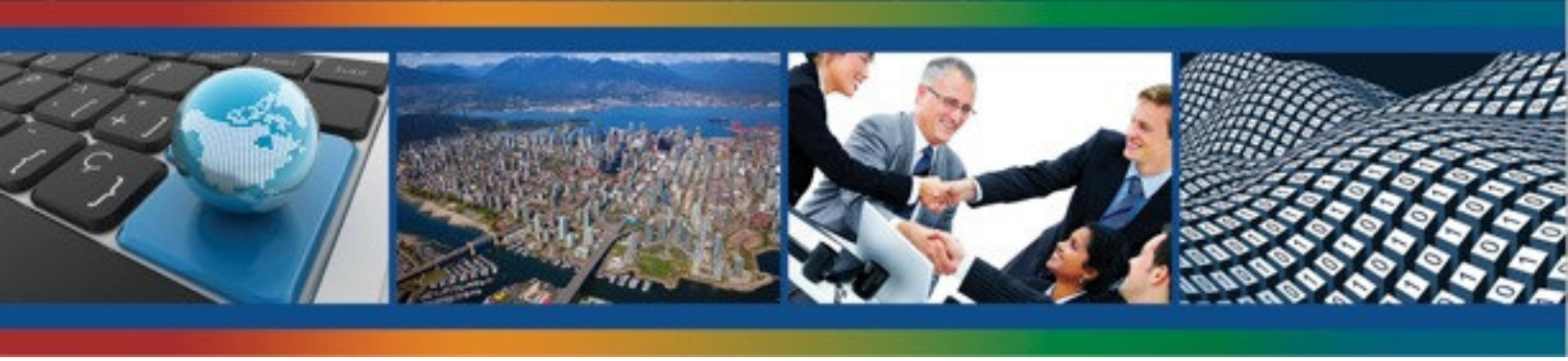

CANADIAN GEOSPATIAL DATA INFRASTRUCTURE
INFORMATION PRODUCT 2

Canadian Geospatial Data Infrastructure Target Vision

GeoConnections

2001

Natural Resources Canada | Ressources naturelles Canada

Canada

Canadian Geospatial Data Infrastructure

Target Vision

Prepared by the CGDI Architecture Working Group

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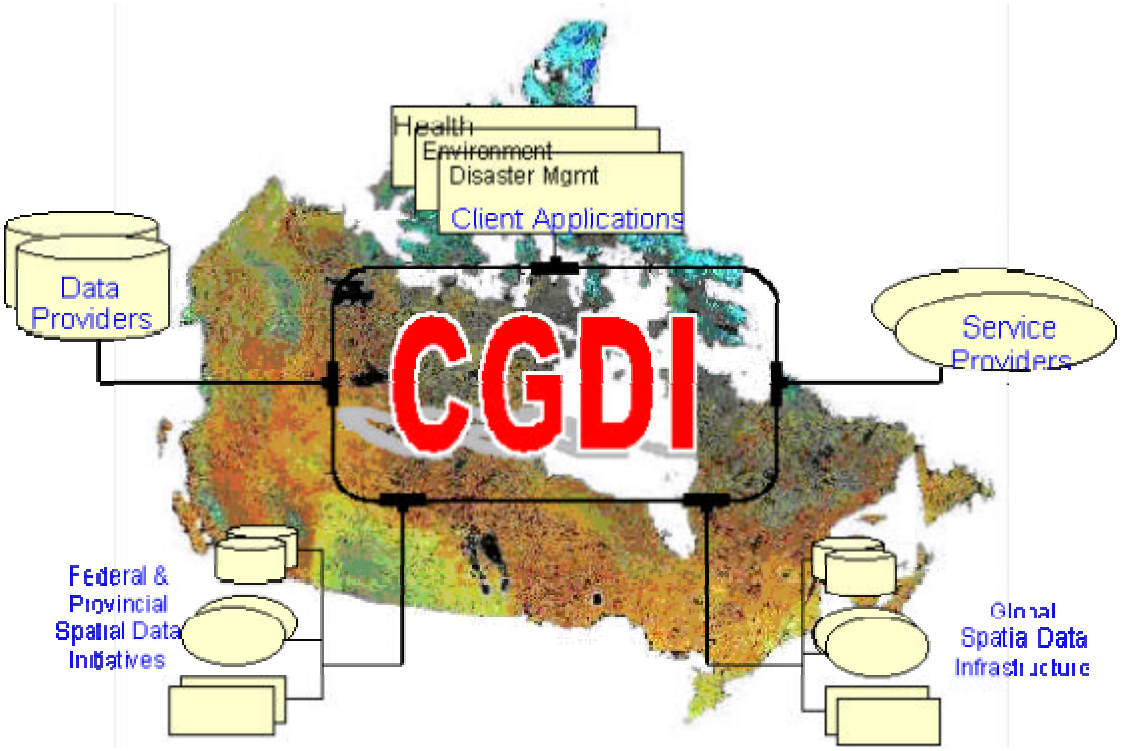

