**CANADIAN GEOSPATIAL DATA INFRASTRUCTURE
INFORMATION PRODUCT 4**

The Canadian Geospatial Data Infrastructure
Achieving the Vision of the CGDI

GeoConnections

2005

Natural Resources
Canada

Ressources naturelles
Canada

Canada

Roadmap

The Canadian Geospatial
Data Infrastructure

Achieving the Vision
of the CGDI

**GeoConnections
2005**

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Preface

This roadmap document explains how to achieve the vision of the Canadian Geospatial Data Infrastructure (CGDI). It synthesizes research, strategy, and a rich consultation process. The document captures the collective wisdom of many and will serve not only to better the CGDI but to build upon its successful history.

This roadmap complements two related documents—*the CGDI Vision* and the CGDI Architecture—by providing important goals and tasks to tackle in the short, mid and long term. The roadmap helps set the operational priorities and will serve as a foundation for detailed project plans.

Intended Audience

This document presents a roadmap for those with a keen or casual interest in the CGDI's future. Those with a more technical interest can download a detailed architecture document at http://www.cgdi.ca.

Scope

The CGDI roadmap document aims to tie the vision and the architecture to measurable goals and specific tasks. This document is not intended to be a project plan, but should assist in developing detailed operational plans.

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Executive Summary

Developments in information technology over the past decade have exponentially expanded both the need for geospatial information and the access to this information. To meet this demand, the Government of Canada invested $60 million in the GeoConnections initiative with a goal, among others, of accelerating the development of the Canadian Geospatial Data Infrastructure (CGDI). GeoConnections will come to a close in March 2005, but a plan and roadmap are needed to continue the important work of building the CGDI.

This roadmap provides the direction to achieve the CGDI's vision. The future for the CGDI looks bright, but action, effort, and perseverance will be necessary to make the CGDI's vision a reality. The roadmap complements the vision and architecture work by providing key goals and tasks to tackle in the short, mid and long term.

The CGDI has matured technologically to the point that we can now explore the issues and opportunities that will shape its final form. Great strides have been made, but refinement and greater participation are needed to ensure a critical mass of geospatial data, services, applications and users. The CGDI's external and internal environments need to be explored to understand the opportunities and challenges that lie ahead.

The CGDI's success has been founded on strong partnerships with external and internal stakeholder communities. These types of partnerships should continue to play an important part in the future of the CGDI. The CGDI must look to associations, academia, standards organizations, industry and all levels of government for continued guidance, support and contributions.

The vision for the CGDI is to enable access to the authoritative and comprehensive sources of Canadian geospatial information to support decision making. The mission statement furthers the vision by outlining how a future coordinating organization will need to operate to achieve the vision of the CGDI.

The CGDI's mission comprises specific objectives. Each objective has corresponding goals that indicate how the CGDI should evolve . These goals also indicate what results need to be achieved. The mission, however, does not explain *how* to produce these results—that role falls to this roadmap and its goals and tasks.

These goals and tasks can be grouped into four streams: **coordination, users, content,** and **infrastructure**. This roadmap identifies goals and tasks for each of these areas to reach the short-, mid-, and long-term milestones established in this document.

In the short term, funding sources and governance issues will remain in the forefront. In the long term, it will be essential to engage new communities of practice and to have most provinces, territories, and several large municipalities contributing data to the CGDI and using the CGDI. Leadership and technology have been the focus and strength of the CGDI to this point. The next era of the CGDI needs to focus on service delivery and nurturing strong user communities that have the capacity to work with the CGDI.

1. Introduction

Geospatial information plays an important role in the everyday lives of Canadians. Every time someone watches a weather forecast on TV, uses a roadmap, or phones 911, they use geospatial data. Over the past decade, developments in information technology have exponentially expanded both the need for geospatial information and the access to this information.

What is geospatial data?

Geospatial data is information that can be mapped or otherwise associated with a particular place, for example, the location of a river, crime statistics for a neighbourhood, or the spread of infectious diseases.

Recognizing this new environment, in 1999, the Government of Canada invested $60 million in the GeoConnections initiative. This initiative was a national partnership program led by Natural Resources Canada (NRCan) to develop the Canadian Geospatial Data Infrastructure among other priorities. The underlying goal of the GeoConnections initiative was to improve access to geographic information over the Internet. GeoConnections will come to a close in March 2005, and efforts are underway to develop plans to continue working on the CGDI past that point. Developing these plans is a key component of the CGDI roadmap.

The CGDI today makes it easy for people to discover, share and use Canadian geospatial information and services. The CGDI's ability to share information is leading to innovations and unforeseen applications that increasingly add social and economic value. Tremendous progress has been made by early adopters including the National Forest Information System (NFIS), Land Information Ontario (LIO), GeoNova and the Canadian Geoscience Knowledge Network (CGKN).

What is the CGDI?

Simply put the CGDI is made up of people, partnerships, geospatial content and technology with an aim to facilitate better policy and decision making.

