDI web services, you can also make available client applications and tools for users of those services. The services registration component of the GeoConnections Discovery Portal has specific categories for suppliers to list CGDI web clients, while its discovery component has categories to highlight those CGDI web service clients for users to discover, access, download or order.

To help guide you, please refer to the following example of a "best practice" of a CGDI web service that is registered and promoted in the GeoConnections Discovery Portal.

- The **GeoDiscover (CGDI) Viewer**, based on Chameleon technology, is a general purpose Open Geospatial web map client open-source solution that can be implemented as a visualization client in portals and

applications. It is registered and promoted as a web service in the Discovery Portal as:

http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryType=webService&entryId=2172&entryLang=en

A2.5 How to Register and Promote Your Services, Including Web Services

You can register and promote any of your geospatial services in the GeoConnections Discovery Portal. These can include web map servers or clients, web feature servers or specification descriptions. When you promote a service within the CGDI, you are helping to build the CGDI by making your service available for others to use.

A2.5.1 Why Should You Register and Promote Your Web Services?

You may host a CGDI web service for your own application requirements related to map-based visualization, discovery and other needs. For example, by registering a map server with the GeoConnections Discovery Portal, you enable others to develop applications that use your registered map server. As a result, users benefit from being able to access the spatial datasets available through your server, without the requirement of maintaining the data themselves. Using simple HTML and by providing parameters which are acceptable by the Web Map Service (WMS) specification, users can embed and display geographically referenced images to their own application.

Users and developers can take advantage of CGDI web services by using these technologies to provide more interactive, interoperable and seamless functions to their end users.

Applications benefit from always having the most up-to-date underlying content and services available "closest to the source" through commonly published standards.

External developers can use the CGDI infrastructure to avoid the costly custom-development of similar tools in-house.

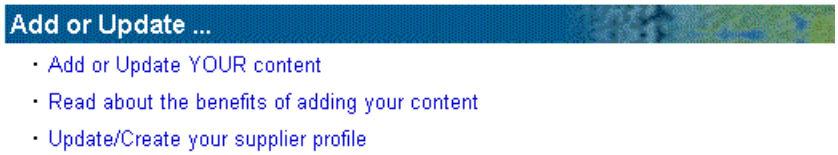
You will find details related to CGDI-endorsed standards by selecting CGDI and Developers' Corner from the GeoConnections web site (see http://www.geoconnections.org/CGDI.cfm/fuseaction/developersCorner.endspecs/gcs.cfm).

A2.5.2 Registering Your Services, Including Web Services

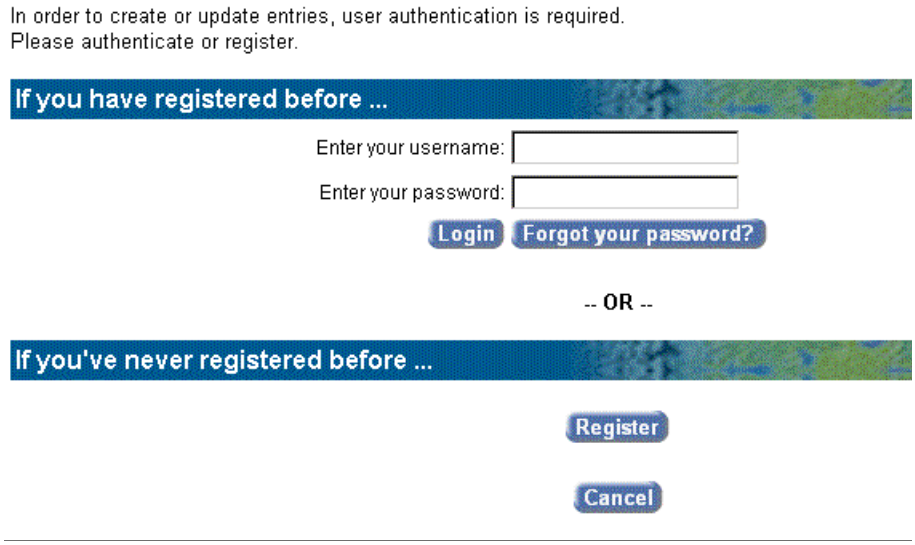
To register your (web) services, follow these 6 steps:

Note: Steps 1-5 are the same for registering both a CGDI web service and a service.

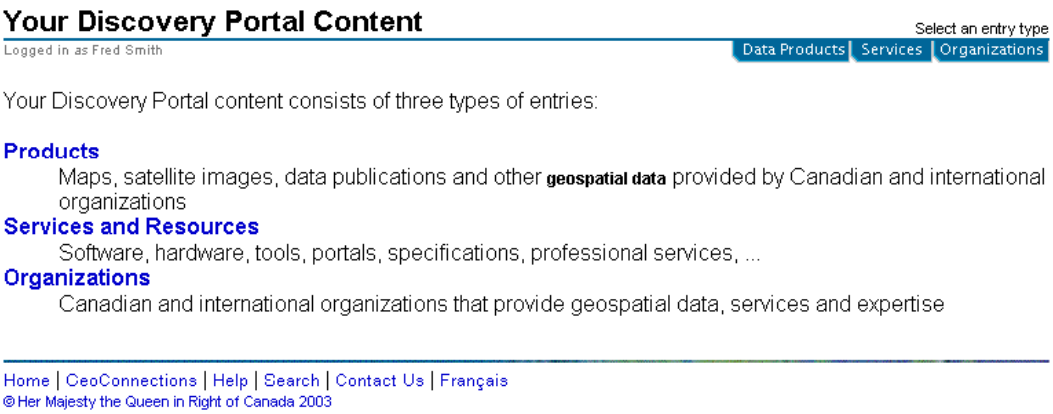
1. Go to the GeoConnections Discovery Portal web site at http://geodiscover.cgdi.ca and select the Update Your Content tab on the home page.



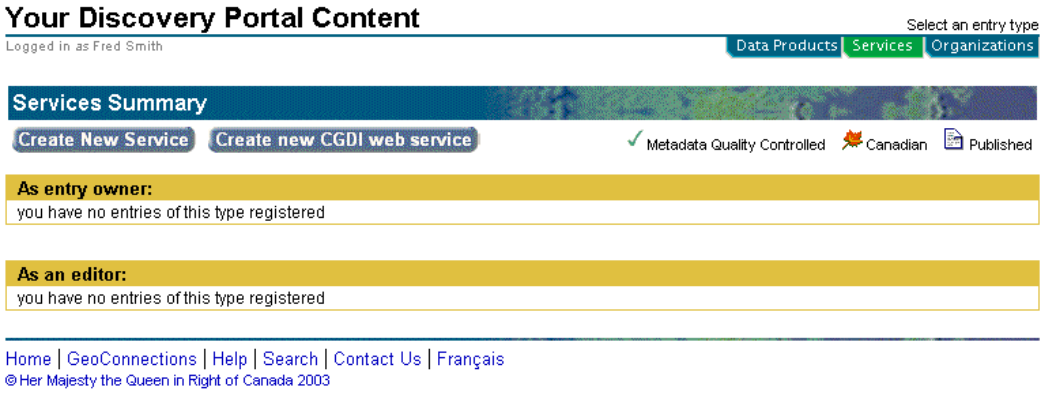
2. Log in using an existing user name and password (if you have one), or select Register to create a new user account. If you are already logged-in, this page will not appear.



3. Select the Services link.



4. You will now be provided with a list of all the services under your ownership; if you have just registered as a new user, you will not have any. Select either Create New Service or Create New CGDI Web Service.



5. After you have saved your service or CGDI web service for the first time, you can use the Add/Edit Associations button to create associations. Associations are to let users know where the service comes from. Please see A2.5.4, Adding Associations for Services, including Web Services, for full details.
6. Enter the required information using the example in A2.6.3, Recommended Metadata Fields for Services, including Web Services, as a guide.

If you need help, select the Help tab at the top of any Discovery Portal web page.

A2.5.3 Recommended Metadata Fields for Services, Including Web Services

The following example illustrates the mandatory metadata fields that you must complete when you register and promote your (web) service.

Helpful tips:

- The fields in red (in this manual) are mandatory and must be completed.
- The remaining fields listed are valuable and important and it is recommended that they be completed, but they are optional. Not all fields available online have been shown in this manual.

Name of the Service

The name of your (web) service may be either the formal name of a service or it may be an informal, descriptive title. In either case, the title of your (web) service should immediately communicate to your prospective users what the (web) service offers.

For example, rather than a service name of "Consulting", a more descriptive name would be "Consultation Service for Preparation of Legal Survey Descriptions". Again, rather than a service name of "Fieldlog", "Fieldlog: A Computer-Based Field Mapping Tool" provides more information to prospective users.

Example: **Name of the Service**: Atlas of Canada - Web Map Service

Acronym of the Service

While this is not a mandatory field, some (web) services are better known by their acronym than by their full title. If this is the case for your (web) service, or if you want to encourage use of an acronym, you should complete this field.

Description of the Service

This is one of the most important fields for describing your (web) service. It is helpful to think of describing your service in marketing terms by answering questions like:

What is it?
What is its purpose?
Does it have a particular focus or area of coverage?
How would a user use it?
Why would a user want to acquire the service?
What would be the output/outcome of the service?
Is this service maintained and supported?

While the description field box does not look very big, you can enter a considerable amount of information here. When you enter long descriptive text, a scroll bar will appear thereby permitting you to rapidly scan the text.

Example: **Description of the Service**: The Atlas of Canada's Web Map Service

(WMS) is an Internet-based service designed to provide developers of online OGC (Open Geospatial Consortium) WMS compliant mapping tools access to the Atlas of Canada's base layers. By using this service, developers will have access to our most current and accurate base data for rendering customized maps. Our OGC-compliant WMS technology is provided free of charge and does not require a contract or license agreement.

Country

This field is used to identify the country of origin for a particular service. The default is set to Canada; however, a list of countries is available by opening the drop down menu.

Cost of the Service

This field is used to enter cost or pricing details for your (web) service. If it is free click the button to the left of the word "free". This will display the words Gratuit-Free in the published view of the service registration.

If there is a cost associated with your service, click the button to the left of the blank field and then fill in pricing details. Please specify if the cost of the (web) service is in a currency other than Canadian, i.e. "US$69.00 per copy plus shipping". If the price depends on a number of factors, you may enter the statements "Please consult organization" or "Please contact the supplier".

User or Access Constraints

User or access constraints are generally legal prerequisites and restrictions regarding access to your data and what users are permitted to do with the data after access is granted. A copyright statement is but one example of what might be entered in this field. Enter "None" if there are no constraints rather than leaving it blank.

Keyword Descriptions
Access Mechanism

This field automatically defaults to "On-line Service" when you register a CGDI web service.

Type of Service

For web services: To better describe the type of service you are promoting on the GeoConnections Discovery Portal, select the appropriate web service type from the list of OGC-CGDI web service types offered. Select at least one string of

keywords appropriate to the web service type by clicking on the Select Type button.

For services: To better describe the type of service you are promoting on the GeoConnections Discovery Portal, select at least one string of keywords by clicking on the Select Type button. By identifying Type keywords appropriate to the service, you will facilitate the discovery of your entry by users who are conducting searches using these keywords. Example: Discovery and Access > Warehouse

Category of the Service:

To better describe the category of the service that you are promoting, select at least one string of keywords by clicking on the Select Category button. By identifying Category keywords appropriate to your web service, you will facilitate the discovery of your entry by users who are conducting searches using these keywords.

Example: Surveys and Mapping (non Geophysical)
> Geographic Information System (GIS) Development and Customization
> Processing

Theme Description

While this is not a mandatory field, you can choose one or more theme keyword strings from the selection offered by clicking on the button Select Theme Keyword.

On-line Service Description
URL for More Information About this Service

If there is a URL that offers more information about a particular service that you are registering, identify this address here. Give the full URL address starting with "http://...". This provides a quick and efficient link to additional specific information about the service and this in turn may provide other links of interest to the user.

GetCapabilities URL for Open Geospatial Type Services

To provide access to the GetCapabilities document, enter the full URL address in this field. GetCapabilities are described in A1.3.4, OGC's WMS Interfaces. For example: http://cgns.nrcan.gc.ca/wms/cubeserv.cgi?request=getCapabilities .

URL for Accessing the Service

If there is a direct URL for accessing the service, list it here. This is very valuable information for your users. Like the requirements for the previous field, give the full URL address starting with "http://...".

Contact Information
Metadata Contact

Under "Name", list the first and last names of the person responsible for the content of your registered (web) service.

Enter the complete and proper name of your organization.

For federal government departments, please follow Treasury Board guidelines that require "Government of Canada" to be listed first, followed by your department name, and on down the organizational hierarchy. All names should be written out in full.

For example: Government of Canada, Natural Resources Canada,
Geological Survey of Canada, Terrain Sciences Division.

For the telephone number, include the country code followed by the area code and then the telephone number. For Canada and the United States, the country code is written as +01. A telephone number in full would then be +01-613-947-4213. If there is a toll-free number using an 800 or an 888 area code the +0 is dropped. The toll-free number would look like 1-800-555-1212.

The facsimile number follows the same format for the phone number i.e. +01-613-947-4213. Should it be a toll free number the same guidelines outlined for the phone number apply, i.e. 1-800-555-1212.

Technical Contact

The technical contact information follows the same conventions outlined for the metadata contact. If your technical contact information is the same as the metadata contact simply click the button Copy from Metadata Contact and the metadata contact information will be automatically loaded.

Reference Information
Future review date for this entry (YYYY-MM-DD)

The date for future review of your (web) service entry automatically defaults to six months. Should you want a longer or shorter time period for review of your entry, you can alter the year, month and day. The individual identified as the metadata contact will automatically be sent an email on the review date reminding him/her to confirm the service metadata details.

A2.5.4 Adding Associations for Services, Including Web Services

You may add an association to an organization for your (web) service to let users know where the service comes from and how it is distributed. There are three types of associations that a (web) service may have with an organization:

Distributor: An organization from which the (web) service may be acquired or accessed. A (web) service may have more than one distributor.

Custodian: The organization which holds the authoritative source of the (web) service. A (web) service may have only one custodian.

Originator: An organization which contributed to the creation of the (web) service. A (web) service may have more than one originator.

Any organization that you add as an association must already be registered in the GeoConnections Discovery Portal. This means that when you create a new (web) service, you must save it before you can add associations.

In the preceding Atlas WMS example, the association for that entry is: Service Custodian: Canada Centre for Remote Sensing, ESS / NRCan.

To add an association, select the Add/Edit Associations button, available either in the save confirmation page, or in the edit form. A window will appear that allows you to select existing GeoConnections Discovery Portal organizations and to assign any of them as a Distributor, Custodian or Originator for your (web) service.

After identifying and entering organizations associated with your (web) service, click on the Submit button located in the bottom right corner of the web page. This will complete and save your association links.

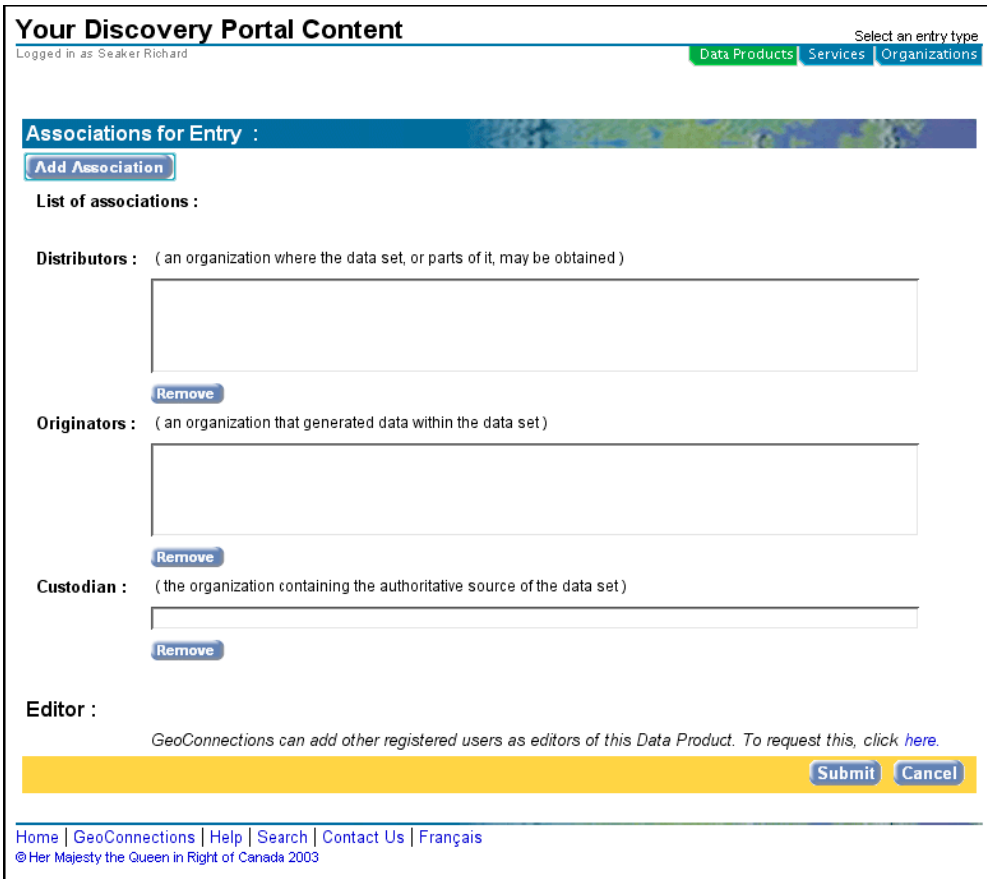


Figure 42 Your Discovery Portal Content

A2.5.5 Previewing, Saving and Publishing Service Metadata, Including Web Services

After you enter the metadata for your (web) service, you can preview your entry by clicking on the Preview button, located at the top and bottom of the (web) service entry form. If the preview of the entry is acceptable, select Return to Form and then use the Save button to finalize the publishing process of your (web) service. Your entry will automatically be **published** unless the checkmark is removed to the left of the word *Publish*. Once it is published, your service is live on the Discovery Portal and is being promoted.

You may **save** your (web) service entry without formally publishing the entry on the GeoConnections Discovery Portal. The entry will be saved but will be viewable only to the owner and any assigned editors.

To add a logo or icon, to delete, or to use the current entry as a template for a new (web) service, you must open the (web) service entry form after initially saving the entry. Opening the (web) service again will engage these buttons.

Helpful tips:

- ☑ The Delete button will take you through a series of steps that will remove the entire (web) service entry from the GeoConnections Discovery Portal.
- ☑ To enter a logo or icon for a (web) service, click on the Logo/Icon button and follow the instructions.
- ☑ To create a new (web) service entry, where considerable information is identical to an existing entry, use the Save As button to copy the entry and to provide a new (web) service name. Once you have copied and renamed the new (web) service, you can make additional changes to your entry.
- ☑ The Cancel button will remove only unsaved text that has been entered into the (web) service entry form.

A2.6 How to Register and Promote Your Data Product

You can register and promote your data product with the GeoConnections Discovery Portal by entering information in an online form. When the form is submitted, the information is added to the GeoConnections Discovery Portal's catalogue. Users can then perform a search though the GeoConnections Discovery Portal to find your data product.

In addition, your data product promotion page can contain a link to a database search server, which allows users to search the database directly for individual data products, once the necessary connections are made. Users can then find any individual datasets, map sheets, images, reports, and other data product information that you want to make available. Installing a search server and allowing remote searching via the Internet makes your database "searchable".

Registering your data product gives you total control over your content. The promotion page should describe the data product in detail, using keywords, geographical location, etc. The data products contained in the GeoConnections Discovery Portal follow the U.S. Federal Geographic Data Committee's approved Content Standard for Digital Geospatial Metadata (FGDC CSDGM). This standard provides a consistent approach and format for the description of data characteristics. It was chosen for its quality, popularity of use, established support, as well as for the tools that have been and are continuing to be created. Note that there are a few fields in the data product registration promotion form that also make the product metadata compatible with the ISO 19115 core profile.

There are metadata fields describing specific geospatial attribute information, such as the time period that your data covers and spatial and thematic keywords. There are approximately 270 fields; of these, about 50 must be completed, and

depending on your data product the remaining fields may or may not apply. The main metadata information categories for data products are as follows:

1. Identification information;
2. Data quality information;
3. Spatial data organization information;
4. Entity and attribute information;
5. Distribution information;
6. Metadata reference information; and
7. Spatial reference information;.

The **Mandatory Information** section is a summary of metadata information fields required for completion. You can submit the form with just the "Name of the Product Collection" completed, but the content management team will not let your entry pass quality control until all the required fields are completed (or until you provide a reasonable explanation for the fields that are not completed).

You may create or update your registration and/or promotion page for free at any time over the Internet; all that is required is a web browser, Internet access, a GeoConnections Discovery Portal user name and password. From time to time, you will be notified by email to update your registration and promotion details; this feature ensures that metadata in the GeoConnections Discovery Portal is current.

A2.6.1 Data Product Best Practices

To help guide you, please refer to the following examples of "best practices" of data products registered in the GeoConnections Discovery Portal.