Canadian Geospatial Data Infrastructure

Infrastructure canadienne de données géospatiales

Canada

Table of Contents

List of Figures

1 Introduction to CGDI

Geospatial information underlies many of the facilities and services that we take for granted today. Everything from postal codes to weather maps is referenced to geographic location. A tour guide that describes museums but includes no road or address information is not very useful. A weather chart without a map as a backdrop is difficult to interpret. Demographic data without reference to location is of little value. Geospatial information today is pervasive and a core component of our society and our economy. It should not be strange to think of geospatial information as an infrastructure anymore than we think of highways, telecommunications, health care, air traffic control, and policing as infrastructures that we depend on and use daily. The concept of a Canadian Geospatial Data Infrastructure (CGDI) is born of this recognition.
Geospatial information is a significant subset of the information explosion that has occurred over the last decade. In the broadest sense, geospatial databases are databases that include information about the location (street address, latitude/longitude, section/township/range) of features in the databases. For many information technology applications, this locational information, or geographic reference, is a key component that facilitates the integration, analysis, and visualization of data.
There is a wide and rapidly expanding range of information technology applications that rely on geospatial databases and their embedded geographic reference information.

- An emergency response application is the ability 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.
- A public safety example is the ability to map a group of similar crimes or accidents to identify patterns that can assist in solving or preventing these incidents.
- An environmental application is the use of soil maps, population counts, and road network information to make land use planning decisions.
- An economic development application is the capability to bring together the information that a manufacturing plant developer requires in identifying and evaluating potential development sites. Such information might include: the location of potential properties, the availability and nature of transportation systems in the area, the nearby availability of qualified personnel, the proximity of available suppliers, and nature and the availability of utility infrastructure.

For all of these applications, location is a critical part of the information because it allows the information to be brought together so that it can be analyzed and displayed. Each of these examples is commonplace today. But many applications are achieved only though tremendous effort and great expense because the underlying information infrastructure either does not yet exist or has not been developed consistently.
GeoConnections is a national initiative comprised of seven programs, led by Natural Resources Canada. GeoConnections facilitates broad-based collaboration among federal, provincial, municipal governments as well as the private sector, that is fostering the development of the CGDI. It is anticipated that this infrastructure will, through its ease of use and demonstrable value, become a self-sustaining infrastructure like the Internet, and its many pieces will be supported by the commercial and government organizations that employ it. The CGDI will work on top of existing Internet technology. It will be that portion of the Internet related to the discovery, sharing and use of Canadian geospatial information and services.
The CGDI is intended to provide Canadians with on-demand access to geospatial information, technologies and services through an inter-connected network of data, service and technology suppliers. It will advance the development of knowledge applications, decision support systems and commercial products that use geospatial data and technologies.
CGDI will enable the sharing and use of geospatially referenced information. The basic ability to share and use information will lead to innovation and unforeseen applications that have broad

social and economic value. For this reason, the development of CGDI will focus on the architecture and enabling technologies rather than on any specific applications. Organizations will use CGDI specifications to implement operational systems, and thus ensure their ability to share and use geospatial information and services. CGDI will succeed through those who use it and contribute to it. It has the potential to provide significant and lasting social, environmental, and economic benefit to the people of Canada.

1.1 Purpose of this document

This Target Vision document presents a non-technical view of the purpose, goals and guiding principals for the development of the CGDI. It is intended to communicate to a broad audience the potential value and worthiness of CGDI. It is intended to facilitate the identification of possible applications that might emerge from the implementation and support of a shared public information infrastructure.
This Target Vision is expected to generate critical response and tangible support from organizations that can see the value of using CGDI to accomplish their operational mission, or to deliver their services or to share their information with those who need it.

1.2 Scope of this document

This document is not a technical specification for something that is to be manufactured. Rather it is a description of the characteristics of the CGDI as they are currently envisaged.
This document describes the target vision, and then provides an overview of the conceptual architecture and the implementation plan for the CGDI. More detailed and technical information about the latter two topics can be found in two companion documents: CGDI Conceptual Architecture, and CGDI Implementation plan.

2 The Vision Of CGDI

The target vision defines the role of the GeoConnections project and CGDI, and includes the following three aspects: a mission statement, a vision statement, and guiding principles. The mission defines the role of GeoConnections in developing the CGDI. The vision describes the core functionality and nature of the CGDI. The guiding principles describe the key defining elements and characteristics of the CGDI.

2.1 The Mission of GeoConnections

GeoConnections will foster the creation of a Canadian Geospatial Data Infrastructure to enable online access and sharing of geographic information and services.

2.2 The Vision of CGDI

"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."

2.3 Guiding Principales

There are several key principles that characterize the evolution and application of CGDI. These guiding principles are identified below.

Open: CGDI will be 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 will be based on national and international standards where available.

Transparent: CGDI will allow users to access data and services seamlessly in a manner that removes the complexities of the underlying technology and information infrastructure. By seamless is meant the elimination or hiding of artificial spatial boundaries introduced by jurisdictional organization structure or by technical artifacts such as scale or quality of information.

Cooperative: CGDI will facilitate the cooperation and interoperability of autonomous participating organizations. CGDI will define common technologies and standards rather than proscribing single or proprietary implementation solutions.

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

Self-organizing: CGDI will enable various levels of participating organizations to contribute geospatial information, metadata, services and applications without the requirement for centralized administration, access, and warehousing.

Self-sustaining: CGDI will ensure its long-term sustainability through its relevance to the needs of the participating agencies and users.

Timely: CGDI will define/recommend technologies and services that will support real-time and timely response in support of distributed access to information and 'location-based' services. CGDI may define minimum levels of service that must be met by participants in order to offer a service to the infrastructure.

3 The Architecture of CGDI

The CGDI conceptual architecture identifies the major elements of the CGDI and their functions and interrelationships. Collectively, these elements and their interactions form the CGDI, which in turn interfaces to the Global Spatial Data Infrastructure (GSDI).

3.1 Conceptual Architecture

The conceptual architecture for CGDI includes three main elements: 1) data; 2) services; and 3) applications. The diagram in Figure 1 diagram illustrates these three main elements.