- The Canadian Ice Service has several datasets registered and promoted in, and connected to, the GeoConnections Discovery Portal that enable users to search for and order ice charts.
    - To access these datasets go to the GeoConnections Discovery Portal http://geodiscover.cgdi.ca/gdp/search?action=searchForm&entryType=productCollection&formType=advanced&language=en, enter "ice" as a keyword, then select Search. The results returned will include datasets such as:
        - - Canadian Ice Service Daily Analysis Ice Charts
        - - Canadian Ice Service Standard Ice Climate Products
    - Select the checkboxes to the right of these titles, then select Search Databases. The GeoConnections Discovery Portal connects to the databases to search for individual data products. When the search is finished, select View Results.
    - Each result will have a "thumbnail" (or small) image, and its footprint (an outline of the area of interest) will be displayed in the

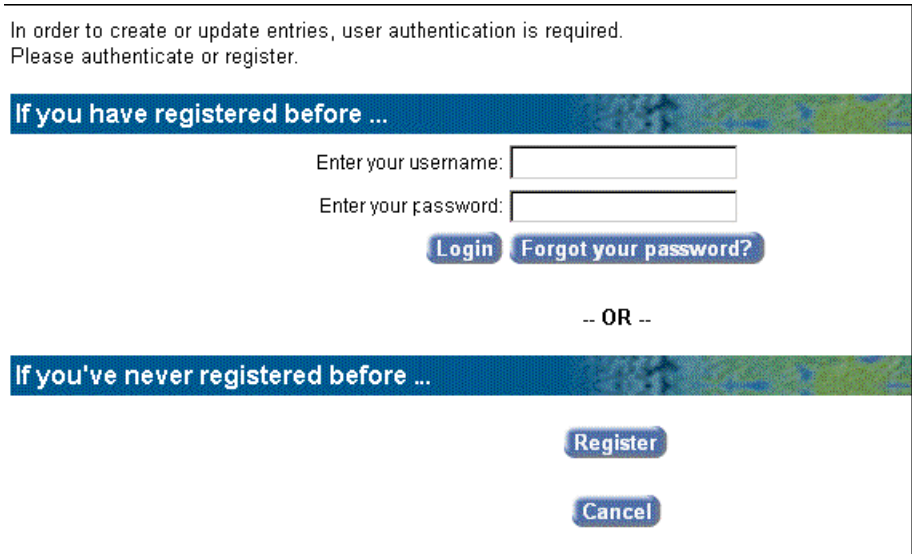
index map. You can retrieve the detailed metadata for the data product by selecting Details, or the access service from the supplier can be invoked by selecting the Access button. Once Access is selected, users are passed to the supplier's site (the Canadian Ice Service), which provides more details for the selected product, and a mechanism to order the selected product.

- The **CCRS North American Landsat-7 ETM Archive** is another example of a highly functional connected database. The search form for this data product enables users to search using the Landsat-7 reference geometry (path and row). The search form is available at:
  - http://geodiscover.cgdi.ca/gdp/search?action=entrySummary&entryId=9471&entryLang=en&portal=gdp&entryType=productCollection.
  - Once your search is complete and you are viewing the results, you can request product orders through the GeoConnections Discovery Portal, and have the order sent to the supplier's order desk. This service also offers browse images, which are visualizations of the full data product, which can also be viewed through the connection service in the GeoConnections Discovery Portal.

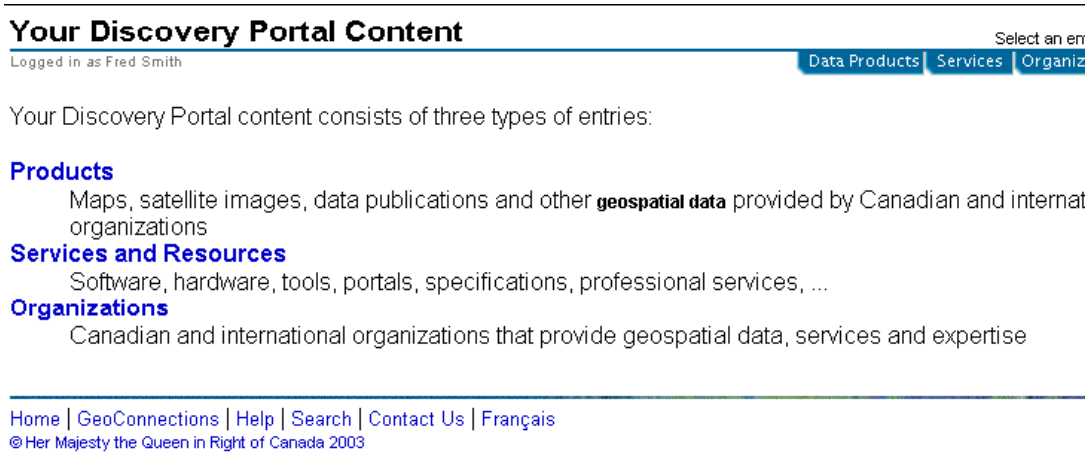
A2.6.2 Registering Your Data Product

To register your data product, follow these 6 steps:

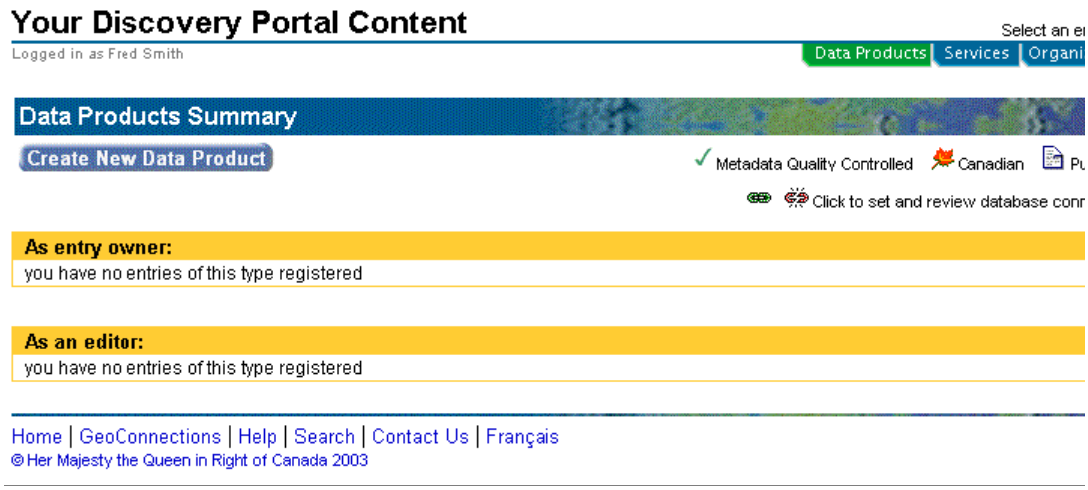
1. Go to the GeoConnections Discovery Portal web site at http://geodiscover.cgdi.ca
   and select the Add or Update Your Content link in the home page.
2. Log in using an existing username and password if you have one, or select Register to create a new user account. If you are already logged-in, this page will not appear.



3. Select the Products link.



4. You will now be provided with a list of all data products under your ownership. If you have just registered as a new user, you will not have any. If this is the case, select Create New Data Product.



5. Enter the required information using the example in A2.6.3, Recommended Metadata Fields for Data Products, as a guide.

6. After you have saved a data product for the first time, you can use the Add/Edit Associations button (see A2.6.5, Adding/Editing Associations for Data Products) to create associations that let users know where the data product comes from and how it is distributed, or you can use the Add/Edit Search Service button to add details for connected search servers for the database (in order to make your database searchable through the GeoConnections Discovery Portal).

If you need help, select Help/FAQ on the GeoConnections Discovery Portal menu bar at the top of the web page; then, in the new page that opens, select Tutorial. The tutorial explains the entire procedure.

A2.6.3 Recommended Metadata Fields for Data Products

The following example illustrates the mandatory metadata fields that you must complete when you register a data product.

Helpful tips:

- ✓ The fields in red (in the manual) are mandatory and must be completed.
- ✓ The remaining fields and information sections are valuable and important and it is recommended that they be completed, but they are optional.
- ✓ Throughout the online form you will repeatedly see the symbol . Click on this  symbol to link you to the relevant help information for each topic. It will describe what is required for each line item.

MANDATORY INFORMATION

This section retrieves and incorporates the mandatory information from the FGDC metadata information categories for data products.

Name of the Product Collection

The title should include Canada and/or the province or geographic region of the dataset (i.e. National Forestry Database - Forest Inventory, Canada).

Temporal information (i.e. year) is acceptable and welcomed but the title should also reflect the content, theme and location of the data collection.

Although the system can handle more than 160 characters, other systems are known to truncate data product titles that have more than 160 characters after export from the GeoConnections Discovery Portal.

Acronym

Some data products are better known by their acronym rather than their full title. If this is the situation, or if you want to encourage use of an acronym, this is an excellent field to consider.

While this field is listed as mandatory, you may leave it blank if there is no acronym for your data product.

This is not an FGDC field.

Country of Origin

This field is used to identify the country of origin for a particular service. The default is set to Canada, however, a list of countries is available by opening the drop down menu.

This is not an FGDC field.

Originator

The name of the Originator is usually an organization such as a provincial government, federal government, or commercial organization. For federal government departments, Treasury Board guidelines specify that the hierarchical naming convention be used. For example: Government of Canada, Natural Resources Canada, Geological Survey of Canada, Northern Canada Division.

Sometimes, if the originator is a person, then that person's name should be listed. If the name of editors or compilers are provided, the names must be followed by "(ed.)" or "(comp.)" respectively.

For the federal government, "(ed.)" or "(comp.)" information should be placed in the Other Citation Details field and the federal government and sector/departments listed under Originator.

Time Period of Content

Example: **Beginning Date (YYYY-MM-DD)**: 1991-01-01
Ending Date (YYYY-MM-DD): present

You are strongly encouraged to include the year, month, and day for the beginning and ending date, although just the first year and last year of the event are acceptable using FGDC standard definitions.

The word "Unknown" is acceptable for both the beginning and end date as well as the word "Present" for the ending date.

Online Linkage

Online Linkage is the name of an online computer resource that contains the dataset. This is generally a URL such as http://geonames.nrcan.gc.ca/info/cgndb_e.php.

There may not always be an online linkage URL available when you register a data product.

Geospatial Data Presentation Form (Product Type)

From the menu of options which are listed below, select at least one of the Geospatial Data Presentation Form items that best describes your product:

Atlas, Audio, Diagram, Digital, Document, Film, Globe, In-situ Measurement, Map (Digital Elevation Model, Geopolitical Map, Thematic Map, Topographic Map), Model, Multimedia Presentation, Navigational Chart (Aeronautical Chart, Nautical Chart), Paper, Photo, Raster Digital Data, Remote sensing data (Airborne, Spaceborne), Section, Spreadsheet, Study, Tabular Digital Data, Vector Digital Data, Video, View

Description

For the Description, you must use proper sentence structure, grammar, and spelling and, most importantly provide a good description of your data collection. Description lengths will vary.

You can also use the Clean Up Text button here to clear ragged edges or tags from text that you have cut and pasted into this field from different sources (i.e. the Web).

Abstract

The statements you make in the Abstract field must be in agreement with the information you provide in other fields.

Always define the full acronym/abbreviation the first time you use it, and include the acronym/abbreviation in parentheses.

For example: Canada's Forest Inventory 1981 (CanFI81).

Purpose

You must use proper sentence structure, grammar, and spelling when describing why your data product was created or developed. Purpose statements are generally short. The previous helpful tips for Abstract also apply here for Purpose.

Bounding Coordinates

The bounding coordinates must reflect coverage for the area under discussion.

To determine or select the coordinates you can use one of the following options: select from the drop down menu, draw the region on a map, look up the postal code, find the place by name or enter the coordinates in the boxes provided.

Once you have published your product information, you can examine the coordinates on the map provided in the short form of the metadata entry. This will ensure that you have selected the correct geographical extent (bounding coordinates) for your data product.

Theme Keywords

For theme keywords, we recommend using more than one Global Change Master Directory (GCMD) keyword string from its theme keyword thesaurus.

The keyword string must include a minimum of three levels.

For example: Earth Science > Cryosphere > Snow/Ice. Simply entering Earth Science > Cryosphere (two levels) are not acceptable when transferring to the GCMD.

Self-generated keywords that scientists use in their field are encouraged and are acceptable. These may be typed into the text box provided for non-standardized theme keywords.

When populating a French data product it is best to use the French interface as the menu or keyword options will then be offered in French.

Place Keywords

Using the GCMD international place keyword list, Canadian entries should generally have the following place keywords:

Northern Hemisphere
Western Hemisphere
Mid-latitude
Arctic (if applicable)
Polar (if applicable)
Global Land (if applicable)
North America
Canada

When you use the noun "Canada" as a place keyword, you should also list all relevant provinces and territories and/or the Canadian Regions from the Canada place keyword list:

Canada > British Columbia
Canada > Alberta
Canada > Saskatchewan
Canada > Manitoba
Canada > Ontario
Canada > Quebec
Canada > New Brunswick
Canada > Nova Scotia
Canada > Prince Edward Island
Canada > Newfoundland and Labrador
Canada > Nunavut
Canada > Northwest Territories
Canada > Yukon Territory
Canadian Regions > (choose from the list provided)

The GCMD also provides a place name list for bodies of water for consideration.

As with theme keywords, self-generated place names are welcomed. These may be typed into the text box provided for non-standardized place keywords.

Fees

Under Fees, use the radio buttons to either select Free or enter an amount or dollar range. Specify the currency if it is not Canadian dollars.

"Please contact the distributor" is an acceptable phrase for the Fees field.

Network Resource Name

The Network Resource Name is the service from which the dataset can be obtained. This is typically a URL such as http://geogratis.cgdi.gc.ca/.

There may not be a Network Resource Name when you register your data product.

Contact Information
Primary

For Contact Person, enter the first and last names of the person who is the contact for the data collection.

For Contact Organization, if your organization belongs to the federal government, please follow Treasury Board guidelines. Federal organizations are to start with the "Government of Canada", then department name and on down the organization's hierarchy.

For example: Government of Canada, Natural Resources Canada, Geological Survey of Canada, Northern Canada Division. All names should be written in full.

For Address Type, "Mailing and Physical Address" is the common phrase in this field. However, you may also enter "Mailing Address" or "Physical Address" here. Sometimes the mailing address will be different from the physical address i.e. the mailing address has a post office (P.O.) box whereas the physical address has a street name.

Under Province or State, enter your province or territory in full. If you enter your province or territory in French, place parentheses around the name, e.g. (Ontario).

For Postal Code/ZIP Code, enter a valid Canadian postal code (eg. K1A 0E9).

For Country, please spell the country name in full, i.e. Canada rather than Can.

For Contact's Telephone Number, enter the country code followed by the area code and then the telephone number. For Canada and the United States of America, the country code is written as +01. A telephone number in full would then be: +01-613-947-4213. For toll-free numbers with an 800 or an 888 area code, the +0 is dropped. The toll-free number would look like: 1-800-555-1212.

For Contact's Facsimile Telephone, please follow the same rules as for the Contact's Telephone Number, e.g. +01-613-947-4210. If you have a toll-free number, the same rules apply i.e. 1-800-555-1212.

For Contact Electronic Mail Address, follow the standard format with name of person, group, etc. followed by the @ sign and the organization and country code, e.g. firstname.surname@companyname.ca. Note that our Web displays the @ sign in your email address as _AT_ to reduce problems with spam.

Contact Information
Distributor

For Distributor Contact Information, please follow the same conventions as the previous list contact fields.

There is room for more than one distributor if required by going to the Distribution Information section.

Contact Information
Metadata

You must enter the first and last name of the contact person in this field. This is the person who is responsible for the metadata (i.e. entering and updating) for the data product collection described.

The rest of the entry follows the same contact guidelines as outlined for the primary and distributor contact fields.

OPTIONAL METADATA INFORMATION CATEGORIES

The following describes some of the optional metadata information fields and sections where information may be readily available.

 Click on this symbol to link you to the relevant help information for each metadata field in each information section. It will describe what is required for each line item.

1. IDENTIFICATION INFORMATION

Citation

It should be noted that the descriptive Name of the Product Collection is automatically loaded into the Title field. However, you may need to alter the title under 'Citation Information' if it is different from the name of the product collection since ‘Citation Information’ is the official name.

Example: **Citation Information**
Title: National Forestry Database - Forest Inventory, Canada

Publication Information

Under Publication Place, enter city, province and country written in full, e.g. Brandon, Manitoba, Canada.

Under Publisher, enter the name of the publisher, which is generally the same as the originator. For federal government departments, please follow Treasury Board guidelines for the hierarchical naming convention.

Example: **Publication Place**: Brandon, Manitoba, Canada

Publisher: Government of Canada, Natural Resources Canada, Canadian Forest Service

Status

Progress refers to the state of your dataset. Enter "Complete", "In work", or "Planned".

Maintenance and Update Frequency refers to the frequency with which changes and additions are made to your dataset after the initial dataset is completed. Enter one of the following:

Continually	Unknown	Daily
As needed	Weekly	Irregular
Monthly	None planned	Annually

free text (you can provide your update frequency eg. bi-weekly)

Access Constraints

Access Constraints refer to restrictions and legal prerequisites for accessing your dataset. These include any access constraints applied to ensure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the dataset.

In this field the word "None" is commonly used for publicly accessible data products.

Use Constraints

Use Constraints refer to restrictions and legal prerequisites for using your dataset after access is granted. These include any use constraints applied to ensure the protection of privacy or intellectual property, and any special restrictions or limitations on using your dataset.

Example: Copyright - Canadian Council of Forest Ministers 1998. The data used in these documents have been provided by the National Forestry Database Program, Canadian Council of Forest Ministers. Reproduction or future utilization is authorized as long as reference is made to the source.

2. DATA QUALITY INFORMATION

All of the metadata fields in this section are optional, as they are specific to many different types of data. It is however recommended that you review these fields; if any fields are relevant and do apply to your data product, fill them in, as the additional information will offer greater value to users looking for data.

3. SPATIAL DATA ORGANIZATION INFORMATION

The Indirect Spatial Reference Method fields in this section is the system of objects used to represent space in the dataset. The domain can be "Point", "Vector" or "Raster".

4 ENTITY AND ATTRIBUTE INFORMATION

All of the metadata fields in this section are completely optional. Some or all may apply depending on the data product you are registering. If any fields are relevant and do apply to your data product, fill them in, as the additional information will offer greater value to users.

5. DISTRIBUTION INFORMATION

The Distribution Liability field within the Distribution Information section gives you an opportunity to provide a statement of the extent of liability that you are prepared to assume.

Example: **Distribution Liability**: Links from the National Forestry Database site to other sites are presented as a convenience to users. The National Forestry Database Program is not responsible for the information found at these sites.

Users should also note that the National Forestry Database Program does not assume any responsibility for the quality of external products or services listed or described in such sites.

Also, please consult the 'Introduction and Background' web page (*http://nfdp.ccfm.org/cp95/text_e/sect1e.htm*) for a statement of precautions in using the data.

6. METADATA REFERENCE INFORMATION

The date for future review of your entry automatically defaults to six months. Should you want a longer or shorter time period for review of your entry, you can alter the year, month and day. The individual identified as the metadata contact will automatically be sent an email on the review date reminding him/her to confirm the metadata details.

7. SPATIAL REFERENCE INFORMATION

All of the metadata fields in this section are optional. Some or all may apply depending on the data product you are registering. If any fields are relevant and do apply to your data product, fill them in, as the additional information will offer greater value to users.

A2.6.4 Previewing, Saving and Publishing Data Product Metadata

After you enter the metadata for your data product, you can **preview** your entry by clicking on the Preview button, located at the top and bottom of the data product entry form. If the preview of the entry is acceptable, select Return to Form and then use the Save button to finalize the registration of your data product. Your entry will automatically be **published** unless the checkmark is removed to the left of the word Publish. Once it is published, your data product is available live on the Discovery Portal and is being promoted.

You may **save** your data product entry without formally publishing the entry on the Discovery Portal. The entry will be saved and will be viewable only to the owner and any assigned editors.

To add a logo or icon, to delete, or to use the current entry as a template for a new data product, you must open the data product entry form after initially saving the entry. Opening the data product again will engage these buttons.

Helpful tips:

- The **Delete** button will take you through a series of steps that will remove the entire data product entry from the GeoConnections Discovery Portal.
- To enter a **logo** or **icon** for a data product, click on the Logo/Icon button and follow the instructions.
- To create a **new data product** entry, where considerable information is identical to an existing entry, use the Save As button to copy the entry and to provide a new data product name. Once you have copied and renamed the new data product, you can make additional changes to your entry.
- Engaging the **Cancel** button will remove only unsaved text that has been entered into the data product entry form.

A2.6.5 Adding/Editing Associations for Data Products

You can add associations to organizations for your data products to let users know where the data product comes from and how it is distributed. Note: The process is the same as for services. There are three types of associations that a data product may have to an organization:

Distributor: An organization from which the data product may be acquired or accessed. A data product may have more than one distributor.

Custodian: The organization that holds the authoritative source of the data

product. A data product may have only one custodian.