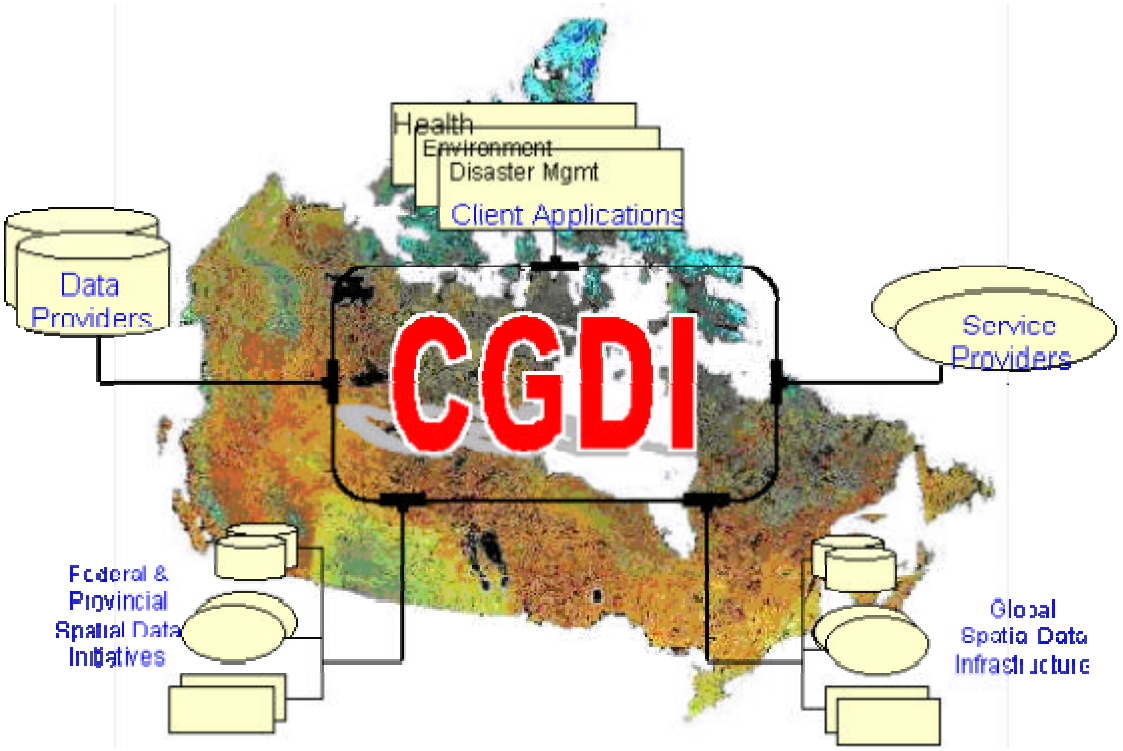

Figure 1: CGDI Conceptual Architecture

The organization of the CGDI shown in Figure 1 consists of a network of providers of information and services, and consumers or users with applications that use the information and services provided by those organizations.

The infrastructure will provide clients with access to information and services, and will enable client applications to make use of geospatial information. The CGDI will build upon federal, provincial, territorial, municipal, and industrial spatial data and initiatives, and be a collaborative information framework that will integrate and function with other spatial information infrastructures in existence around the world.

3.2 Data

First and foremost, CGDI is all about data. The primary motivating factor behind the development of the CGDI is the series of problems encountered when attempting to access and use geospatial data. Naturally, CGDI facilitates the use of and access to all geospatial data. However, it also promotes sharing and compatibility of geospatial data by identifying a common set of Framework Data.

Framework Data provides a common geographical reference for the country. It is widely used and underpins most geospatial applications. Framework Data includes physical features such as roads and rivers, as well as conceptual boundaries such as municipal and provincial boundaries. By identifying and providing access to this common set of Framework Data, CGDI will facilitate the referencing and integration of all geospatial data. For more information about Framework Data, see the CGDI Framework Data Definition.

3.3 Services and Interfaces

The CGDI defines a set of abstract services that enable access to geospatially-referenced information, and a set of interfaces to these services. One or more of these services supports every interaction that a user has with CGDI.
CGDI services include things like:

1. Catalogues and Registries to assist in the discovery and direct access of services and information;
2. Web Coverage Services, to provide delivery of vector datasets, raster imagery, and other types of spatial datasets;
3. Web Feature Servers, to allow access to databases for retrieval or editing of individual geo-spatial features over the Internet;
4. Map Style Servers and Map Symbol Libraries, to make web mapping easy and consistent;
5. Event Notification Services, to notify applications of changes to reference datasets or other services;
6. Geographic Measurement Databases, including information gathered in surveys, and hydrographic and oceanographic measurements, and;
7. Spatial Reference System Dictionaries, to facilitate the use of multiple datums and projections.

CGDI will define the interfaces to these services, so that organizations can develop and/or implement compliant components or systems that offer these services.

3.4 Components, Systems, and Applications

When using the CGDI, clients will use services that obtain and manipulate data, but this will be done using applications that access the physical implementations of these services. These physical implementations are called systems.
Developers will use the service and interface specifications to develop compliant components, and deploy them on systems to offer CGDI compliant services. For example, a CGDI data provider will provide metadata through a system that complies with the specifications for the Geographic Data Registration Service. That system could be based on either a software component obtained from another organization, or it could be based on a custom component developed entirely in-house. The Registration Service itself (and the associated Data Discovery Service) would probably be housed at some other organization.
Application developers would also use the service and/or interface specifications, in order to develop end-user applications. In the introduction to this document, the public safety example suggested that CGDI would support the ability to map a group of similar crimes or accidents to identify patterns that can assist in solving or preventing these incidents. A service provider could provide this kind of mapping by developing a system that uses the following chain of services:

1. Use a Geocoding Service to convert street addresses from the crime statistics into geographic coordinates;
2. Use a Catalogue Service to locate street map data for the area of interest;
3. Use a Coverage Service to access street map data for the area of interest; and
4. Use a Web Feature Service and a Map Style Service and a Map Symbol Library Service to produce a map of the crimes.

It will be possible to chain together any number of CGDI services in order to provide a wide variety of specialized systems and applications.

3.5 Architectural Characteristics

The architecture of the CGDI will:

1. enable universal access to any kind of geospatial information, anywhere, anytime;
2. enable applications to discover and access remote online information through a distributed infrastructure;
3. enable integration of disparate geospatial information to provide seamless views;
4. enable the seamless chaining of applications, data and services or combinations of these;
5. provide geospatial update and exchange capabilities, enabling collaborative activities;
6. promote the sharing of geospatial semantics to make integration of information easier;
7. enable wide-scale interoperability by adhering to common and open information standards and specifications;
8. facilitate the development of effective partnerships with regional and sector-specific Spatial Data Infrastructures (SDIs), and linkages with other national SDIs to form a Global Spatial Data Infrastructure (GSDI);

Organizations that implement and deploy components in the CGDI will leverage the underlying information technology (IT) infrastructure of the Internet and the World Wide Web. The ISO 19100 and OGC series of standards will be used to provide a guideline for building geospatial information systems using IT standards and infrastructure. Building on the existing IT infrastructure will save time in implementing the CGDI and provide easier access to organizations that will build enterprise solutions with the CGDI. Figure 2 illustrates the CGDI architecture in the context of IT architecture.