Originator: An organization that contributed to the creation of the data product. A data product may have more than one originator.

Any organization that you add as an association must already be registered in the GeoConnections Discovery Portal. You can only add an association to a data product that is already stored in the GeoConnections Discovery Portal's directory. This means that when you create a new data product, you must save it before you can add associations.

To add an association, select the Add/Edit Associations button (available either in the save confirmation page, or in the edit form). An Associations for Entry window will appear that will allow you to select existing GeoConnections Discovery Portal organizations and to assign any of them as a Distributor, Custodian or Originator for the data product. After identifying and entering organizations associated with your data product, click on the Submit button located in the bottom right corner of the web page. This will complete and save your association links.

A2.6.6 Adding/Editing a Search Service

After you save your data product, you can add **connectivity details** by selecting the Add/Edit Search Service button, which is located to the right and just above the first set of Preview and Save buttons, among others.

The following three fields are required only if you intend to make your database "searchable" through the GeoConnections Discovery Portal. Making your database searchable is the process that allows you to connect, through the Internet, one or more of your in-house database(s) and or catalogue(s) for remote searching within the CGDI. This allows users to directly search the contents of your database(s) while you maintain complete control over what information and data users can access. It also allows users to simultaneously search a group of databases that are individually located anywhere in Canada and the world. Complete details on connecting a database can be found in Section III.

Example:

Connectivity details for enhanced (Z39.50/FGDC) search:
Hostname or IP address of enhanced (Z39.50/FGDC) search server:
ceolinc.ccrs.nrcan.gc.ca
Port number of enhanced (Z39.50/FGDC) search server: 6675
Database name for enhanced (Z39.50/FGDC) search server:
LANDSAT_5_TM_CITIES

For more help with the Search Service, contact geodiscover@ccrs.nrcan.gc.ca.

A2.7 How To Register and Promote Your Organization

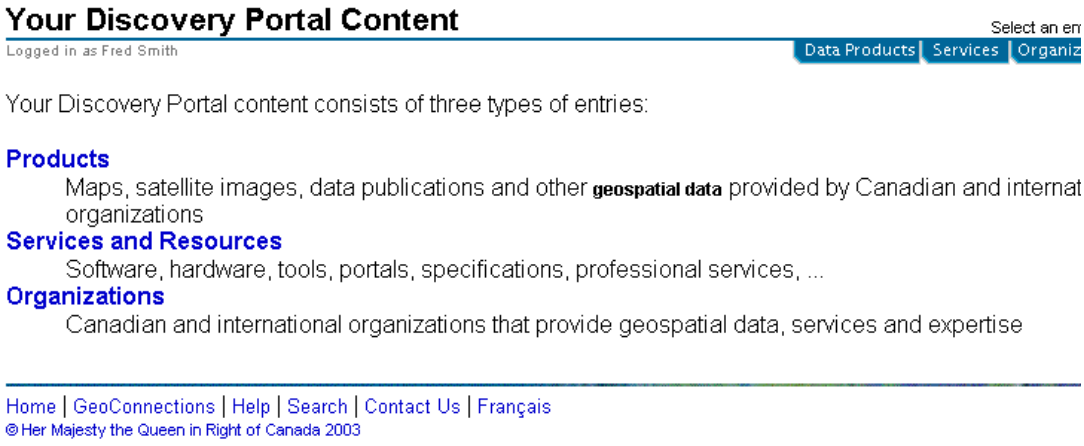
You can register and promote your organization with the GeoConnections Discovery Portal by entering information about your organization and/or its services and data products using online forms. Again, promotion is free.

Once your organization is registered, users can find your organization through the GeoConnections Discovery Portal, as well as the specific data products and services it has to offer.

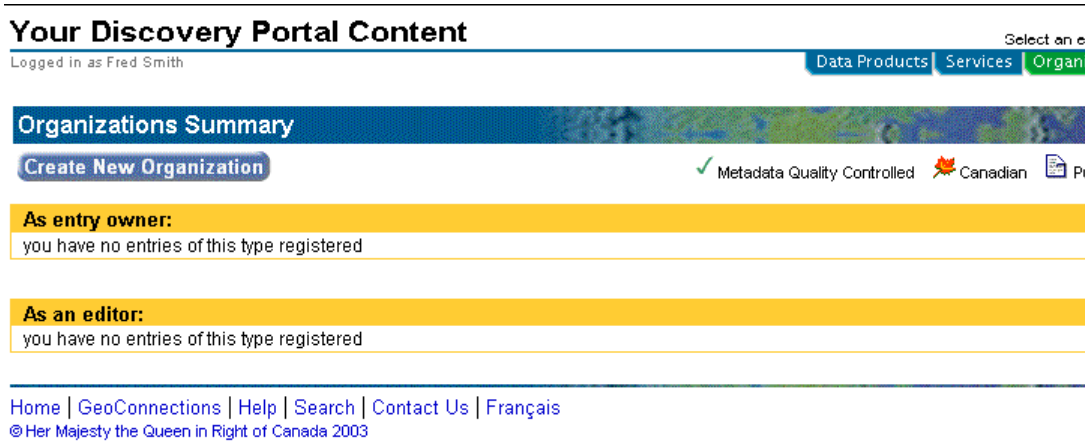
To register your organization, follow these 5 steps:

1. Go to the GeoConnections Discovery Portal web site at http://geodiscover.cgdi.ca
   and select the Add or Update Your Content link in the home page.

2. Log in using an existing username and password if you have one, or select Register to create a new user account. If you are already logged-in, this page will not appear.
3. Select the Organizations link.



4. You will now be provided with a list of all organizations under your ownership. If you have just registered as a new user, you will not have any. If this is the case, select Create New Organization.



5. Enter the required information using the example in A2.7.1, Recommended Metadata Fields for Organizations, as a guide.

If you need help, select Help/FAQ on the GeoConnections Discovery Portal menu bar at the top of the web page; then, in the new page that opens, select Tutorial. The tutorial explains the entire procedure.

A2.7.1 Recommended Metadata Fields for Organizations

When you register your organization, there are several essential metadata fields that you must complete. The following example of an organization entry shows the type of information that you should enter for each field.

Helpful tips:

- ✓ The fields in red (in the manual) are mandatory and must be completed.
- ✓ The remaining fields are valuable and important and it is recommended that they be completed, but they are optional.
- ✓ Under the Mission statement and General Profile, you must use proper sentence structure, grammar, and spelling and, most importantly, provide a good description of your organization. Description lengths will vary.
- ✓ You can also use the Clean Up Text button here to clear ragged edges or tags from text that you have cut and pasted into this field from different sources (i.e. the Web).
- ✓ Areas of involvement/positioning of your organization include:

Thematic areas: Agriculture, atmosphere, cartography, data distribution, directory services, earth sciences/geology, education and training, environment, forestry, government agency, ice and oceans, land use, mapping, software and systems, survey, value added.

Work and product types: Consulting, databases, engineering, satellite imagery, research, software, statistics.

Example:
GENERAL INFORMATION ABOUT YOUR ORGANIZATION

The full formal name of your organization (any length):
Acronym for your organization (any length): CCFM
Parent organization or organization type:
Government of Canada Federal Departments / Organizations > Natural Resources Canada > Canadian Forest Service
Street address (as would be useful to visitors):
Address: 580 Booth Street, 7th floor
City: Ottawa
Province/State: Ontario
Country: Canada
Postal Code/ZIP Code: K1A 0E4
Postal address (as an envelope should be addressed):
Address: Room 7-C3, 580 Booth Street
City: Ottawa
Province/State: Ontario
Country: Canada
Postal Code/ZIP Code: K1A 0E4

DESCRIPTION OF YOUR ORGANIZATION

Mission statement of your organization (any length of free text):

The Canadian Council of Forest Ministers (CCFM) founded the National Forestry Database Program (NFDP) in 1990 to establish a comprehensive national forestry database, to develop a public information program, and to provide forestry information to the federal, provincial and territorial policy processes.

Natural Resources Canada (NRCan), Canadian Forest Service (CFS) developed and maintains the National Forestry Database. The CFS has responsibility for disseminating national forestry statistics and for responding to questions from the public.

General profile of your organization (any length of free text):

The National Forestry Database (NFD) is the central database used to compile Canada's national forestry statistics. The database is structured to permit a description of the level of activity in any period, and to mark change in activity and in the resource itself. Most of the provincial and territorial data appearing in the NFD are provided each year to the database managers by the provincial or territorial resource management organizations. The CFS compiles information for federal lands from data provided by the responsible federal departments. Forest inventory data are compiled every five years.

Positioning of your organization

Thematic Areas (select at least one): Forestry, Government Agency, Data Distribution
Work and Product Types (select at least one): Statistics, Databases

Contacts within your organization

Central Contact Point:
Phone number (possibly the switchboard): +01-613-947-9074
Fax number: +01-506-452-3525
Email address (e.g. postmaster or info): rjacques@nrcan.gc.ca

Commercial contact person (if applicable):

Name:
Phone number:
Fax number:
Email address:

Technical contact person (if applicable):

Name: Brian Haddon
Phone number: +01-613-947-9065
Fax number: +01-613-947-9020
Email address: bhaddon@nrcan.gc.ca

Internet resources provided by your organization:

URL of your organization's home page (e.g. http://geodiscover.cgdi.ca):
http://nfdp.ccfm.org/

URL for FTP access (e.g. ftp://ftp.CCRS.NRCan.gc.ca):

A2.8 Searching or Browsing Databases in the GeoConnections Discovery Portal

Users can find the specific geospatial resources they are looking for by searching or browsing the GeoConnections Discovery Portal for databases (catalogues or inventories), and then in turn searching for a specific data product. There are two main types of searches, the single database search and the distributed database search.

A2.8.1 Single Database Search in the GeoConnections Discovery Portal

Figure 43, Searching a Single Database, illustrates what happens when a single database is searched using the GeoConnections Discovery Portal search function.

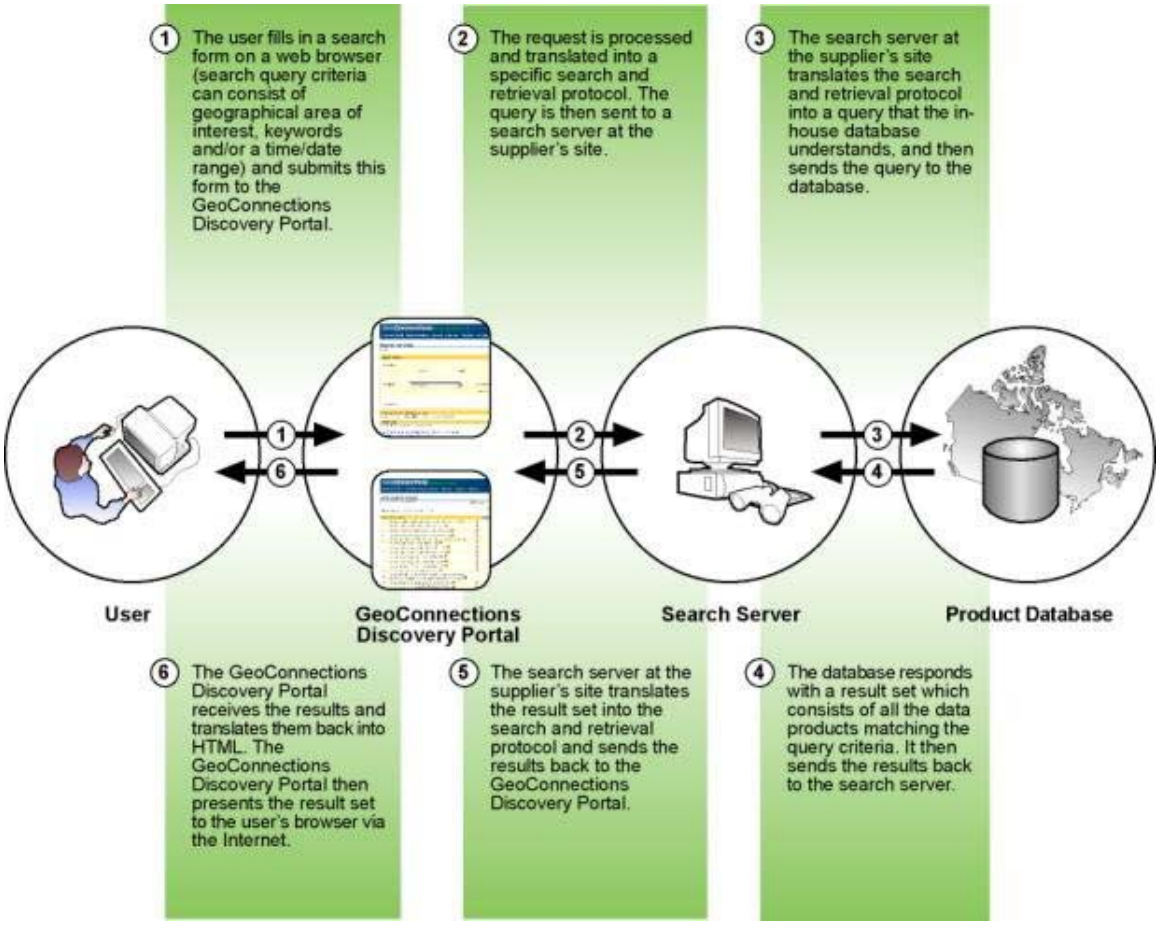


Figure 43 Searching a Single Database

A2.8.2 Distributed Database Search in the GeoConnections Discovery Portal

Users can also search multiple distributed databases (containing catalogues or inventories) in parallel, by sending their search request to many databases at the same time. As each database responds to the request, the discovery mechanism amalgamates, formats and presents the results to them.

Figure 44, Searching Distributed Databases, depicts the process of searching multiple databases in different locations. Distributed searching is relatively transparent to the user, who may not realize that physically separate databases are being queried.

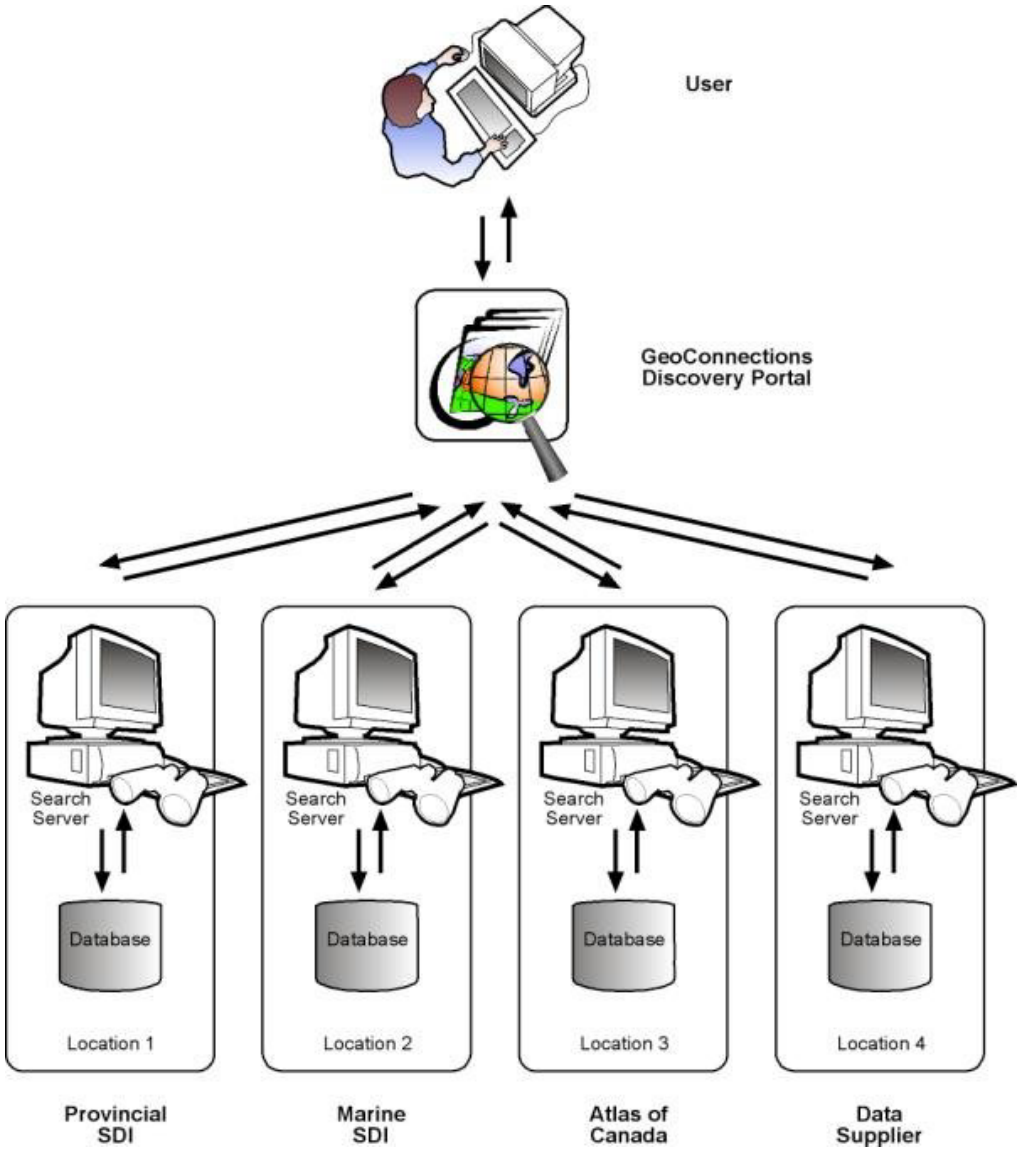


Figure 44 Searching Distributed Databases

Appendix 3

Building Your Application with GeoConnections Discovery Portal APIs

This appendix explains how you can enhance your own applications with application program interfaces (API) from the Canadian Geospatial Data Infrastructure (CGDI). GeoConnections Discovery Portal APIs allow you to offer your users a customized portal into CGDI catalogues and to search any of the remote geospatial databases that are connected to the CGDI. This appendix:

- Describes the architecture of GeoConnections Discovery Portal APIs and how you can use them in your own applications;
- Provides general programming considerations for HTML APIs, and lists their parameter specifications, values and meaning;
- Describes several programming principles for XML APIs and lists their parameter specifications, values and meaning;
- Lists the format specifications for all GeoConnections Discovery Portal APIs; and
- Provides examples of “best practices” of these programming concepts and technologies.

Incorporate geospatial services into your applications

Allow your users to discover and access online geospatial resources

Use HTML and XML APIs

A3.1 Using GeoConnections Discovery Portal APIs

Application program interfaces from the Canadian Geospatial Data Infrastructure allow you to program an interface to the GeoConnections Discovery Portal's services, so that you can incorporate these services into your application. This appendix:

- Describes the design and structure of GeoConnections Discovery Portal APIs; and
- Explains the different ways you can use GeoConnections Discovery Portal APIs to provide value-added services for your users.

A3.1.1 Architecture of GeoConnections Discovery Portal APIs

An **application program interface** (API) is an interface between an operating system and application programs. This interface includes the way the application programs communicate with the operating system, and the services the operating system makes available to the programs. The GeoConnections Discovery Portal offers two kinds of APIs:

1. An **HTML API**: The result of the service call is an HTML web page;
2. An **XML API**: The result of the service call is an XML document.

XML-based services are the backbone of the GeoConnections Discovery Portal. These services have interfaces that drive the Human-Machine Interface (HMI) within user-level services, but they may also be called directly by external applications. If you do not wish to parse the XML into the context of your application, you can direct your users to the HTML interface, and have the GeoConnections Discovery Portal return the results directly to the user in an HTML page.

In both interfaces, the same application services are used: the application that does the processing also generates the results. In other words, the GeoConnections Discovery Portal HTML interface consumes the same XML services that are provided to external applications. The difference between the two interfaces lies in the interface specifications (the user-level services have presentation controls in the interface specification), and in the output format (XML vs. HTML).

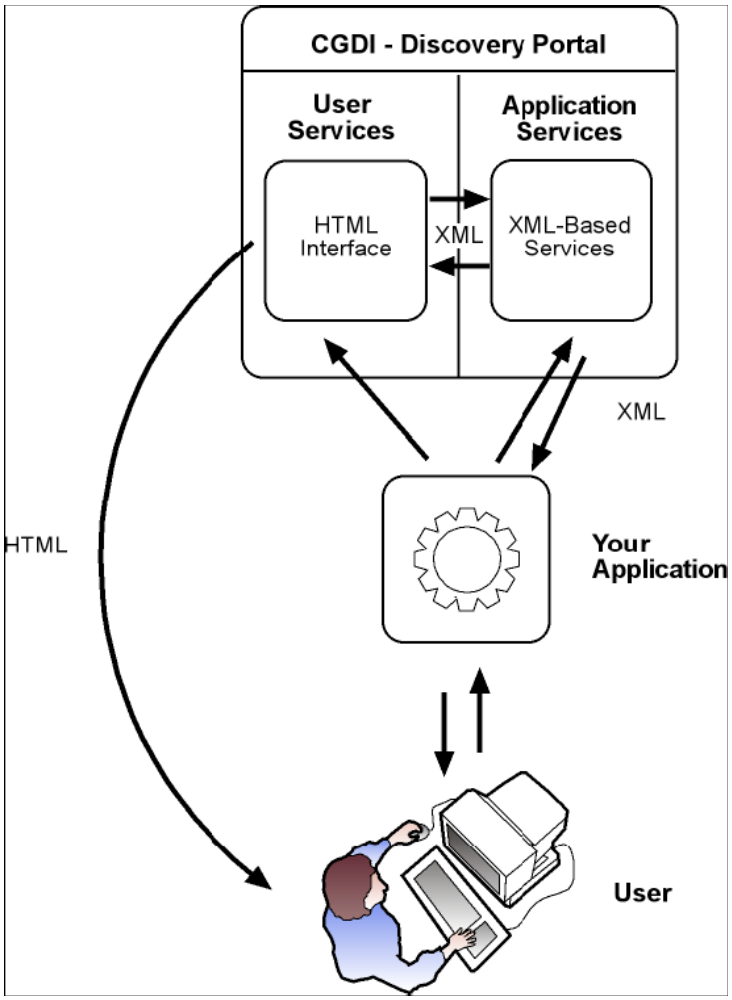


Figure 45 Architecture of the GeoConnections Discovery Portal Interfaces

A3.1.2 How Can You Use GeoConnections Discovery Portal APIs?

When you use a GeoConnections Discovery Portal API in your application, your users can:

- Browse or search through thousands of geographic services, databases and organizations;
- Display descriptions of services, databases and organizations;
- Search distributed Internet-based databases for millions of maps, remote sensing images and other geographical data products; and
- Access other core GeoConnections Discovery Portal services directly. For more details about GeoConnections Discovery Portal services, please see Section IV, Using CGDI Web Resources.

There are two ways that you can use a GeoConnections Discovery Portal API to provide value-added services to your users:

1. You can direct your users from your web pages to invoke web services delivered by the CGDI; and/or

2. You can use the API in your programming environment to configure CGDI interactions into your application.

A3.1.2.1 Directing Your Users to API Services

The easiest way to use a GeoConnections Discovery Portal API is to build a direct hyperlink in your web pages to redirect your users to the CGDI service. To do this, the hyperlink must be an API call.

To build the hyperlink, follow these 4 steps:

1. Use the web API wizard, an online form, to create the configured hyperlink for your web page. Go to http://geodiscover.cgdi.ca/gdp/about/en/6.4.html and click Wizard in the Developer's Guide box.
2. The wizard then returns a URL, which includes a CGI call to the GeoConnections Discovery Portal API.
3. Include the URL as a reference in your web page.
4. When your users link via the URL, it will connect to the GeoConnections Discovery Portal API, and the result will be provided in their browser.

Figure 46, using the API with a Direct Hyperlink, shows how this method works.

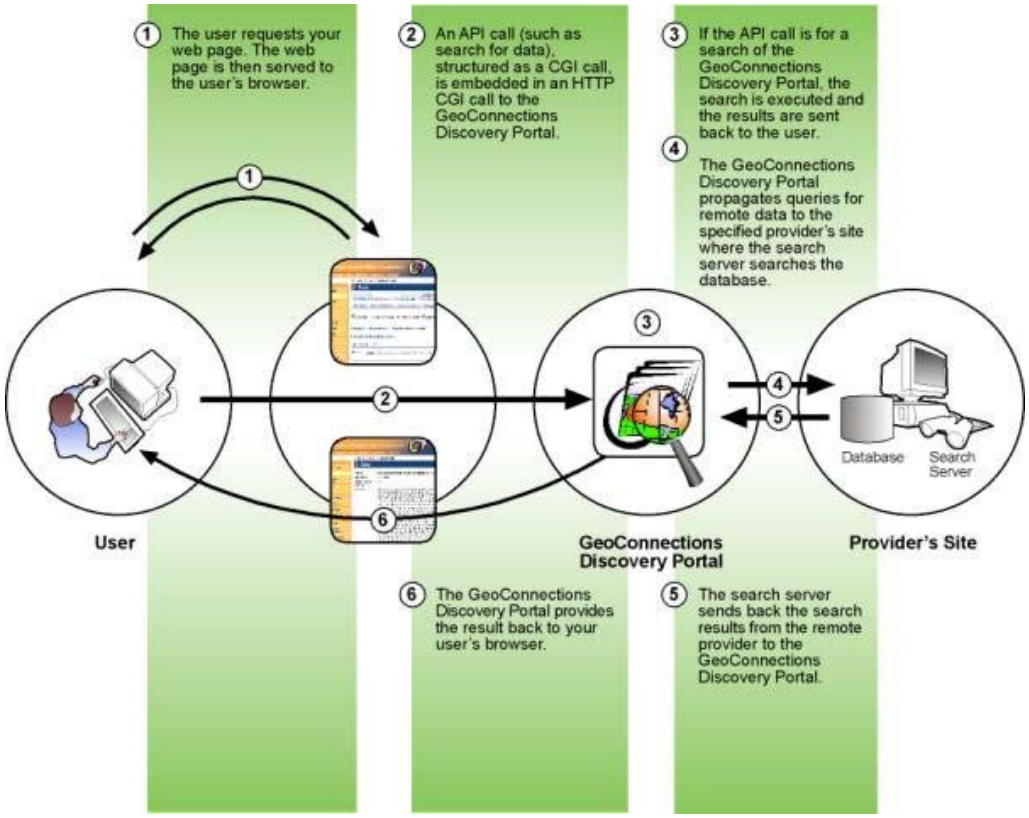


Figure 46 Using the API with a Direct Hyperlink

A3.1.2.2 Using the API With Your Look-and-Feel (Application Services with XML Output)

The second method of using the API is to direct requests through your own CGI (Common Gateway Interface) through an embedded link. In this case, the results are returned in XML and can be interpreted and presented in your own application.

Figure 47, Using the API with Your CGI, shows how this method works.

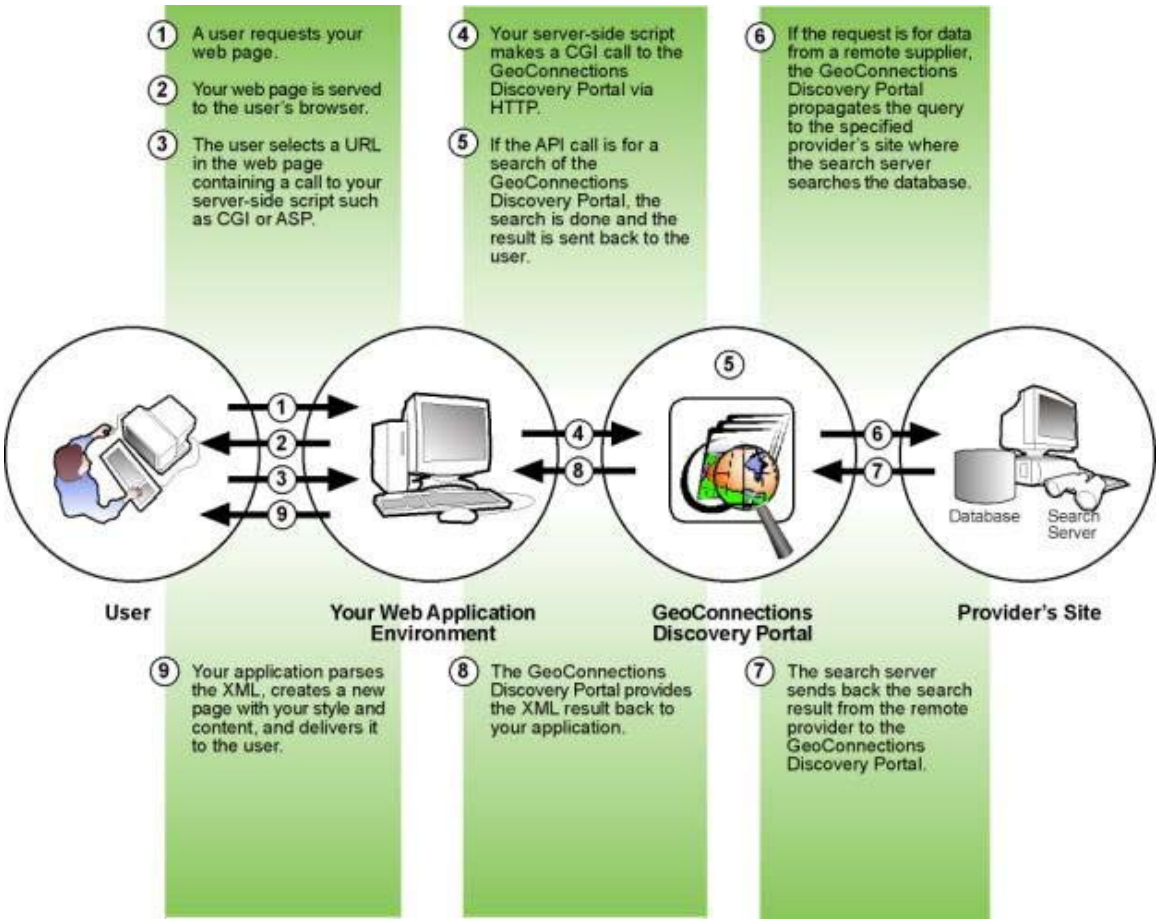


Figure 47 Using the API with Your CGI

A3.2 Programming and Using HTML APIs

If you decide to use the GeoConnections Discovery Portal HTML API in your application, there are several programming considerations to keep in mind. This appendix describes:

- General programming principles and methods of the HTML API;
- The overall structure and meaning of the parameters and values;
- The conditions for including parameters; and
- The specifications of the HTML API.

A3.2.1 HTTP Methods Supported by the API

Parameters can be passed to the API using HTTP GET or POST methods. There is no change required in parameters or values. The two methods of submission are automatically recognized and handled by the API.

A3.2.2 Format and URL Address of an API GET Call in the HTML Interface

A CGI generates output for an API request. The general form (template) of the API GET request (hyperlink) to the CGI call is defined below:

http://geodiscover.cgdi.ca/gdp/[Mode]?Parameter=Value&Parameter=Value&Parameter=Value

In the above URLs, "Mode", "Parameter" and "Value" are placeholders that you must replace with suitable text. The values of these variables dictate the action that will be performed by the system and hence the resultant display. The question mark (?), equal sign (=), and ampersand (&) are literal characters which you must include in the URL as indicated.

This manual defines the "Modes" for every interface in the HTML interface.

Note that some browsers have limitations on the number of characters that can be passed using the GET method. Before you embed a GET method URL in an HTML page, invoke the URL from a number of browsers, to ensure that no browser has difficulty with the length of the URL.

A3.2.3 Permissible Characters in an HTTP "GET" API URL

Within any URL whose parameters are passed using the HTTP GET method, certain characters are determined to be unsafe or reserved, and thus need to be encoded by escape sequences. These escape sequences take the format %**<ASCII-character-hexadecimalvalue>**.

Unsafe characters **are those that may be interpreted by a browser or web server differently than intended.** Reserved characters **are characters that have special meaning within URLs, and must be coded so that they are not interpreted as their special meanings.**

Table 10, Permissible Characters in an HTTP "GET" API URL, lists these characters and their escape sequences. Note that alphabetic letters in the code are not case sensitive.

Char	Code	Char	Code
SPACE	%20	@	%40
#	%23	[	%5B
%	%25	\	%5C
&	%26	]	%5D
/	%2F	^	%5E
:	%3A	`	%60

;	%3B	}	%7B
<	%3C	|	%7C
=	%3D	}	%7D
>	%3E	~	%7E
?	%3F		

Table 10 Permissible Characters in an HTTP "GET" API URL

Therefore, to specify the subject page named:

subject/geology/earthquakes

You must add the appropriate character code; in this case / = %2f:

subject%2fgeology%2fearthquakes

Note that a hyphen is one of the few non-alphabetic characters that can be used without requiring hexadecimal encoding.

You can ignore the encoding if you are willing to implement a JavaScript function, called escape(), that can do the encoding for you.

HTTP POST requests do not need this hexadecimal encoding.

A3.2.4 Format of an API POST Call in the HTML Interface

Similar to GET calls, **parameter** and **value** are placeholders that you must replace with suitable text. The values of these variables dictate the action that is performed by the system as well as the resultant display.

In the HTML interface, the general format (template) of the GeoConnections Discovery Portal API POST call is defined as follows:

```
<FORM ACTION="http://geodiscover.cgdi.ca/gdp/Mode" METHOD="POST">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
...
<INPUT TYPE="submit" Value="">
```

Example of an API POST call in the HTML Interface:

```
<FORM ACTION="http://geodiscover.cgdi.ca/gdp/search" METHOD="POST">
<INPUT TYPE="hidden" NAME="Action" Value=" searchForm ">
<INPUT TYPE="hidden" NAME="entryType" Value="productCollection">
<INPUT TYPE="hidden" NAME="displayHeader" Value="false">
<INPUT TYPE="hidden" NAME="language" Value="fr">
```

This manual defines the "Modes" for every interface in the HTML interface.

A3.2.5 Specifying Parameters

Parameters fall into three categories:

1. **Required**: The parameter must always be specified in the URL.

2. **Conditional**: The parameter may or may not be required, depending on what value you specify for the parameter named 'request'.

3. **Optional**: The parameter may be omitted from the URL. Some optional parameters have default values that apply if a parameter is not specified. This is defined in detail in the following pages.

It is not necessary to specify one of every type of parameter.

The GeoConnections Discovery Portal API is designed so that there is no need to enter parameters more than once in an API request. If a parameter is entered more than once, only the last specification of the parameter will be used.

If you specify a combination of parameters or values that are illegal, incomplete, inconsistent, etc., either an HTML error page is returned for HTML interfaces, or an XML encoded error is returned for XML interfaces.

A3.2.6 HTML API Specifications

This subsection provides the specifications of all the parameters in the HTML API. To learn which parameters to use within individual service requests, please see A3.2.7, HTML API Parameter Definitions.

The following tables list the different parameters, as well as the possible values for each parameter, that you can specify. In most cases, a **value** is a literal string that must be specified exactly as shown. However, any value in the table which is enclosed in angle brackets (<...>) is variable, i.e. it is up to you to replace it with text appropriate for what you are trying to accomplish. The definitions of each of the actions that these parameters invoke are provided in the following sections. The order of the parameters in the URL is not significant.

Always remember to insert an ampersand (&) between each **parameter** and **value** pair that you specify in an HTTP GET request. Note that if they are not specified, some of the parameter values have <default> values. If the base URL is specified with no parameters at all, then extensive online help information is returned to the user's requested browser.

The **action parameter** is the essential key to all functionality, since it dictates the action that is to be performed, as well as the other parameters that should be present on the URL and their meaning.

A3.2.6.1 Parameters Common to All Modes

Every HTML API request accepts the parameters shown in Table 11, Parameters Common to All Modes. These parameters are persistent. Once the parameters are set to true or false, they remains set until they are switched.

Parameter	Obligation	Value
displayHeader	Optional	true or falseDefault: true
language	Optional	en or fr Default: en

Table 11 Parameters Common to All Modes

A3.2.6.2 Display the Home Page

This mode displays the home page.

The mode for this request is index.jsp (as required by the HTML interface format described in A3.2.2, Format and URL Address of an API GET Call in the HTML Interface).

This section describes the parameter specifications only. The service description and parameter definitions are provided in A3.2.7.1, Display a Description of a Particular Service, Database or Organization.

No parameters are required for this mode. This mode simply displays the GeoConnections Discovery Portal home page without the GeoConnections Discovery Portal banner at the top.

For example:
http://geodiscover.cgdi.ca/gdp/index.jsp?displayHeader=false&language=en

A3.2.6.3 Display Search Forms, List Entries, Get Entry Summaries

This mode displays search forms, lists entries and gets entry summaries.

The mode for this request is search (as required by the HTML interface format described in A3.2.2, Format and URL Address of an API GET Call in the HTML Interface).

Table 12, Parameters and Values to Display Search Forms, List Entries, Get Entry Summaries, provides the parameter specifications only. The service descriptions and parameter definitions are provided in:

- A3.2.7.1, Display a Description of a Particular Service, Database or Organization;
- A3.2.7.2, Perform a Directory Search or Display a Search Form for Data Products;
- A3.2.7.3, Display a Search Form for Services;
- A3.2.7.4, Execute a Search for Services;
- A3.2.7.5, Display a Search Form for Organizations;
- A3.2.7.6, Execute a Search for Organizations;
- A3.2.7.7, Display the Entries a User Owns or Can Edit; and
- A3.2.7.8, Display the Registration Interface (to Update a Service, Database or Organization Registration)

Parameter	Obligation	Value
action	Required	**searchForm** or **listEntries** or **entrySummary**
entryType	Required	**productCollection** or **organization** or **service**
selectionCriterion	Conditional	<any letter **a-z** > **all** **other** **nonAlpha** **hasSearchService** **isFree** **IsFreeCanadian**
numResultsPerPage	Conditional	<an integer> Default: 50
page	Conditional	<an integer> Default: 1
entryId	Conditional	<an integer>
formType	Conditional	**basic or advanced** Default: advanced

Table 12 Parameters and Values to Display Search Forms, List Entries, Get Entry Summaries

For example:

http://geodiscover.cgdi.ca/gdp/search?action=searchForm&
entryType=productCollection& displayHeader=false& language=en

http://geodiscover.cgdi.ca/gdp/search?action=listEntries& entryType=service& selectionCriterion=c& numResultsPerPage=20& page=3& displayHeader=true& language=en

A3.2.6.4 Search for Databases

This mode allows you to search for databases. Note that a **product collection** is another term for a **database**.

The mode for this request is search (as required by the HTML interface format described in A3.2.2, Format and URL Address of an API GET Call in the HTML Interface.

Table 13, Parameters and Values to Search for Databases, provides the parameter specifications and definitions. The service descriptions are provided in A3.2.7.4, Execute a Search for Services.

Parameter	Obligation	Value	Meaning
action	Required	**executeSearch**	
entryType	Required	**productCollection**	
request	Required	**searchForData**	
levelOfDetail	Required	**Brief** or **summary**	Defines how much detail describing each result is returned.
sortBy	Conditional	**placeName** or **metadata** or **coordinates** Default: placeName	
keywords	Optional	<free text> See A3.4.2, Specifying Free Text for a Database Search. Default: A default value **must** be provided, even if no keyword is specified.	Free-text search expression.
numResults PerPage	Optional	<an integer> Default: 50	Number of results to return from a single request.
page	Optional	<an integer> Default: 1	Page number of the results to return.
sortBy	Optional	**metadata** or **placeName** or **coordinates** Default: Depends on the input criteria.	
sortOrder	Optional	See web API form for a valids list. Default: alphabetic	Determines the order of sorting the results.

		http://geodiscover.cgdi.ca/ceonetWeb/doc? dispatchServlet=/biz&servletName=bizServlet&service=searchForData	
includeCoordinates	Optional	<**true** or **false**> Default: false	Includes, or not, bounding coordinates as search constraints.
allowOverlap	Optional	<**true** or **false**> Default: false	If bounding coordinates are included as search constraints, this parameter specifies whether regions that overlap the bounding box are allowed in the search results.
allowGlobal	Optional	<**true** or **false**> Default: false	If bounding coordinates are included as search constraints, and if overlapping regions are allowed in the search results, this parameter specifies whether regions that have global coverage are allowed in the search results.
northCoord	Optional	<a real number from **-90** to **90**> Default: 90	Defines the northernmost coordinate to search.
northbc	Optional	<a real number from **-90** to **90**> Default: 90	
Parameter	**Obligation**	**Value**	**Meaning**
southCoord	Optional	<a real number from **-90** to **90**> Default: -90	Defines the southernmost coordinate to search.
southbc	Optional	<a real number from **-90** to **90**> Default: -90	
eastCoord	Optional	<a real number from **-180** to **180**> Default: 180	Defines the easternmost coordinate to search.
eastbc	Optional	<a real number from **-180** to **180**> Default: 180	
westCoord	Optional	<a real number from **-180** to **180**> Default: -180	Defines the westernmost coordinate to search.
westbc	Optional	<a real number from **-180** to **180**> Default: -180	
chkIncludePlaceName	Optional	<**true** or **false**> Default: false	
chkIncludeCoords	Optional	<**true** or **false**> Default: false	
chkIncludeO	Optional	<**true** or **false**>	

verlaps		Default: false	
chkAllowGlobal	Optional	<**true** or **false**> Default: false	
fromMonth	Optional	<**1** to **12**>	Specifies the month in the "from" date range.
fromDay	Optional	<**1** to **31**>	Specifies the day in the "from" date range.
fromYear	Optional	<a 4 digit integer>	Specifies the year in the "from" date range.
toMonth	Optional	<**1** to **12**>	Specifies the month in the "to" date range.
toDay	Optional	<**1** to **31**>	Specifies the day in the "to" date range.
toYear	Optional	<a 4 digit integer>	Specifies the year in the "to" date range.
subjectBoolExpr	Optional	See A3.4.3, Specifying Boolean Search Expressions.	FGDC attribute search constraint-arbitrarily complex Boolean expression.
subject	Optional	See web API form for valids list. http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForData	Constrains the subject of the results from a predefined list.
productTypeBoolExpr	Optional	See A3.4.3, Specifying Boolean Search Expressions.	FGDC attribute search constraint-arbitrarily complex Boolean expressions.
productType	Optional	See web API form for valids list. http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForData	Constrains the subject of the results from a predefined list.
Parameter	**Obligation**	**Value**	**Meaning**
locationBoolExpr	Optional	See A3.4.3, Specifying Boolean Search Expressions.	FGDC attribute search constraint-arbitrarily complex Boolean expressions.
location	Optional	See web API form for valids list. http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForData	Constrains the subject of the results from a predefined list.
locationName	Optional	**/world** **/africa** **/asia** **/australia** **/europe** **/northAmerica**	

		/northAmerica/canada **/northAmerica/canada/alberta** **/northAmerica/canada/britishColumbia** **/northAmerica/canada/manitoba** **/northAmerica/canada/NewfoundlandAndLabrador** **/northAmerica/canada/northwestTerritories** **/northAmerica/canada/novaScotia** **/northAmerica/canada/nunavut** **/northAmerica/canada/ontario** **/northAmerica/canada/princeEdwardIsland** **/northAmerica/canada/quebec** **/northAmerica/canada/saskatchewan** **/northAmerica/canada/YukonTerritory** **/northAmerica/unitedStatesOfAmerica** **/southAmerica**	
Parameter	**Obligation**	**Value**	**Meaning**
productType	Optional	**productType/allProductTypes** **productType/airborneProducts** **productType/airborneProducts/airborneImagery** **productType/airborneProducts/airPhotos** **productType/mapsCharts** **productType/mapsCharts/aeronautical** **productType/mapsCharts/digitalElevationModel** **productType/mapsCharts/geopolitical** **productType/mapsCharts/nautical** **productType/mapsCharts/thematic** **productType/mapsCharts/topographic** **productType/satelliteProducts** **productType/satelliteProducts/satelliteImagery** **productType/onsiteMeasurements** **productType/studies** Default: all product types	

Table 13 Parameters and Values to Search for Databases

Note that the "/" character in the values must be escaped as %2f in HTTP GET requests.