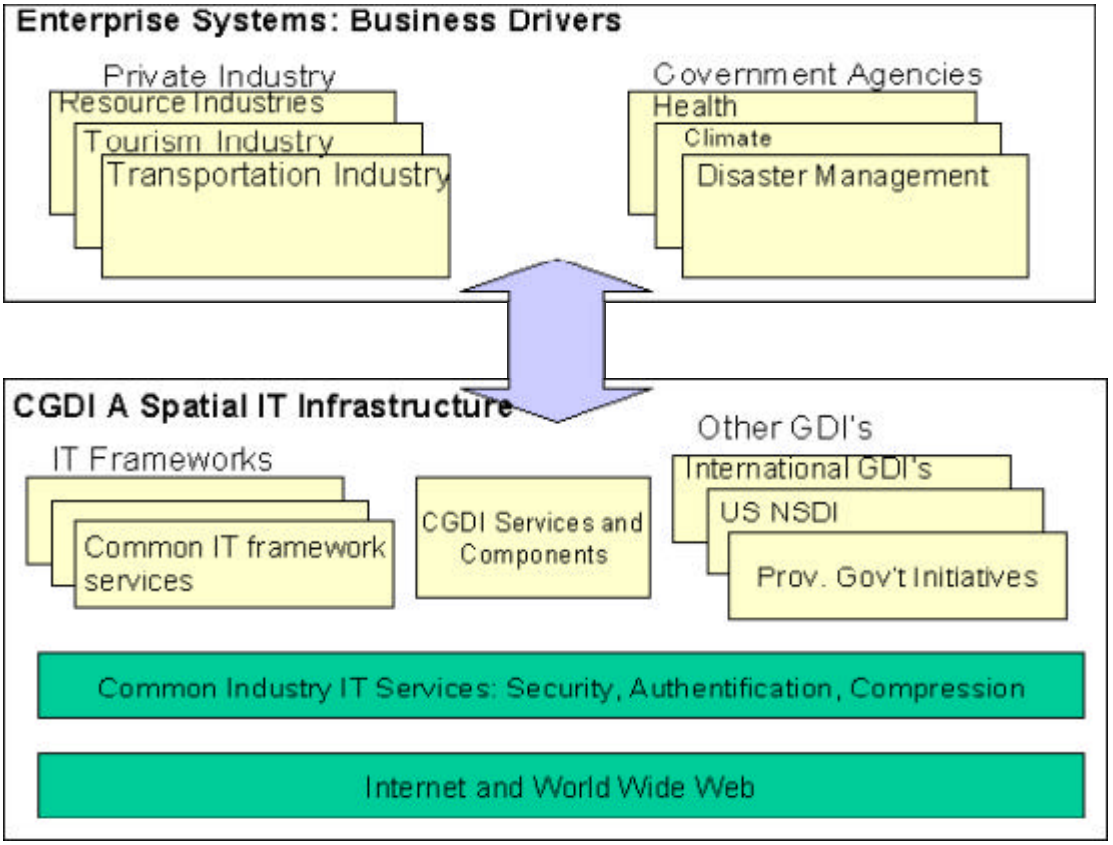

Figure 2: Information Technology Context for CGDI

4 Implementation plan for CGDI

The implementation goals of GeoConnections are:

1. To specify a functional CGDI and develop some critical data discovery, framework data, and data access services not later than March 2003;
2. To achieve a fully operational CGDI not later than March 2005. To achieve the initial goal of a functional CGDI with critical core services within the initial two-year period of the program requires:

- A well defined Reference Architecture and Implementation Plan in the early stages;
- Demonstrations of infrastructure service capabilities at incremental stages to establish the credibility required to engage stakeholders and to build momentum;
- A proactive interface with other spatial data initiatives;
- Good relationships with those organizations that may become early adopters of the CGDI.

The development of the CGDI Reference Architecture began in February 2001, with a four-month activity that will put in place the foundations of the architecture and define priority requirements and services for early specification and development. This work will produce a revised release of the Target Vision, Architecture Description and Implementation plan for the longer-term work. The development of the CGDI Reference Architecture will be an incremental and evolutionary process with each increment adding additional capabilities and clarifications. The progress of the

CGDI Reference Architecture will be marked by technology demonstrations to establish credibility in the user community and to encourage the early adopters to engage the CGDI.

5. Glossary of Terms

The following terms are found in the body of this document. The definition of these terms provided here is intended to clarify their meaning and application.

Term

Definition

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 over time.

Application

A program that performs a specific function directly for a user.

Component

A physical, replaceable part of a system that packages implementation and provides the realization of set of interfaces. A component represents a physical piece of implementation of a system, including software code (source, binary or executable) or other equivalents such as scripts or command files.

Conceptual Architecture

An overview of the services, data, technology and institutional environment of CGDI. It describes, in general terms, both what the CGDI will include, and how it will operate.

Interface

A specification for a set of operation signatures that are made externally available by a component to other components. The state and functionality of a component is hidden, and is only made externally accessible through the interfaces of the components. The interfaces are the only "public" or "visible" part of the component. The same interface may be provided by several components and used by many components or applications.

Reference Architecture

A technical blueprint that identifies and defines the services that comprise the CGDI, and specifies the interfaces to those services.

Service

A capability that a service provider makes to a service user through a set of logically related interfaces that define a set of behaviors.

System

People, computers, components, and data organized to accomplish one or more services.