For example:

http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&entryType=productCollection&language=en&displayHeader=false&locationName=%2FnorthAmerica%2Fcanada%2Fsaskatchewan& northbc=60&westbc=-110&eastbc=-101.5&southbc=49&chkIncludePlaceName=true&chkIncludeCoords=true&chkAllowOverlap=true&chkAllowGlobal=true&subject=subject%2FlandSurface%2Fagriculture&fromMonth=06&fromDay=30&fromYear=1998&toMonth=06&toDay=30&toYear=2003& productType=productType%2FmapsCharts

A3.2.6.5 Search for Services

This mode allows you to search for services.

The mode for this request is search (as required by the HTML interface format described in A3.2.2, Format and URL Address of an API GET Call in the HTML Interface).

Table 14, Parameters and Values to Search for Services, provides the parameter specifications and definitions. The service descriptions are provided in A3.2.7.6, Execute a Search for Organizations.

Parameter	Obligation	Value	Meaning
action	Required	**executeSearch**	
entryType	Required	**service**	
request	Required	**searchForService**	
levelOfDetail	Required	**brief** or **summary**	Defines how much detail describing each result is returned.
numResultsPerPage	Optional	<an integer> Default: 50	Number of results to return from a single request.
page	Optional	<an integer> Default: 1	Page number of the results to return.
language	Optional	**En** or **fr** Default: en	Preferred language of the metadata

			content of the matching entries.
sortOrder	Optional	See web API form for valids list. Default: alphabetic http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForService	Determines the order of sorting the results.
keywords	Optional	<free text> See A3.4.2, Specifying Free Text for a Database Search.	Free-text expression. Cannot be used in conjunction with serviceType.
serviceType	Optional	**Iso Client Viewer** **Iso CGDI Web Services** **Iso Production Management** **Iso Data Processing** **Iso Packaging and Transfer** **Iso Geographic System Management** **Iso Supporting Software**	One selection from a predefined list of service types. Cannot be used in conjunction with keywords.

Table 14 Parameters and Values to Search for Services

To search for services visit:

http://geodiscover.cgdi.ca/gdp/search?action=searchForm&entryType=service

A3.2.6.6 Search for Organizations

This mode allows you to search for organizations.

The mode for this request is search (as required by the HTML interface format described in A3.2.2, Format and URL Address of an API GET Call in the HTML Interface).

Table 15, Parameters and Values to Search for Organizations, provides the parameter specifications and definitions. The service descriptions are provided in A3.2.7.8, Display the Registration Interface (to Update a Service, Database or Organization Registration).

Parameter	Obligation	Value	Meaning

action	Required	**executeSearch**	
entryType	Required	**organization**	
request	Required	**searchForOrganization**	
level of detail	Required	**brief** or **summary**	Defines how much detail describing each result is returned.
numResultsPerPage	Optional	<an integer> Default: 50	Number of results to return from a single request.
page	Optional	<an integer> Default: 1	Page number of the results to return.
language	Optional	**en** or **fr** Default: en	Preferred language of the metadata content of the matching entries.
sortOrder	Optional	See web API form for a valids list. Default: alphabetic http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForOrganizations	Determines the order of sorting the results.
keywords	Optional	<free text> See A3.4.2, Specifying Free Text for a Database Search.	Free-text search expression. Cannot be used in conjunction with location or cdnOrgType.
location	Optional	**canada** **Alberta** **manitoba** **britishColumbia** **northwestTerritories** **yukonTerritory** **ontario** **quebec** **saskatchewan** **newBrunswick** **newfoundlandAndLabrador** **novaScotia** **nunavut**	This parameter defines the location of the organization. It is a selection from a predefined list of locations. Cannot be used in conjunction with keywords or cdnOrgType.

		princeEdwardIsland	
cdnOrgType	Optional	**academic** **associationOrConsortium** **commercial** **municipal** **federalOrganizations** **agrifood** **heritage** **internationalTrade** **environment** **fisheries** **health** **indianAffairs** **industryCanada** **stateMinister** **nationalDefence** **publicWorks** **transportCanada** **naturalResources** **privyCouncil** **provincialOrganizations**	This parameter defines the organization type (e.g. a government of a particular geographic area, a commercial organization, etc.) It is a selection from a predefined list of locations. Cannot be used in conjunction with keywords or location.
cdnOrgType	Optional	**alberta** **manitoba** **britishColumbia** **northwestTerritories** **yukonTerritory** **ontario** **quebec**	This parameter defines the organization type (e.g. a government of a particular geographic area, a commercial organization, etc.) It is a selection from a predefined list of locations. Cannot be used in conjunction with keywords or location.

		saskatchewan **newBrunswick** **newfoundlandAndLabrador** **novaScotia** **nunavutprinceEdwardIsland**	

Table 15 Parameters and Values to Search for Organizations

For example:

http://geodiscover.cgdi.ca/gdp/search? action=executeSearch& entryType=organization& language=en& location=novaScotia& language=en& displayHeader=true& numResultsPerPage=30

A3.2.7 HTML API Parameter Definitions

This section describes how to use the parameters for each individual service request. The following service requests are available in the HTML API:

- A3.2.7.1, Display a Description of a Particular Service, Database or Organization;
- A3.2.7.2, Perform a Directory Search or Display a Search Form for Data Products;
- A3.2.7.3, Display a Search Form for Services;
- A3.2.7.4, Execute a Search for Services;
- A3.2.7.5, Display a Search Form for Organizations;
- A3.2.7.6, Execute a Search for Organizations;
- A3.2.7.7, Display the Entries a User Owns or Can Edit;
- A3.2.7.8, Display the Registration Interface (to Update a Service, Database or Organization Registration)

A3.2.7.1 Display a Description of a Particular Service, Database or Organization

Table 16, Parameters and Values to Display a Description of a Particular Service, Database or Organization, shows the parameters you must specify to

display a listing of a description of a particular service, database or organization, and the meaning of each value.

The mode for this HTML request is "search" (meaning the URL is http://geodiscover.cgdi.ca/gdp/search).

The following sample URL displays a description of a database. Because no language parameter is specified, the list is displayed by default in English.

http://geodiscover.cgdi.ca/gdp/search?action=fullMetadata& entryType=productCollection& entryId=5136& entryLang=en& displayHeader=true& language=en

Parameter	Value	Meaning
action	**entrySummary**	Displays a promotion page (a description of a service, database or organization).
	fullMetadata	Displays the full FGDC metadata (for a product collection only).
entryType	**organization**	Displays a description of an organization.
	service	Displays a description of a service.
	productCollection	Displays a description of a database (product collection).
entryId	<an integer>	The GeoConnections Discovery Portal ID of the entry to be displayed.
displayHeader	**true** or **false**	Displays (or not) the page banner.
entryLang	**en** or **fr**	Displays the English or French metadata content for the entry. If the entry is available only in one language, then the content in that language only will be displayed
language	**en** or **fr**	Displays the web page in English or French.

Table 16 Parameters and Values to Display a Description of a Particular Service, Database or Organization

A3.2.7.2 Perform a Directory Search or Display a Search Form for Data Products

A directory search enables you to search the central directory for databases and organizations of interest. The web API provides two interfaces to the directory search capability of the system:

1. **Display** a "Search for Product Collections" form ("product collection" = "database") containing specified search constraints. This form enables the end user to modify the default search parameters provided and then to submit the form to actually execute the search.
2. **Execute** a "Search for Product Collections" ("product collection" = "database") using specified search constraints, and display the results of that search. This interface does not provide a means for the end user to

modify the search parameters; only the results of the defined search are displayed.

Table 17, Parameters and Values to Perform a Directory Search or Display a Search Form for Data Products, shows the parameters you must specify to do a directory search for a database (product collection), and the meaning of each value.

The mode for this HTML request is "search" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/search).

Parameter	Value	Meaning
action	**searchForm** **execSearch**	Displays the search form populated with the specified search parameters. Displays search results (i.e. executes the search with the search parameters specified).
entryType	**ProductCollection**	Searches the central directory of databases (product collections).
sortBy	**metadata** **placename** **coordinates**	Applies to execSearch action only; defines the order of relevance on the search results, based on best match of the metadata record to the search criteria within the specified sortBy attribute.
numResultsPerPage	<an integer>	Applies to execSearch action only; defines how many results to display on each page.
page	<an integer>	Applies to execSearch action only; defines the page number to display.
northbc	<a real number from **-90** to **90**&	Defines the northernmost coordinate to search.
southbc	<a real number from **-90** to **90**>	Defines the southernmost coordinate to search.
eastbc	<a real number from **-180** to **180**>	Defines the easternmost coordinate to search.
westbc	<a real number from **-180** to **180**>	Defines the westernmost coordinate to search.
chkIncludePlaceName	<**on** or **off**>	Defines if the place name is to be included as a search constraint.
chkIncludeCoords	<**on** or **off**>	Defines whether the bounding coordinates are to be included as search constraints.
chkIncludeOverlaps	<**on** or **off**>	If bounding coordinates are included as search constraints, this parameter specifies whether regions that overlap the bounding box are allowed in the search results.
chkAllowGlobal	<**on** or **off**>	If bounding coordinates are included as search constraints, and if overlapping

		regions are allowed in the search results, this parameter specifies whether regions that have global coverage are allowed in the search results.
fromMonth	<**1** to **12**>	Specifies the month in the "from" date range.
fromDay	<**1** to **31**>	Specifies the day in the "from" date range.
fromYear	<a 4 digit integer>	Specifies the year in the "from" date range.
toMonth	<**1** to **12**>	Specifies the month in the "to" date range.
toDay	<**1** to **31**>	Specifies the day in the "to" date range.
toYear	<a 4 digit integer>	Specifies the year in the "to" date range.
keywords	<free text> See A3.4.2, Specifying Free Text for a Database Search.	Free-text search expression.
subject	See A3.2.6.4, Search for Databases, for subject values.	Constrains the subject of the results.
productType	See A3.2.6.4, Search for Databases, for productType values.	Constrains the product type of the results.
language	**en** or **fr**	Displays the web page in English or French.
displayHeader	**true** or **false**	Displays (or not) the page banner.
location	See A3.2.6.6, Search for Organizations, for location values.	Constrains the location (place name) of the results.
formType	**basic** or **advanced**	Indicates whether to display the basic or advanced search form, or whether a refine search resolves to displaying the basic or advanced search form.
sortBy	**placeName** **metadata** **coordinates**	Applies to advanced search only. Specifies whether to order results by best score from the place name search, the metadata search (subject, keywords, product type) or by the best fit to the specified bounding box coordinates.

Table 17 Parameters and Values to Perform a Directory Search or Display a Search Form for Data Products

A3.2.7.3 Display a Search Form for Services

A directory search enables you to search the central directory for services of interest. The web API provides an interface to display the Services Search form.

Table 18, Parameters and Values to Display a Search Form for Services, shows the parameters you must specify to display the Services Search Form, and the meaning of each value.

The mode for this HTML request is "search" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/search).

The following sample URL displays an English language "Search for Product Collection" form ("product collection" = "database") containing the specified values in the spatial and temporal constraint fields:

http://geodiscover.cgdi.ca/gdp/search?action=searchForm&
entryType=productCollection& language=en& formType=advanced&
location=%28-69+-
64+48+45%29%2FnorthAmerica%2Fcanada%2FnewBrunswick&
locationName=%2FnorthAmerica%2Fcanada%2FnewBrunswick&
northbc=48&westbc=-69&eastbc=-64&southbc=45&
chkIncludePlaceName=true&chkIncludeCoords=true&
chkAllowOverlap=true&chkAllowGlobal=true&
subject=subject%2FatmosphereWeather%2Fwinds&
keywords=&date=All&fromMonth=&fromDay=&
fromYear=&toMonth=&toDay=&toYear=&
CurrentYear=2003&CurrentMonth=10&CurrentDay=14&
productType=productType%2FallProductTypes&sortBy=placename

When you change the action from "searchForm" to "executeSearch", the search is executed and the results are displayed.

The following sample URL displays the services search form in French:

http://geodiscover.cgdi.ca/gdp/search?action=searchForm& entryType=service&
language=en

Parameter	Value	Meaning
action	**searchForm**	Displays the search form populated with the specified search parameters.
entryType	**service**	Displays the search form for services.
language	**en** or **fr**	Displays the web page in English or French.
displayHeader	**true** or **false**	Displays (or not) the page banner.
formType	**basic** or **advanced**	Applies to data product search form only.Indicates whether to display the basic or advanced search form.

Table 18 Parameters and Values to Display a Search Form for Services

A3.2.7.4 Execute a Search for Services

A directory search enables you to search the central directory for services of interest. The web API provides an interface to execute a specified search for services.

Table 19, Parameters and Values to Execute a Search for Services, shows the parameters you must specify to execute a services search, and the meaning of each value.

The mode for this HTML request is "search" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/search).

The following sample URL executes a search for geospatial software products:

http://geodiscover.cgdi.ca/gdp/search?action=executeSearch&entryType=service& serviceType=SoftwareProducts& numResultsPerPage=25&page=3

Parameter	Value	Meaning
action	**execSearch**	Displays the search form populated with the specified search parameters.
entryType	**service**	Displays the search form for services.
keywords	<free text> See A3.4.2, Specifying Free Text for a Database Search.	Free-text search expression. Cannot be used in conjunction with serviceType.
serviceType	See A3.2.6.5, Search for Services, for serviceType values.	One selection from a predefined list of service types. Cannot be used in conjunction with keywords.
numResultsPerPage	<an integer>	Applies to execSearch action only; defines how many results to display on each page.
page	<an integer>	Applies to execSearch action only; defines the page number to display.
language	**en** or **fr**	Displays the web page in English or French.
displayHeader	**true** or **false**	Displays (or not) the page banner.

Table 19 Parameters and Values to Execute a Search for Services

A3.2.7.5 Display a Search Form for Organizations

A directory search enables you to search the central directory for organizations of interest. The web API provides an interface to display the Organizations Search form.

Table 22, Parameters and Values to Display a Search Form for Organizations, shows the parameters you must specify to display the Organizations Search Form, and the meaning of each value.

The mode for this HTML request is "search" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/search).

The following sample URL displays the organization search form in French:

http://geodiscover.cgdi.ca/gdp/search? action=searchForm& entryType=organization& language=en

Parameter	Value	Meaning
action	**searchForm**	Displays the search form populated with the specified search parameters.
entryType	**organization**	Displays the search form for organizations.
language	**en** or **fr**	Displays the web page in English or French.
displayHeader	**true** or **false**	Displays (or not) the page banner.

Table 20 Parameters and Values to Display a Search Form for Organizations

A3.2.7.6 Execute a Search for Organizations

A directory search enables you to search the central directory for organizations of interest. The web API provides an interface to execute a specified search for organizations.

Table 21, Parameters and Values to Execute a Search for Organizations, shows the parameters you must specify to execute an organization search, and the meaning of each value.

The mode for this HTML request is "search" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/search).

The following sample URL executes a search for geospatial-related organizations within the New Brunswick provincial government:

http://geodiscover.cgdi.ca/gdp/search?action=executeSearch& entryType=organization& language=en& orgType=newBrunswick

The following sample URL executes a search for all types of geospatial-related organizations within New Brunswick:

http://geodiscover.cgdi.ca/gdp/search?action=executeSearch& entryType=organization& language=en& location=newBrunswick

Parameter	Value	Meaning
action	**execSearch**	Displays the search form populated with the specified search parameters.
entryType	**organization**	Displays the search form for organizations.
keywords	<free text>See A3.4.2, Specifying Free Text for a Database Search.	Free-text search expression. Cannot be used in conjunction with location or cdnOrgType.
location	See A3.2.6.6, Search for Organizations, for location values.	This parameter defines the location of the organization.It is a selection from a predefined list of locations. Cannot be used in conjunction with keywords or cdnOrgType.
cdnOrgType	See A3.2.6.6, Search for Organizations, for cdnOrgType values.	This parameter defines the organization type (i.e. a government of a particular geographic area, a commercial organization, etc.)It is a selection from a predefined list of locations. Cannot be used in conjunction with keywords or location.
numResultsPerPage	<an integer>	Applies to execSearch action only; defines how many results to display on each page.
page	<an integer>	Applies to execSearch action only; defines the page number to display.
language	**en** or **fr**	Displays the web page in English or French.
displayHeader	**true** or **false**	Displays (or not) the page banner.

Table 21 Parameters and Values to Execute a Search for Organizations

A3.2.7.7 Display the Entries a User Owns or Can Edit

Table 22, Parameters and Values to Display the Entries a User Owns or Can Edit, shows the parameters you must specify to display the user's summary of entries in the GeoConnections Discovery Portal.

The mode for this HTML request is "advertising" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/advertising).

The following sample URL displays a user's content summary once the user has been authenticated:

http://geodiscover.cgdi.ca/gdp/advertising?entryType=service

Parameter	Value	Meaning
entryType	**organization**	Displays an organization's promotion page for update.
	service	Displays a service's promotion page for update.
	productCollection	Displays a database's (product collection) promotion page for update.

displayHeader	**true** or **false**	Displays (or not) the page banner.
language	**en** or **fr**	Displays the web page in English or French.

Table 22 Parameters and Values to Display the Entries a User Owns or Can Edit

If the user is not already authenticated, the GeoConnections Discovery Portal authentication system intercepts this request before the summary page is displayed, and requests the user to authenticate.

After the user authenticates, he or she will receive a summary of his or her GeoConnections Discovery Portal entries.

A3.2.7.8 Display the Registration Interface (to Update a Service, Database or Organization Registration)

Table 23, Parameters and Values to Display the Registration Interface (to Update a Service, Database or Organization Registration), shows the parameters you must specify to display the promotion interface and the meaning of each value.

The mode for this HTML request is "advertising" (i.e. the URL is http://geodiscover.cgdi.ca/gdp/advertising).

The following sample URL displays a promotion update page:

http://geodiscover.cgdi.ca/gdp/advertising?action=edit& entryType=productCollection& entryLang=en& entryId=5136& language=en& displayHeader=false

You can use this interface to enable the user to invoke a delete operation.

Parameter	Value	Meaning
action	**edit**	Displays the advertising interface to update a service, database or organization promotion page.
entryType	**organization**	Displays an organization's promotion page for update.
	service	Displays a service's promotion page for update.
	productCollection	Displays a database's (product collection) promotion page for update.
entryId	<an integer>	The GeoConnections Discovery Portal ID of the entry to be edited.
displayHeader	**true** or **false**	Displays (or not) the page banner.
entryLang	**en** or **fr**	Edits the English or French metadata content for the entry. If the entry is available only in one language, then only the content in that language will be edited
language	**en** or **fr**	Displays the web page in English or French.

Table 23 Parameters and Values to Display the Registration Interface (to Update a Service, Database or Organization Registration)

If the user is not already authenticated, the GeoConnections Discovery Portal authentication system intercepts this request before the edit page is displayed, and requests the user to authenticate.

After the user authenticates, he or she will be able to edit the entry.

However, if the user is not an owner or an editor of the entry that he or she is trying to edit, then he or she will not be able to save changes to the entry. The user can save a copy of the entry (and all changes made to it) as a new entry under his or her ownership.

A3.3 Programming and Using XML APIs

If you use the GeoConnections Discovery Portal XML API in your application, there are several programming considerations to keep in mind. This chapter describes:

- General programming principles and methods of the XML API;
- The overall structure of the parameters, values and their meaning;
- The conditions for including parameters; and
- The specifications of the XML API.

A3.3.1 The Format of an API POST Call in the XML Interface

Refer to A3.2.1-A3.2.5 for general methods.

In the XML interface, the general format of the GeoConnections Discovery Portal API POST call is defined as follows:

```
<FORM ACTION="http://geodiscover.cgdi.ca/ceonetWeb/biz" METHOD="POST">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
<INPUT TYPE="hidden" NAME="Parameter" Value="Value">
...
<INPUT TYPE="submit" Value="">
```

Example of an API POST call in the XML interface:

```
<FORM ACTION="http://geodiscover.cgdi.ca/ceonetWeb/biz" METHOD="POST">
<INPUT TYPE="hidden" NAME="request" Value="searchForData">
<INPUT TYPE="hidden" NAME="levelOfDetail" Value="brief"
<INPUT TYPE="hidden" NAME="includeCoordinates" Value="true">
<INPUT TYPE="hidden" NAME="northCoordinates" Value="70">
```

```
<INPUT TYPE="hidden" NAME="southCoordinates" Value="40">
<INPUT TYPE="hidden" NAME="eastCoordinates" Value="-80">
<INPUT TYPE="hidden" NAME="westCoordinates" Value="-100">
<INPUT TYPE="hidden" NAME="language" Value="en">
```

This manual defines the "Modes" for every interface in the XML interface.

A3.3.2 XML API Input and Output Structure

A web form is available for you to understand the structure of XML API specifications, and to construct and execute examples of XML API calls. You can get the code lists from the web form for the specified service. This manual discusses only how to use the parameters; it does not discuss all the code lists for the parameters.

You can construct all XML API services with the aid of this web form, which can be found at http://geodiscover.cgdi.ca/ceonetWeb/index.jsp; follow the business layer servlet link.

The XML Output Schema

An XML Schema Definition (XSD) file is published at:

http://geodiscover.cgdi.ca/schemas/cgdi/gdp/bizAPI.xsd

This manual does not discuss the format of the XML output.

A3.3.3 XML API Specifications

The following tables list the different parameters that you can specify, as well as the possible values for each parameter. In most cases, a value is a literal string that must be specified exactly as shown in the table. However, any value in the table which is enclosed in angle brackets (<...>) is variable, i.e. it is up to you to replace it with text appropriate for what you are trying to accomplish. The following sections provide the definitions of each of the actions that these parameters invoke. The order of the parameters in the URL is not significant.

Always remember to insert an ampersand (&) between each **parameter** and **value** pair that you specify in an HTTP GET request. Note that some of the parameter values have <default> values if they are not explicitly specified. If the base URL is specified with no parameters at all, then extensive online help information is returned to the user's browser.

A3.3.3.1 Search for Databases

Request name
searchForData

Description
Executes a search for databases (product collections); returns an XML response with all results.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/bizserletName=biz&servlet&services=searchForData

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForData

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForData&language=en& numResultsPerPage=400& page=1& levelOfDetail=brief&sortOrder=& northCoord=60& southCoord=49& eastCoord=-110& westCoord=-120& keywords=& subjectBoolExpr=themekey%3Aforest*& subject=&productTypeBoolExpr=& productType=& locationBoolExpr=&location=%2FnorthAmerica%2Fcanada%2Falberta& includeCoordinates=true&allowOverlap=true& allowGlobal=true& fromDay=& fromMonth=& fromYear=&toDay=& toMonth=& toYear=

Table 13, Parameters and Values to Search for Databases, summarizes the parameters for this service.

A3.3.3.2 Search for Services

Request name
searchForService

Description
Executes a search for services or other resources; returns an XML response with all results.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/biz/dispatchRequest.jsp?service=searchForService

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForService

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForService&language=en& numResultsPerPage=30& page=1& levelOfDetail=brief&sortOrder=& keywords=& serviceType=Portals

Table 14, Parameters and Values to Search for Services, summarizes the parameters for this service.

A3.3.3.3 Search for Organizations

Request name
searchForOrganization

Description
Executes a search for geospatial organizations; returns an XML response with all results.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForOrganization

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForOrganization

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForOrganization& language=en& numResultsPerPage=1000& page=& levelOfDetail=brief& sortOrder=& keywords=& location=& cdnOrgType=commercial

Table 15, Parameters and Values to Search for Organizations, summarizes the parameters for this service.

A3.3.3.4 Search for Web Service Data

Request name
searchForWebServiceData

Description
Executes a search through the CGDI catalogue for web map layers and returns an OGC context document with the layers that matched the request.

The specification for OGC context documents is provided at:
http://test.Open Geospatial.org/docs/03-036r2.pdf.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=searchForWebServiceData

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForWebServiceData

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=searchForWebServiceData&language=en&northCoord=60&southCoord=49&eastCoord=-110&westCoord=-120&width=400&height=400&keywords=forest&subject=&srs=&version=1.0.0&useBaseMap=true&filterCascade=true

Table 24, Parameter Definitions to Search for Web Service Data, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	searchForWeb ServiceData	
northCoord	Required	<a real number from **-90** to **90**>	Defines the northernmost coordinate to search and the extent of the returned map.
southCoord	Required	<a real number from **-90** to **90**>	Defines the southernmost coordinate to search and the extent of the returned map.
eastCoord	Required	<a real number from **-180** to **180**>	Defines the easternmost coordinate to search and the extent of the returned map.
westCoord	Required	<a real number from **-180** to **180**>	Defines the westernmost coordinate to search and the extent of the returned map.
width	Required	<an integer>	Preferred width of the viewer. This is a pass-through coordinate that gets written to the context document; it is required for fetching the resulting map.
height	Required	<an integer>	Preferred height of the viewer. This is a pass-through coordinate that gets written to the

			context document; it is required for fetching the resulting map.
language	Optional	**en** or **fr** Default: en	Preferred language of the metadata content of the matching entries.
keywords	Optional	<free text>	A free-text search string that will be used to match layer descriptions.
subject	Optional	See web API form for valids list. http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz& servletName=bizServlet&service=searchForWebServiceData	A text search string that is used to match layer descriptions.
srs	Optional	An EPSG (European Petroleum Survey Group) code (a database of map projections)	Restricts the search for WMS that support particular SRS (spatial reference system); the resulting context will also use the corresponding SRS.
version	Optional	See web API form for valids list. http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz& servletName=bizServlet&service=searchForWebServiceData	Requested version of the context document.
useBaseMap	Optional	<**true** or **false**> Default: true	Indicates whether to include standard base map layers in the context document.
filterCascade	Optional	<**true** or **false**> Default: true	Attempt to avoid including layers more than once if more than one WMS server describes them.

Table 24 Parameter Definitions to Search for Web Service Data

A3.3.3.5 Search for Remote Data

A search for remote data is not yet published in the business layer. It is, however, available from a separate servlet called the "remote site" servlet. To get to the interfaces for the remote site servlet, simply go to http://geodiscover.cgdi.ca/ceonetWeb/index.jsp and select remote site servlet.

This search will connect you to remote database search servers (usually Z39.50 GEO servers) and will return the products that matched the search criteria.

Request name
execSearch

Description
Executes a search through one or more remote search servers (using varying search protocols) and returns the XML data of the products that matched the search criteria from each server.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=execSearch

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=execSearch

Table 25, Parameter Definitions to Search for Remote Data, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**execSearch**	
northBc	Required	<a real number from **-90** to **90**>	Defines the northernmost coordinate to search and the extent of the returned map.
southBc	Required	<a real number from **-90** to **90**>	Defines the southernmost coordinate to search and the extent of the returned map.
eastBc	Required	<a real number from **-180** to **180**>	Defines the easternmost coordinate to search and the extent of the returned map.
westBc	Required	<a real number from **-180** to **180**>	Defines the westernmost coordinate to search and the extent of the returned map.
searchDuration	Required	An integer	The time (in seconds) to allow the search to continue. The search will terminate after the searchDuration is reached.
resultsReturned	Required	An integer	Specifies the maximum number of results to return from each server. Once a server reaches that number of results, the search will terminate on that server only.
entryLang	Optional	**en** or **fr** Default :en	Some GeoConnections Discovery Portal entries have different search targets for English

			or French searching. This parameter specifies which target to use.
freeText	Optional	text	Free-text search string.
fromDay	Optional	<**1** to 12>	Specifies the month in the "from" date range.
fromMonth	Optional	<**1** to **31**>	Specifies the day in the "from" date range.
fromYear	Optional	<a **4** digit integer>	Specifies the year in the "from" date range.
toDay	Optional	<**1** to **12**>	Specifies the month in the "to" date range.

Table 25 Parameter Definitions to Search for Remote Data

A3.3.3.6 List Entries

Request name
getListOfEntries

Description Lists entries of any type by alphabetical selection, or some other common selection criterion, and returns an XML response with all results.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/biz/dispatchRequest.jsp?service=getListOfEntries

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=getListOfEntries

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=getListOfEntries& language=en& entryType=productCollection& selectionCriterion=hasSearchService& levelOfDetail=brief& sortOrder=& numResultsPerPage=1000& page=

Table 26, Parameter Definitions to List Entries, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getListOfEntries**	
levelOfDetail	Required	**brief** or **summary**	Defines how much detail describing each result is returned.

entryType	Required	**organization**	Lists organizations.
		productCollection	Lists databases (product collections).
		service	Lists services or other resources.
selectionCriterion	Required	<A single character from **a** to **z**>	Displays the list of items that begin with the given character.
		all	Displays the list of all items.
		nonAlpha	Displays all entries that start with a non-alphabetic character.
		isFree	Displays all entries that are designated as being available for free (applies to services and product collections only).
		isFreeCanadian	Displays all Canadian entries that are designated as being available for free (applies to services and product collections only).
		numeric	Displays the list of items that start with a number.
language	Optional	**en** or **fr** Default: en	Preferred language of the metadata content of the matching entries.
numResultsPerPage	Optional	<an integer> Default: 50	Number of results to return from a single request.
page	Optional	<an integer> Default: 1	Page number of the results to return.
sortOrder	Optional	See web API form for a valids list. Default: alphabetic http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=getListOfEntries	Determines the order of sorting the results.

Table 26 Parameter Definitions to List Entries

A3.3.3.7 Get Metadata for an Entry

Request name
getEntry

Description
Displays the metadata for an entry in the GeoConnections Discovery Portal.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/biz&servletName=bizServlet&service=getEntry

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=getEntry

Example
http://geodiscover.cgdi.ca/ceonetWeb/biz?request=getEntry& language=en& entryId=5134& entryType=productCollection& levelOfDetail=full

To use this service, there must be a valid entry ID that has been provided by the GeoConnections Discovery Portal, either by a search, a list of entries, or a service in the advertising interface such as addNewEntry.

Table 27, Parameter Definitions to Get Metadata for an Entry, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getEntry**	
language	Required	**en** or **fr** Default: en	Preferred language of the metadata content of the matching entries.
levelOfDetail	Required	**brief** or **summary** or **full**	Defines how much detail describing each result is returned.In the case of a database (product collection), the "full" level of detail will return the full FGDC record as an embedded XML structure within the GeoConnections Discovery Portal XML response.
entryType	Required	**organization**	Lists organizations.
		productCollection	Lists databases (product collections).
		service	Lists services or other resources.
entryId	Required	<an integer>	A numeric entry ID of an existing entry in the

			GeoConnections Discovery Portal.

Table 27 Parameters Definitions to Get Metadata for an Entry

A3.3.4 Remote Site API

The Remote Site API is part of the XML API, however it operates quite differently. Its purpose is to connect to remote search servers through the Internet and search for individual products. In order to use this API, you must:

- Already have one or more entry IDs of searchable data products in the GeoConnections Discovery Portal ("searchable" data products is indicated by an API search for data result having an element like "hasSearchService" set to Yes or True for the entry, or an HTML API search for data result showing a check-box in the "Search Databases" column for the entry). If a data product is searchable, it must have a search server connected to the Internet, and the search server must use either the Z39.50 protocol, the Simple Search protocol or the NASA/IMS protocol. Any number of data products may be searched simultaneously, regardless of which protocol they use;

- Be aware that the Remote Site interface is stateful. This means that when you do a search, the connection to the API call disconnects before the search is completed. You are provided a token (a "controllerID") that you must use in subsequent requests to get the status of the search and the results. The controller (which provides the controllerID) times out after 10 minutes.

A3.3.4.1 Execute a General Remote Site Search

Request name
execSearch

Description
Searches one or more searchable data products for individual datasets. The data products must be registered in the GeoConnections Discovery Portal. This service connects simultaneously to any combination of one or more Z39.50, Information Management System (IMS), or Simple Search servers.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet&service=execSearch

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=execSearch

Example

http://geodiscover.cgdi.ca/ceonetWeb/rs? request=execSearch& entryLang=en& entryIds=8360& northbc=90& southbc=45& eastbc=-50& westbc=-120& searchDuration=30& resultsReturned=10

This request returns an XML structure that includes a controllerID. That ID used in all subsequent requests to determine the progress of the search and to get the results.

Table 28, Parameter Definitions to Execute a General Remote Site Search, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**execSearch**	
entryLang	Required	**en** or **fr** Default: en	Preferred language of the metadata content of the listed entries. This value is not propagated to the remote search servers; it is used in case a GeoConnections Discovery Portal entry has different search server connectivity details for the English view and the French view of a data product.
entryIds	Required	<a comma-separated list of GeoConnections Discovery Portal entry IDs for data products>	The GeoConnections Discovery Portal will look up the database connectivity details from the entries provided.
northbc	Required	<a real number from **-90** to **90**> Default: 90	Defines the northernmost coordinate to search.
southbc	Required	<a real number from **-90** to **90**> Default: -90	Defines the southernmost coordinate to search.
eastbc	Required	<a real number from **-180** to **180** > Default: 180	Defines the easternmost coordinate to search.
westbc	Required	<an real number from **-180** to **180** > Default: -180	Defines the westernmost coordinate to search.
searchDuration	Required	<an integer> Default: 30	A time value, in seconds, after which the search automatically time-outs.
freeText	Optional	<any text>	If text is provided in this field, only entries that have that exact text phrase anywhere in the metadata are returned.
fromDay	Optional	< **1** to **31** >	Specifies the day in the "from" date range.
fromMonth	Optional	< **1** to **12** >	Specifies the month in the "from" date range.

fromYear	Optional	< a 4 digit integer >	Specifies the year in the "from" date range.
toDay	Optional	< **1** to **31** >	Specifies the day in the "to" date range.
toMonth	Optional	< **1** to **12** >	Specifies the month in the "to" date range.
toYear	Optional	< a 4 digit integer >	Specifies the year in the "to" date range.

Table 28 Parameter Definitions to Execute a General Remote Site Search

A3.3.4.2 Search a Specific Z39.50 Target

Request name
Z3950ExecSearch

Description
Searches through one Z39.50 search server. There does not need to be an associated data product registered in the GeoConnections Discovery Portal.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=z3950ExecSearch

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=z3950ExecSearch

Example
http://geodiscover.cgdi.ca/ceonetWeb/rs? request=z3950ExecSearch& host=ceonet.cgdi.gc.ca& port=5566& dbName=PRODUCTS& connectivityType=Z39.50& northbc=90& southbc=45& eastbc=-50& westbc=-120& searchDuration=30& resultsReturned=10& freeText=& fromDay=& fromMonth=& fromYear=& toDay=& toMonth=& toYear=

This request returns an XML structure that includes a controllerID. That ID must be used in all subsequent requests to determine the progress of the search and to get the results.

Table 29, Parameter Definitions to Search a Specific Z39.50 Target, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**z3950ExecSearch**	
host	Required	<an IP address>	IP address of the Z39.50 server.
port	Required	<a port number>	Port number on the target machine to which the Z39.50 server is listening.
dbName	Required	<a string>	Name of a database on the Z39.50

			server to search.
connectivityType	Required	Z39.50	
northbc	Required	<a real number from **-90** to **90**> Default: 90	Defines the northernmost coordinate to search.
southbc	Required	<a real number from **-90** to **90**> Default: -90	Defines the southernmost coordinate to search.
eastbc	Required	<a real number from **-180** to **180** > Default: 180	Defines the easternmost coordinate to search.
westbc	Required	<an real number from **-180** to **180** > Default: -180	Defines the westernmost coordinate to search.
searchDuration	Required	<an integer> Default: 30	A time value, in seconds, after which the search automatically time-outs.
freeText	Optional	<any text>	If text is provided in this field, only entries that have that exact text phrase anywhere in the metadata are returned.
fromDay	Optional	< **1** to **31** >	Specifies the day in the "from" date range.
fromMonth	Optional	< **1** to **12** >	Specifies the month in the "from" date range.
fromYear	Optional	< a 4 digit integer >	Specifies the year in the "from" date range.
toDay	Optional	< 1 to 31 >	Specifies the day in the "to" date range.
toMonth	Optional	< 1 to 12 >	Specifies the month in the "to" date range.
toYear	Optional	< a 4 digit integer >	Specifies the year in the "to" date range.

Table 29 Parameter Definitions to Search a Specific Z39.50 Target

A3.3.4.3 Search a Specific IMS Target

Request name
imsExecSearch

Description
Searches through one IMS search server. There does not need to be an associated data product registered in the GeoConnections Discovery Portal.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=imsExecSearch

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=imsExecSearch

This request returns an XML structure that includes a controllerID. That ID must be used in all subsequent requests to determine the progress of the search and to get the results.

Table 30, Parameter Definitions to Search a Specific IMS Target, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**imsExecSearch**	
host	Required	<an IP address>	IP address of the IMS server.
port	Required	<a port number>	Port number on the target machine to which the IMS server is listening.
dataSetId	Required	<a string>	Name of a data set on the IMS server to search.
dataCentreId	Required	<a string>	Name of the data centre to propagate the search.
connectivityType	Required	IMS V0	
northbc	Required	<a real number from **-90** to **90**> Default: 90	Defines the northernmost coordinate to search.
southbc	Required	<a real number from **-90** to **90**> Default: -90	Defines the southernmost coordinate to search.
eastbc	Required	<a real number from **-180** to **180** > Default: 180	Defines the easternmost coordinate to search.
westbc	Required	<an real number from **-180** to **180** > Default: -180	Defines the westernmost coordinate to search.
searchDuration	Required	<an integer> Default: 30	A time value, in seconds, after which the search automatically time-outs.
freeText	Optional	<any text>	If text is provided in this field, only entries that have that exact text phrase anywhere in the metadata are returned.
fromDay	Optional	< **1** to **31** >	Specifies the day in the "from" date range.
fromMonth	Optional	< **1** to **12** >	Specifies the month in the "from" date range.
fromYear	Optional	< a 4 digit integer >	Specifies the year in the "from" date range
toDay	Optional	< **1** to **31** >	Specifies the day in the "to" date range.

toMonth	Optional	< **1** to **12** >	Specifies the month in the "to" date range.
toYear	Optional	< a 4 digit integer >	Specifies the year in the "to" date range.

Table 30 Parameter Definitions to Search a Specific IMS Target

A3.3.4.4 Search a Specific Simple Search Target

Request name
simpleExecSearch

Description
Searches through one simple search server. There does not need to be an associated data product registered in the GeoConnections Discovery Portal.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=simpleExecSearch

Base URL of the request:
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=simpleExecSearch

Example
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=simpleExecSearch&url=http%3A%2F%2Fatlas.gc.ca%2Fccatlas%2Fceonet.php&connectivityType=Simple+Search& northbc=70& southbc=50& eastbc=-70& westbc=-90& searchDuration=30& resultsReturned=10& freeText=& fromDay=& fromMonth=& fromYear=& toDay=& toMonth=& toYear=

This request returns an XML structure that includes a controllerID. That ID must be used in all subsequent requests to determine the progress of the search and to get the results.

Table 31, Parameter Definitions to Search a Specific Simple Search Target, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**simpleExecSearch**	
url	Required	<an IP address>	IP address of the simple search CGI.
connectivityType	Required	Simple Search	
northbc	Required	<a real number from **-90** to **90**> Default: 90	Defines the northernmost coordinate to search.
southbc	Required	<a real number from **-90** to **90**> Default: -90	Defines the southernmost coordinate to search.

eastbc	Required	<a real number from **-180** to **180**> Default: 180	Defines the easternmost coordinate to search.
westbc	Required	<an real number from **-180** to **180**> Default: -180	Defines the westernmost coordinate to search.
searchDuration	Required	<an integer> Default: 30	A time value, in seconds, after which the search automatically time-outs.
freeText	Optional	<any text>	If text is provided in this field, only entries that have that exact text phrase anywhere in the metadata are returned.
fromDay	Optional	< **1** to **31** >	Specifies the day in the "from" date range.
fromMonth	Optional	< **1** to **12** >	Specifies the month in the "from" date range.
FromYear	Optional	< a 4 digit integer >	Specifies the year in the "from" date range.
Today	Optional	< **1** to **31** >	Specifies the day in the "to" date range.
ToMonth	Optional	< **1** to **12** >	Specifies the month in the "to" date range.
ToYear	Optional	< a 4 digit integer >	Specifies the year in the "to" date range.

Table 31 Parameter Definitions to Search a Specific Simple Search Target

A3.3.4.5 Poll for the Status of the Search

Request name
getState

Description
Determines whether a previously initiated remote site search is still in progress or whether it has completed or failed. This is meant to be a polling mechanism. The client program repeats its call to getState until it is satisfied that it has a success or failure status on all of the targets. If more than one searchable data product is being searched, then a different status is provided for each target.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=getState

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getState

Example
Note that this is a sample only: this hyperlink will not work because the controller session has expired.

http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getState&controllerId=1067973726835

Table 32, Parameter Definitions to Poll for the Status of the Search, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getState**	
ControllerId	Required	<an ID >	This ID must be obtained from a previous execSearch call

Table 32 Parameter Definitions to Poll for the Status of the Search

A3.3.4.6 Get Search Summaries

Request name
getSummaries

Description
Gets the Brief results from the search. The Brief results for a product include the product ID, product description, bounding coordinates, thumbnail image URL, browse image URL, full image URL (used for product access) and a URL for a product description. This operation connects to the remote search server(s) to get the results.

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=getSummaries

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getSummaries

Example
Note that this is a sample only; this hyperlink will not work because the controller session has expired.
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getSummaries&controllerId=1067973726835&targetIds=1&initialResultId=1&numResults=10

Table 33, Parameter Definitions to Get Search Summaries, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getSummaries**	
controllerId	Required	<an ID >	This ID must be obtained from a previous execSearch call.
targetIds	Required	<list of integers, separated by	Indicates from which of the searchable databases the results are to be obtaind. e.g. If

		commas>	5 targets are being searched, then to get results from the first, third and fifth targets, specify targetIds=1,3,5.
initialResultId	Required	<an integer>	For each of the targets requested, you can request an offset in the first returned result. e.g. initialResultId =5 means that you want results starting with the 5th result from each target.
numResults	Required	<an integer> Default: 1	The number of results to return from each target.

Table 33 Parameter Definitions to Get Search Summaries

A3.3.4.7 Obtain Browse Images from a Specified Target

Request name
getBrowse

Description
If results have browse images, you can request to get one or more browse images of those results from the remote server(s).

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet&service=getBrowse

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getBrowse

Example
Note that this is a sample only; this hyperlink will not work because the controller session has expired.
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getBrowse&controllerId=1068039769621&targetIds=1&resultIds=1

Table 34, Parameter Definitions to Obtain Browse Images from a Specified Target, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getBrowse**	
controllerId	Required	<an ID >	This ID must be obtained from a previous execSearch call.
targetIds	Required	<list of integers, separated by commas>	Indicates from which of the searchable databases the results are to be obtained. e.g. If 5 targets are being searched then to get results from the first, third and fifth targets, specify targetIds=1,3,5.
resultIds	Required	<list of integers,	Indicates the result numbers (1, 2, etc.) from which

		separated by commas>	the browse images are retrieved for each target.

Table 34 Parameter Definitions to Obtain Browse Images from a Specified Target

A3.3.4.8 Obtain Information about a Search Target

Request Name
getInfo

Description
Retrieves connectivity details and search status (within the current session) from one or more search targets. The information is obtained from the remote search server(s).

Web API form:
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet& service=getInfo

Base URL of the Request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getInfo

Example
Note that this is a sample only; this hyperlink will not work because the controller session has expired.
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getInfo&controllerId=1068039769621&targetIds=1

Table 35, Parameter Definitions to Obtain Information about a Search Target, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getInfo**	
targetIds	Required	<list of integers, separated by commas>	Indicates from which of the searchable databases the information is to be obtained. e.g. If 5 targets are being searched then to get information from the first, third and fifth targets, specify targetIds=1,3,5.

Table 35 Parameter Definitions to Obtain Information about a Search Target

A3.3.4.9 Get Metadata Details about a Product

Request name
getDetails

Description
Connects to the remote server(s) to retrieve the full metadata description about one or more products that were returned from the search for the current session.

The content and output format of the metadata details are provided directly by the remote server(s).

Web API form
http://geodiscover.cgdi.ca/ceonetWeb/doc?dispatchServlet=/rs&servletName=remoteSiteServlet&service=getDetails

Base URL of the request
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getDetails

Example
Note that this is a sample only; this hyperlink will not work because the controller session has expired.
http://geodiscover.cgdi.ca/ceonetWeb/rs?request=getDetails&controllerId=1068040532255&targetIds=1&initialResultId=1&numResults=1

Table 36, Parameter Definitions to Get Metadata Details about a Product, summarizes the parameters for this service.

Parameter	Obligation	Value	Meaning
request	Required	**getInfo**	
targetIds	Required	<list of integers, separated by commas>	Indicates from which of the searchable databases the details are to be obtained. e.g. If 5 targets are being searched then to get details from the first, third and fifth targets, specify targetIds=1,3,5.
initialResultId	Required	<an integer>	For each of the targets requested, you may request an offset in the first returned result. e.g. initialResultId =5 means that you want details starting with the 5th result from each target.
numResults	Required	<an integer> Default: 1	The number of results for which to return details from each target.

Table 36 Parameter Definitions to Get Metadata Details about a Product

A3.4 Format Specifications for All Interfaces

This appendix describes the formats you must use when you:

- Specify a spatial region of interest for a search;
- Specify free text for a search; and
- Specify a Boolean search expression.

A3.4.1 Specifying a Spatial Region of Interest for a Search

The API uses a very simple format for spatial extents. You must use latitude and longitude values, in decimal (not degrees/minutes). Longitudes in the western hemisphere and latitudes south of the equator are deemed to be negative values and thus must be prefixed by a minus sign. Thus, the valid range for West and East extents is -180 degrees to 180 degrees, and the valid range for North and South extents is 90 degrees to -90 degrees.

Figure 48 show examples of valid spatial regions of interest. The corresponding **BoundingWENS Value** for each example is shown below the figures.

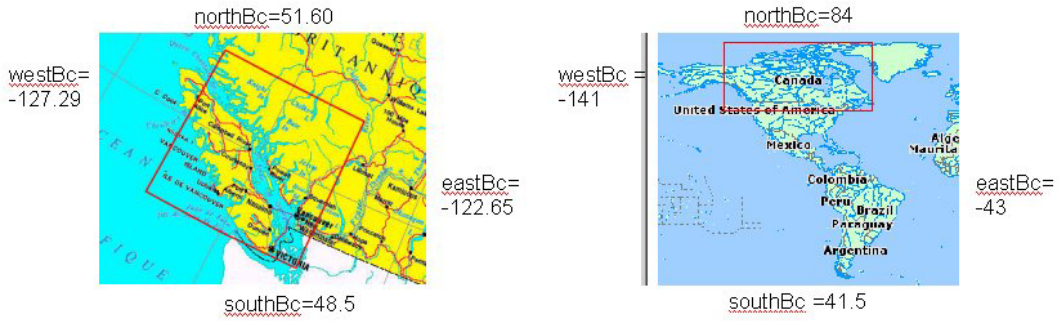


Figure 48 Valid Spatial Regions of Interest

A3.4.2 Specifying Free Text for a Search for a Database Search

To include an exact phrase when entering free text, enclose it in double quotes. To require a particular term or phrase to appear in search results, precede it with a + character. To exclude a particular term or phrase from search results, precede it with a - character. Text searches are not case-sensitive.

When you enter (a) search term(s) in the provided text box, use the methods demonstrated in the following examples to hone your search capability:

- Enter **natural resources** to retrieve entries that contain either or both of these words.
- To search for entries that contain an exact phrase, use double quotes to surround the words of interest. For example, enter: "**natural resources**".
- To search for entries that must contain specific terms, precede the term or phrase with a plus sign (+). For example, enter: **+"natural resources" +forestry**. Entries returned will contain the phrase "natural resources" and the term "forestry".

- To exclude entries containing a specific term or phrase, precede the term or phrase with a minus sign (-). For example, enter: **+"natural resources" -forestry** to retrieve entries that contain the phrase "natural resources", but not the term forestry.

You may combine the inclusive (+), exclusive (-) and exact phrase ("...") search techniques in one search string.

A3.4.3 Specifying Boolean Search Expressions

Boolean search expressions apply only when you search for databases (product collections) in FGDC format. In order to construct a Boolean search expression, you must understand the GEO use attribute structure, and you must know which SGML (Standard Generalized Markup Language) tags, from the FGDC CSDGM fields, that you want to search on. For more information on the FGDC use attributes, see: http://www.blueangeltech.com/standards/GeoProfile/annex_a.htm#Use%20Attributes.

The Boolean search syntax takes the following form:

Singular expression
<sgml tag>:<search term>

Compound expression
<operator>(expression expression expression ...)

All search phrases are case-independent.

A compound expression can contain any number of singular or compound expressions. Compound expressions within compound expressions can themselves contain any number of singular or compound expressions.

The more complex an expression becomes, the slower the search will be.

A3.4.3.1 Search Term Syntax

A search term can be in one of two forms: an **unbroken word** or a **phrase**.

For example, a singular expression can be:

themekey:forest

where themekey is an SGML tag name from the FGDC/GEO profile.

Singular expressions can be **truncated** on the left or the right. For example, to match the word "reforestation", the following can be used:

themekey:*forest*

Truncation (especially left-hand truncation) generally slows the search down.

Special characters can be used in the unbroken word. For example, the characters , = and / can be used, although some characters, like /, have to be escaped with a backslash \. A forward slash in a search phrase looks like:

placekey:canada\/alberta (this matches: canada/alberta).

You can manipulate the relevance of the results returned by the search by weighting the score of individual search terms. To do this, append to the right of the search word a pound (#) sign, followed by an integer from 1 to 10. This will multiply the search score for that term by the value that you specify.

For example:

OR(themekey:forest*#3 abstract:forest#10)

This searches for the word "forest" in either the themekey tag or the abstract tag, but if it is matched in the abstract tag, it will get a higher weighting. Therefore the results with "forest" using the abstract tag get a higher relevance if the keyword score sorts the output.

Phrases are coded as such:

placekey:phrase(New Brunswick)

This matches the multi-word string as a single, unbroken phrase.

You cannot use truncation or weights or special characters with phrases.

A3.4.3.2 Compound Expressions

The following operators are valid in compound expressions:

- AND
- OR
- NOT

There must always be an operator at the left of the compound expression. Compound expressions with the AND or OR operators must have at least two or more expressions inside. Compound expressions with the NOT operator may have one expression inside.

The following is an example of a compound expression:

> AND(themekey:forest*#3 OR(title:forest#10 title:tree#10) title:phrase(New Brunswick))

This expression requires the substring "forest" to appear in the themekey, and it requires the phrase "New Brunswick" to appear in the title, and it requires either the word "forest" or "tree" to appear in the title.

To put a weight on the term "New Brunswick" in the title, you can rewrite the expression as:

> AND(themekey:forest*#3 OR(title:forest#10 title:tree#10) AND(title:new#10 title:brunswick#10))

This is almost the same as the original expression, although it does not necessarily require the words "New" and "Brunswick" to appear in order or consecutively.

A3.4.3.3 Free Text

To search for free text across any of the FGDC fields, use the **keywords** parameters as described in the interface specifications in A3.4.2, Specifying Free Text for a Database Search.

A3.4.3.4 Other Considerations

The XML interface that searches for data products (searchForData) has three Boolean expressions: subjectBoolExpr, locationBoolExpr and productBoolExpr. However, you need only one of these expressions, since you can enter a complex Boolean expression across all metadata tags in any one of the Boolean expressions.

However, if there are many tags to be searched, it is simpler to break them into different search expressions. Also, the different score selections calculate the score based on the different interface parameters, not the tags that are specified expressions.

Again, all search phrases are case-independent.

A3.5 Best Practice: GeoGratis

GeoGratis (http://geogratis.cgdi.gc.ca) is a free data portal that allows users to download national-scale data. GeoGratis uses the GeoConnections Discovery Portal business-layer XML API to retrieve XML product descriptions from the GeoConnections Discovery Portal and reformats the XML to HTML for display.

Many organizations are successfully putting into practice the concepts and technologies discussed in this section. To make the most of available GeoConnections Discovery Portal APIs, you should use the sample interfaces and related web services discussed in the previous chapters. This Appendix provides other examples of how to consume these services.

Appendix 4

Information Sources

This appendix provides links for sources cited in the Guide to the CGDI.

A4.1 Information Sources

The Guide to the CGDI uses or refers to the following sources of information:

• AltaLIS Ltd (Alberta):
http://www.altalis.com/

• Atlantic Coastal Database Directory:
http://aczisc.dal.ca/

• Atlas of Canada:
http://atlas.nrcan.gc.ca/site/english/index.html

• Blue Angel Technologies:
http://www.blueangeltech.com/default.html

• British Columbia – Land and Resource Data Warehouse (LRDW):
http://www.lrdw.ca

• British Columbia – Integrated Land Management Bureau:
http://ilmbwww.gov.bc.ca/bmgs/

• CardSpace:
http://msdn2.microsoft.com/en-us/library/aa480189.aspx

• CGKN - Canadian Geoscience Knowledge Network:
http://cgkn.net/2002/index_e.html

• Canadian Council on Geomatics:
http://www.geobase.ca/geobase/en/about/ccog.html

• CISE – Canadian information System for the Environment (CISE):
http://gis.ec.gc.ca/ec-cise/

• CanSIS – Canadian Soil Information System:
http://sis.agr.gc.ca/cansis/intro.html

• Catalogue Services:
http://portal.opengeospatial.org/modules/admin/license_agreement.php?suppressHeaders=0&access_license_id=3&target=http://portal.opengeospatial.org/files/index.php?artifact_id=20555
http://www.opengeospatial.org/standards/cat
http://www.loc.gov/standards/sru/

http://z3950.loc.gov:7090/voyager?operation=searchRetrieve&version=1.1&maximumRecords=20&recordSchema=dc&query=fruit

• Cookbooks:
http://www.gsdi.org/pubs/cookbook/chapter01.html
http://www.opengeospatial.org/resource/cookbooks

• CWC^2 - CGDI WEB Map Service Client Component:
http://www.maptools.org/chameleon/

• DACS – Distributed Access Control System:
http://dacs.dss.ca/what_is_dacs2.html
http://dacs.dss.ca

• EMAN - Environmental Monitoring and Assessment Network:
http://www.eman-rese.ca/eman/datamanage.html

• ESRI ArcIMS:
http://www.esri.com/software/arcgis/arcims/index.html

• ESRI Canada Geography Network:
http://www.geographynetwork.com/

• FGDC metadata standards:
http://www.fgdc.gov/metadata//csdgm/

• Framework data currently available:
http://www.geoconnections.org/opportunities/rfp/framework/rfp_sd_definition_E.pdf

• GeoArctic's MapWraptor:
http://www.mapwraptor.com/home.htm

• GeoBase Portal:
www.geobase.ca

• GeoConnections Discovery Portal:
http://geodiscover.cgdi.ca

• GeoConnections web site:
http://www.geoconnections.org

• GeoNOVA in Nova Scotia:
http://www.gov.ns.ca/geonova/home/default.asp

• GeoPlace.com:

http://www.geoplace.com/ME2/Default.asp

• Geo Portal – Department of Fisheries and Ocean:
http://geoportal-geoportail.gc.ca/index_en.html

• GeoRM – Geo – Rights Management:
http://www.opengeospatial.org/ogc/programs/spec
http://www.opengeospatial.org/projects/groups/geormwg
http://portal.opengeospatial.org/files/?artifact_id=17802

• GeoRSS – Geo-Enabling Really Simple Syndication:
http://portal.opengeospatial.org/files/index.php?artifact_id=15755

• Global Spatial Data Infrastructure:
http://www.gsdi.org

• GeoScope:
http://www.intelec.ca/html/fr/technologies/geoscope.html

• GeoXACML – Geo eXtensible Access Control Markup Language:
http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=xacml
http://www.geoxacml.org/

• HTTPS - The Hypertext Transfer Protocol over Secure Socket Layer:
http://searchsoftwarequality.techtarget.com/sDefinition/0,,sid92_gci214006,00.html

• Information Services Corporation of Saskatchewan:
http://www.isc.ca/default.aspx?DN=1,Documents

• International Directory Network:
http://gcmd.gsfc.nasa.gov

• Indian and Northern Affairs GeoPortal:
http://geoportail-geoportal.ainc-inac.gc.ca/main_e.html

• ISO 19115:
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26020.
http://webstore.ansi.org/RecordDetail.aspx?sku=INCITS/ISO%2019115-2003
http://grdc.bafg.de/servlet/is/2376/
http://www.fgdc.gov/metadata/us-national-profile-iso19115
http://grdc.bafg.de/servlet/is/6494/
http://www.cits.rncan.gc.ca/html/brodeurj/.protege/.napMetadata/napMetadataWebsite/napMetadataProfileV11_20070726.pdf

http://www.fgdc.gov/metadata/csdgm/

• Internet Engineering Task Force:
www.ietf.org

• Kerberos:
http://web.mit.edu/kerberos/www/
http://www.oasis-open.org/committees/download.php/16788/wss-v1.1-spec-os-KerberosTokenProfile.pdf

• Keyhole Markup Language (KML):
http://code.google.com/apis/kml/documentation/

• Land Information New Zealand:
http://www.linz.govt.nz/rcs/linz/pub/web/root/core/Topography/ProjectsAndProgrammes/geospatialmetadata

• Le Territoire:
http://www.mrnfp.gouv.qc.ca/english/home.jsp

• Manitoba Land Initiative:
http://web2/mli

• Metadata for Geodata:
http://www.geoconnections.org/en/communities/developers/standards/fa=technical.metadata_for_geodata

• Metadata Toolkit:
http://www.sco.wisc.edu/wisclinc/metatool/noaasea.htm
http://www.metadatamanager.com/

• M^3 Cat (Multistandard, Multilingual Metadata Cataloguing Tool):
http://www.intelec.ca/index.html

• NFIS - National Forestry Information System:
http://nfis.org

• National Land and Water Information Service:
http://www.agr.gc.ca/nlwis-snite/index_e.cfm

• North American Weather Today:
http://cgdi-dev.geoconnections.org/prototypes/owsview/index.html

• OASIS:
www.oasis-open.org

• Ontario Land Information Directory:
http://www.lio.mnr.gov.on.ca/

• Open Geospatial Consortium, Inc.:
http://opengeospatial.org

• RésEau:
http://map.ns.ec.gc.ca/reseau/en/

• SAML – OASIS Security Services:
http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security
http://www.oasis-open.org/committees/download.php/16768/wss-v1.1-spec-os-SAMLTokenProfile.pdf

• Service New Brunswick:
www.snb.ca

• Service Nova Scotia and Municipal Relations:
http://www.gov.ns.ca/snsmr/land/

• Simple Object Access Protocol (SOAP):
http://www.w3.org/TR/soap/
http://www.w3.org/TR/2000/NOTE-SOAP-20000508/

• UDig – GeoConnections:
http://udig.refractions.net/confluence/display/UDIG/Home

• USGS MetaLite:
http://gisdata.usgs.net/metalite/

• W3C – World Wide Consortium:
www.w3c.org

• X.509 Encryption Certificates:
http://msdn2.microsoft.com/en-us/library/ms229744.aspx
http://www.oasis-open.org/committees/download.php/16785/wss-v1.1-spec-os-x509TokenProfile.pdf

• Z39.50 search protocol:
http://www.cni.org/pub/NISO/docs/Z39.50-brochure/
http://lcweb.loc.gov/z3950/agency
http://www.cni.org/pub/NISO/docs/Z39.50-1992/
http://www.blueangeltech.com/standards/GeoProfile/geo22.htm
http://lcWeb.loc.gov/z3950/agency/profiles/profiles.html

Appendix 5

Glossary

This appendix provides definitions for technical terms used throughout the Guide to the CGDI.

A5.1 Glossary

American National Standards Institute (ANSI)
ANSI is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. ANSI provides consensus standards for products, processes and services that are at the foundation of the American economy and society.

Applet
A program designed to be executed from within another application. Unlike an application, an applet cannot be executed directly from the operating system. A well-designed applet can be invoked from many different operations.

Application Program Interface (API)
The interface (calling conventions) by which an application program accesses operating systems and other services. An API provides a means for developing custom user interfaces. The web API provides a programmable interface to the GeoConnections Discovery Portal.

Architecture
The organizational structure and operating environment of the CGDI, including the relationships between its parts, and the principles and guidelines governing their design and evolution.

Application
A program that performs a specific function directly for a user. Applications can make use of CGDI services.

Boolean
In programming, Boolean refers to a combinatorial system devised by George Boole that combines propositions with the logical operators AND and OR and IF THEN and EXCEPT and NOT.

Cadastre
A public record, survey, or map of the value, extent, and ownership of land as a basis of taxation.

Canadian Geospatial Data Infrastructure (CGDI)
An Internet/web infrastructure comprised of the developments of the federal, provincial, territorial and private sector partners who are creating the technology, standards, access systems and protocols necessary to harmonize all of Canada's geospatial databases, and make them available on the Internet.

Catalogue
A complete list of things, usually arranged systematically. Most databases are comprised of catalogues and inventories.

Client
A software component or an application that accesses a service. The Guide to the CGDI distinguishes between a client (an inanimate part of the process) and a user (an individual who uses a computer, program, network or related service).

Community of Practice
An organized group of users who share common interests about a topic or common sets of problems, or who have common needs that can be met by an infrastructure. In this case, a community of practice has common user requirements of the CGDI.

Component

Software that packages the client or server implementation of a service and can provide the realization of a set of interfaces. A component consists of software code (source, binary or executable) or other equivalents such as scripts or command files.

Content Standard for Digital Geospatial Metadata (CSDGM)
The objectives of the FGDC CSDGM are to provide a common set of terminology and definitions for the documentation of digital geospatial data. The standard establishes the names of data elements and compound elements (groups of data elements) to be used for these purposes, the definitions of these compound elements and data elements, and information about the values that are to be provided for the data elements.

Control Widget
A control widget provides the means to adjust the speed of a simulation, as well as to stop, restart and quit a simulation.

Coverage
A continuous representation of a portion of the earth's surfaces. A coverage may be a collection of features (like a vector dataset) or it may be a raster or gridded surface representing one or more attributes.

Data
Distinct pieces of factual information, especially information organized for analysis or used to reason or make decisions. Data are usually formatted in a special way, and exists in a variety of forms: as numbers or text on paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. Data in the CGDI comprises maps, satellite images, publications and other geospatial data provided by Canadian and international organizations.

Data Collection/ Product Collection
Data which has one or several common elements, and which has been assembled by these common elements to form a grouping. For instance, the National Air Photo Collection is comprised of several thousand air photos of the Canadian landscape taken over different dates.

Data Product
Data product and data collection are used to describe data available on the GeoConnections Discovery Portal web site. However, a data product is distinct from a data collection because the data collection groups several data products; for example the following four data products could be grouped together as one data collection by removing reference to the resolution:
RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 250 Metres;
RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 500 Metres;
RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 750 Metres;
RADARSAT Orthorectified Mosaic of Canada, Lambert Conformal Conic, 1000 Metres becomes
RADARSAT Ortho-rectified Mosaic of Canada, Lambert Conformal Conic.

Dataset
A grouping of data by subject topic or type.

Data Warehouse
A repository for data designed to support management decision-making. Creation of a data warehouse includes development of systems to extract data from operating systems plus installation of a warehouse database system that provides managers flexible access to the data.

Directory
A type of catalogue in which data collections are described through metadata. In the GeoConnections Discovery Portal, the directory contains descriptions of geospatial data, services (including web services) and the organizations that provide them. Users can search for content using spatial, temporal, keyword and textual constraints or browse the directory contents.

Discovery Mechanism
An online service that allows users to find, evaluate and access resources (data, services and organizations). Discovery mechanisms bring together suppliers (those providing resources) and users (those using the resources).

Federal Geographic Data Committee (FGDC)
An American government department that coordinates the development of its national spatial data infrastructure. The FGDC was developed by the Content Standard for Digital Geospatial Metadata.

Framework Data
The set of geospatial data that provides the reference framework for all other CGDI-compliant geodata.

GeoConnections
GeoConnections is a national partnership initiative among federal, provincial and territorial governments, the private and academic sectors that is developing the CGDI, to make Canada's geographic data, tools and services readily accessible on the Internet.

GeoConnections Discovery Portal
A free online service that allows individuals and organizations to find geospatial data products and services from around the world. The GeoConnections Discovery Portal enables organizations to register and promote their data, services, resources and organization. The GeoConnections Discovery Portal is part of the CGDI and links to other parts of both the CGDI and other spatial data infrastructures.

Geographic Information System (GIS)
A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the earth's surface. A GIS can be used for handling various types of maps. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image of a map, and layers of data are organized to be studied and to perform statistical analysis.

Geographic Mark-up Language (GML)
A vendor-neutral, XML grammar that transfers geographic features through the Internet.

Geospatial Information (Geo-info)
Includes legal surveys, property cadastre, aerial photography, satellite imagery, aeronautical and nautical charts as well as various types of maps such as topographic maps, and geological, agriculture and forestry maps.

Geospatial Data
Geo-info or geodata with explicit geographic positioning information included, such as a road network from a GIS, or a geo-referenced satellite image. Geospatial data may include attribute data that describes the features found in the dataset.

Geomatics
The science and technology of gathering, analyzing, interpreting, distributing and using geospatial data. Geomatics encompasses a broad range of disciplines including surveying, global positioning systems, mapping, remote sensing and cartography.

Global Change Master Directory (GCMD)
NASA's GCMD is a comprehensive directory of descriptions of datasets of relevance to global change research. The GCMD database includes a description of datasets covering climate

change, agriculture, the atmosphere, biosphere, hydrosphere and oceans, geology, geography and human dimensions of global change.

Global Spatial Data Infrastructure (GSDI)
A global and open organization coordinating the organization, management and use of geospatial data and related activities. GSDI is being advanced through the leadership of many nations and organizations represented by a GSDI Steering Committee. This multinational Steering Committee includes representatives from all continents, and all sectors - government, academia, and the private sector. The "GSDI encompasses the policies, organizational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the global and regional scale are not impeded in meeting their objectives". (http://www.gsdi.org/)

Infrastructure
A reliable, supporting environment, analogous to a road or telecommunications network, that facilitates the access to geographically-related information using a minimum set of standard practices, protocols and specifications.

International Organization for Standardization (ISO)
A worldwide federation of national standards bodies from 130 countries. The ISO's mission is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. The ISO's work results in international agreements that are published as international standards.

Inventory
A catalogue that lists individual data products. Most databases are comprised of inventories and catalogues.

Location Commerce (l-commerce)
A new and growing economic sector that exploits the commercial uses of geospatial data and services.

Metadata
Information about data. Metadata describes how and when and by whom a particular set of data was collected, and how the data are formatted. Metadata is essential for understanding information stored in data warehouses.

National Information Standards Organization (NISO)
NISO (U.S.) is a non-profit association that develops and promotes technical standards used in a wide variety of information services. NISO has developed standards for information retrieval such as the Z39.50 search protocol.

Open Geospatial Consortium, Inc. (OGC)
OGC is a non-profit organization founded to address the lack of interoperability among systems that process geospatial data. The Open Geospatial Consortium, Inc (OGC) is an international industry consortium of 253 companies, government agencies and universities participating in a consensus process to develop publicly available interface specifications. Open Geospatial® Specifications support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT.

Operation
An interaction between a client and a server, resulting in a transfer of information or an action. An operation can be either an interrogation (e.g. request-response) or an announcement (e.g. notification).

Organization
In the GeoConnections Discovery Portal, an organization includes federal, provincial and municipal departments, non-profit organizations, academic organizations (universities, colleges) as well as commercial organizations that offer data, services and resources of a geospatial nature.

Portal
A web site considered as an entry point to other web sites, often by being or providing access to a search engine. The scope of a portal may be unlimited (such as Yahoo), or limited to a specific subject (such as geospatial information on the GeoConnections Discovery Portal).

Profile
For a search protocol, a profile identifies a set of base standards, together with appropriate options and parameters necessary for purposes including interoperability and methodology for referencing the various uses of the base standards, so as to be meaningful for both users and suppliers.
For a data standard: a profile specifies elements to be used by a particular group e.g. North American profile of ISO 19115 is the International standard adapted to address North American's needs (attributes are added).

Relational Database Management Software
A system for database management of a relational database, i.e. a database in the form of tables which have rows and columns to show the relationships between items, and in which information can be cross-referenced between two or more items to generate a third table.

Registry
A listing of the individual datasets, services or other things made available by an organization to CGDI users. There are two kinds of registries: a type registry (a listing of the different types or classes of things, such as services, components or events, which are recognized by CGDI services or applications), and an instance registry (a listing of the individual services, components, datasets or other things that comprise the CGDI or are relevant to its users. Instance registries are used to identify, locate and describe individual instances.)

Reusable Component (RUC)
A free online mapping tool that can be embedded into an organization's web pages from the GeoConnections Discovery Portal. RUCs allow users to quickly add interactive maps and locators to their web site, and to coordinate entry tools to the site. Standardized interfaces (wizards) are provided so that developers can embed the tools into their own applications. Each of the mapping tools automatically interacts with each other when embedded into the same page.

Resource
Within the CGDI, a resource refers to services, including web services and tools, data products and organizations.

Scale
To change the size of an object while maintaining its shape. Most graphics software, particularly vector-based packages, allow you to scale objects freely.
A map scale is a ratio representing the relationship between a specified distance on a map and the actual distance on the ground. For example, at the scale of 1:50,000, 1 unit of measurement on the map equals 50 000 units of the same measurement on the ground. Map scale is frequently expressed as a representative fraction and graphically as a bar scale.

Schema
XML and GML schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content and semantics of XML and GML documents.

Server
A computer on a network that is dedicated to a particular purpose and which stores all information and performs the critical functions for that purpose (http://www.congressonlineproject.org/glossary.html#S).
A search server is a program on a computer that is connected to the Internet. It accepts search queries through the Internet, then queries a database connected to the same local area network as its host computer. The database returns the result to the search server, and the search server returns the result to the Internet client that originated the request.

Service
A collection of operations, accessible through one or more interfaces, that allows a user to evoke a behaviour of value to that user. A service is delivered by a server. A “service instance” is another name for a server.
In the GeoConnections Discovery Portal, a service is a description of professional services, online services and software provided by registered organizations or individuals. See 8.2, What Can You Register and Promote With The Discovery Portal?, for a listing of Discovery Portal services.

Site
A location (e.g. URL) at which a system is accessed.

Spatial (Geospatial) Data Infrastructure (SDI)
The relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. A spatial data infrastructure provides a basis for spatial data discovery, evaluation and application for users and suppliers within all levels of government, the commercial sector, the non-profit sector, academia and citizens in general.

Stateful Search Protocol
With a stateful search protocol, a discovery mechanism opens a connection with a search server and keeps it open for the entire duration of the search session.

Stateless Search Protocol
With a stateless search protocol, a discovery mechanism opens a connection with a search server, sends a bit of information, receives a bit of information, and then closes the connection. The search session consists of a series of such open-send-receive-close interactions between it and the search server, where each open-send-receive-close interaction is independent of the others.

Styled Layer Descriptor (SLD)
A companion specification to the Web Map Server Interface (WMS) specification, the SLD is a means for controlling the portrayal of data rendered from a WMS server.

User
In the Guide to the CGDI, “user” refers to an individual who uses a computer, program, network or related service. The Guide to the CGDI distinguishes between a user (person) and a client (a software component or application that access a service.)

Web Coverage Service (WCS)
An emerging specification for a coverage, i.e. an irregular multi-dimensional grid that describes many types of Earth phenomena at every point in the grid.

Web Feature Service (WFS)
A specification that defines data manipulation operations on geographic features, allowing for querying, retrieval and transactional (i.e. add, update or delete) operations.

Web Map Context (WMC)
Specifies how a specific grouping of one or more maps coming from one or more Web Map Services can be described in a portable format for storage, use and reuse within and between clients.

Web Map Service (WMS)
An Internet-based service that allows clients to display maps and/or images with a geographic component and whose raw spatial data files reside on one or more remote WMS servers. The WMS conforms to the Open Geospatial Web Map Server Interface specification.

Z39.50 Search Protocol
The ANSI/NISO Z39.50 search protocol is a computer-to-computer communications protocol designed to support searching and retrieving of information, full-text documents, bibliographic data, images and multimedia in a distributed network environment. The Z39.50 is currently supported by the GeoConnections Discovery Portal.

Appendix 6

List of Abbreviations

This appendix provides definitions for acronyms and abbreviations used in the Guide to the CGDI.

A6.1 List of Abbreviations

ACL: Access Control Language

ANSI/NISO: American National Standards Institute/National Information Standards Organization

ANZLIC: Australia New Zealand Land Information Council

API: Application Program Interface

ASDI: Australian Spatial Data Infrastructure

ASP: Active Server Pages

B2B: Business-to-business

CanSIS: Canadian Soil Information System

CCFM: Canadian Council of Forest Ministers

CEOS: Committee on Earth Observation Satellites (NASA)

CFS: Canadian Forest Service

CGDI: Canadian Geospatial Data Infrastructure

CGI: Common Gateway Interface

CGKN: Canadian Geoscience Knowledge Network

CGNDB: Canadian Geographic Names Database

CGNS: Canadian Geographic Name Service

CIP: Catalogue Interoperable Protocol

CISE: Canadian Information System for the Environment (CISE)

COM: Common Object Model (Microsoft)

CORBA®: Common Object Request Broker Architecture

CPU: Central Processing Unit

CSDGM: Content Standard for Digital Geospatial Metadata (FGDC)

CSS: Cascading Style Sheets

CSW: Catalogue Service for Web

CWC^2: CGDI Web Map Service Client Component

EbRIM: Electronic business Registry Information Model

EbXML: Electronic Business using Extensible Markup Language

e-GIF: e-Government Interoperability Framework

EMAN: Environmental Monitoring and Assessment Network

EOS: Earth Observation System

EOSDS: Earth Observation System Distribution Station

ESQL: Eiffel SQL Library

ESS: Earth Sciences Sector

FGDC: Federal Geographic Data Committee

FGDC CSDGM: FGDC Content Standard for Digital Geospatial Metadata

FSA: Forward Sorting Area (postal code)

FTP: File Transfer Protocol

GCMD: Global Change Master Directory (NASA)

GeoDRM: Geospatial Digital Rights Management

GeoRSS: Geo-Enabling Really Simple Syndication

GIF: Graphics Interface Format

GII: (European) Geographic Information Infrastructure

GILS: Global Information Location Service

GIS: Geographic Information System

GML: Geography Markup Language

GOFC: Global Observation of Forest Cover

GSDI: Global Spatial Data Infrastructure

HTML: Hypertext Markup Language

HTTP(S): Hypertext Transfer Protocol (over Secure Socket Layer)

IDN: International Directory Network

IETF: Internet Engineering Task Force

IIOP: Inter-Orb Protocol

IMS: Information Management System

INAC: Indian and Northern Affairs Canada

IP: Internet Protocol

ISO: International Organization for Standardization

IT: Information Technology

KML: Keyhole Markup Language

LAN: Local Area Network

LDAP: Lightweight Directory Access Protocol

LIO: Land Information Ontario

M^{3}Cat: Multistandard, Multilingual Metadata Cataloguing Tool

NaLIS: National Infrastructure for Land Information System (Malaysia)

NASA: National Aeronautics and Space Administration

NBII: National Biological Information Infrastructure

NFD: National Forestry Database

NFDP: National Forestry Database Program

NFIS: National Forestry Information System

NGDF: National Geospatial Data Framework (U.K.)

NGSC: National Geological Surveys Committee

NRCan: Natural Resources Canada

NSDI: National Geospatial Data Clearinghouse (U.S.)

NSIF: National Spatial Information Framework (South Africa)

NTS: National Topographic System

OASIS: Organization for the Advancement of Structured Information Standards

ODBC: Open Database Connectivity

OGC: Open Geospatial Consortium, Inc.

OGD: Other Government Departments

OLE: Object Linking and Embedding (Microsoft)

RDBMS: Relational Database Management Software

RFC: Request for Comment

RPN: Reverse Polish Notation

RUC: Reusable Component

SAS: Sensor Alert Service

SAML: OASIS Security Services

SDE: Spatial Database Engine

SDI: Spatial Data Infrastructure

SLD: Styled Layer Descriptor

SGML: Standard Generalized Markup Language

SML: Sensor Model Language

SNB's RPIIS: Service New Brunswick's Real Property Information Internet Service

SNIG: National Spatial Data Infrastructure (Portugal)

SNSMR: Service Nova Scotia and Municipal Relations

SOAP: Simple Object Access Protocol

SOS: Sensor Observation Service

SPS: Sensor Planning Service

SQL: Structured Query Language

SQLNet: Structured Query Language Network

SRS: Spatial Reference System

SRU: Search and Retrieve via URL

SRW: Search and Retrieve for the Web

SSL: Secure Socket Layer

SVG: Scalable Vector Graphics

SWE: Sensor Web Enablement

TAP: Technology Advisory Committee (GeoConnections)

TCP/IP: Transmission Control Protocol/Internet Protocol

TML: Transducer Model Language

UDDI: Universal Discovery, Description, and Integration

URL: Uniform Resource Locator

VBScript: Visual Basic Script

WCS: Web Coverage Service

WFS: Web Feature Service

WMC: Web Map Context

WMS: Web Map Service, Web Map Server

WSDL: Web Services Description Language

WSS: Web Services Security - OASIS

W3C: World Wide Consortium

XACML: eXtensible Access Control Markup Language

XML: Extensible Markup Language

XSD: XML Schema Definition Language

Appendix 7

The Effect of Policy

This appendix discusses the impact of policy on the development of the Canadian Geospatial Data Infrastructure.

A7.1 The Effect of Policy

Although digital technology has removed many of the technical barriers to sharing geospatial data, government policies have not kept pace with the demands of a changing environment. New policies on such key issues as licensing, access and financing of geospatial data are needed to promote data exchange and integration, and to ensure that social and economic decisions are taken with the benefit of the best available information. Part of the role of the **GeoConnections** initiative is finding solutions to the difficult policy issues involved in enhancing access to government geospatial data.

A study conducted by KPMG Consulting Inc. in March 2001 on the Canadian Geospatial Data Policy on behalf of the GeoConnections Policy Advisory Node concluded:

The main goal of Canada's data policies and approaches should be the growth in use of the data. Success will be determined by how fast Canada, and its federal agencies, can supply the market with data and tools (products and services) that will satisfy the demand. The end market does not want complicated data. It wants solutions. The role of the government in the development of a strong value-added industry is crucial…In general, it is believed that the more data are available to the public, the more they will be used for decision-making and policy planning.

The ideal geospatial data policy should promote the use of such data for economic, social and environmental development, facilitate the intra- and inter-governmental distribution of data, develop the global competitiveness of Canadian industry, and maintain the client focus and "business-like" behaviour of public data agencies. The KPMG study made several recommendations on the development of Canada's geospatial data policy, as follows. GeoConnections' responses to these recommendations, written in June 2003, are in italics.

1. Accessibility. Digital geospatial data created by government should be as readily available electronically to the public as possible, unless there are privacy, security or competitive reasons not to do so. Restrictions on redistribution of data should be eliminated, except where commercial data used within government are concerned.

These principles are widely accepted and the Internet has provided the means for putting them into practice, certainly at federal and provincial levels.

2. Core framework data. Such data should be provided free as a public good, i.e. licensed at no cost, in order to encourage use, consistency and standardization.

Manitoba has led the way in this domain. Other jurisdictions are still struggling with the issue. While data distribution via the Internet is relatively inexpensive, some distribution costs must still be met by the distributing agency. Considerably more expensive is the maintenance/updating of such data, currently funded in part through cost recovery tied to distribution. GeoConnections is providing some matching funds to allow its partners to release data at no cost to users, but limits on the amount and duration of this funding have inhibited agencies from making a drastic change to their cost-recovery policies.

3. Thematic data. Costs that lead to private benefits (beyond the public good) should be borne by the user.

Generally accepted.

4. Cadastral data. Transaction fees remain appropriate for updating cadastral data at the municipal and provincial level. Efforts should be extended to integrate cadastral databases with assessment databases.

Generally accepted.

5. Copyright and licensing. Permit the licensed, royalty-free use and redistribution of public geospatial data, and use copyright to protect the quality of geospatial data from governments.

The restrictions discussed under paragraph 2 above still apply. In anticipation that they will eventually be lifted, the licensing sub-group of the GeoConnections Policy Node has been working on standardized licenses for unrestricted use, end use and distributor use in order to minimize the burden on users, who are often faced with a confusing variety of licenses when they access data from various sources.

6. Government data sharing. Encourage and allow free exchange and sharing of geospatial data within governments and between different levels of government.

While the restrictions discussed under paragraph 2 above still apply, federal agencies are making a determined effort in this direction.

7. "Value-added services". Reasonable direct costs should be recovered from clients, both public and private, when a government agency provides some form of "value-added" service to its data, and government work should be limited to instances where the private sector cannot respond because of public good, privacy or security concerns.

Generally accepted.

An additional issue not considered by KMPG but of concern is the long-term preservation of geospatial data. Outdated editions of paper maps are relatively easy to file when updated versions are published, permitting their use for change monitoring and historical analysis. However, it is all too easy to over-write an outdated digital database with new data, losing information that "form both the cornerstone of future economic growth and development, and the foundation for the future of [Canada's] memory."

Even if old datasets are not over-written, the long-term stability of digital media and the conversion of old datasets when new technology comes along are difficult matters to address when there is little commercial advantage in doing so and limited public funding for archiving. The archiving sub-group of the GeoConnections Policy Node recognizes that data management and long-term preservation do incur costs. How to share this work and its costs in the context of a data management cycle needs to be explored.