The CGDI has matured technologically to the point that we can now explore the issues and opportunities that will shape its final form. Great strides have been made, but refinement and greater participation are needed to ensure a critical mass of geospatial data, services, applications and users. Without continued investment and contributions from all its partners, the CGDI will unlikely be able to provide governments, industry, academia and the not-for-profit sector with geospatial information to assist in developing policies and making decisions.

This Roadmap document builds on the proposed vision and architecture of the CGDI and presents an action plan for the next five to ten years. It starts by exploring the external and internal environments of the CGDI, which offer both opportunities and challenges. Next, the document analyzes the CGDI's stakeholders and identifies the current and desired future roles of the CGDI stakeholder community.

The document then identifies the elements and priorities of the vision and mission that need to be put into operation. The document's final section provides a roadmap

that breaks the operational goals into short-, medium-, and long-term timelines and key milestones.

This Roadmap aims to provide input into a detailed action and project plan for the CGDI. While a roadmap can provide the course to follow, it is a snapshot at a single point. Over time, the course will inevitably change and will need to be adjusted. As a result, this document should be updated regularly to reflect changes to the CGDI, its environments and its stakeholders.

The future for the CGDI looks bright, but action, effort and perseverance will be necessary on the part of many to realize the vision—and the vast potential—of the CGDI.

2. CGDI Users and Conceptual Architecture

The CGDI architecture comprises four key elements: **data, services, applications and users.** From a conceptual perspective, the architecture consists of data providers, service providers and consumers who use applications to access geospatial information. The data infrastructure is the highway that all CGDI participants travel. It builds upon federal, provincial, territorial, municipal and industrial geospatial capabilities. The infrastructure's goal is to present a collaborative framework for global access to geospatial information.

The following figure illustrates the four key elements and their relationship to the CGDI. It further delineates the users into four distinct categories: suppliers, developers, marketers and end-users.

CGDI Conceptual Architecture
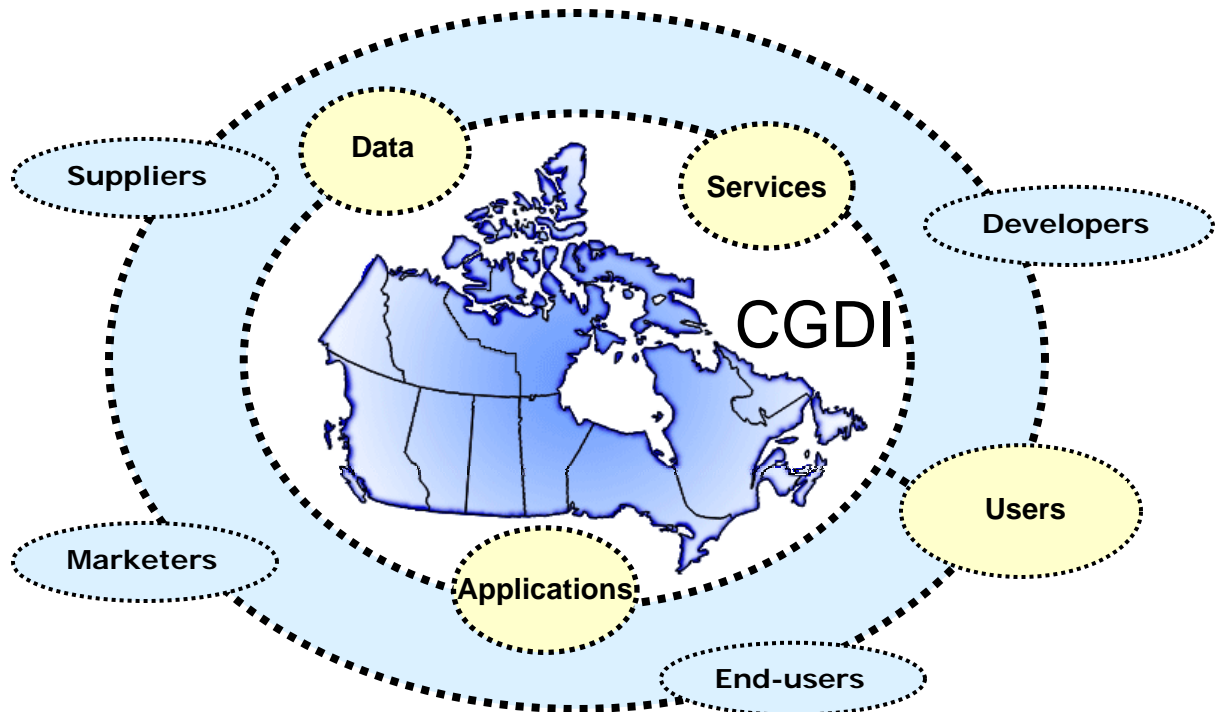
Data – Data is at the core of the CGDI. Timely and secure access to accurate and up-to-date data is vital to any successful data infrastructure.

Services – The CGDI is based on open web services that provide access to geospatial data.

Applications – Applications use Web services to provide users with the ability to produce and analyze geospatial information to make informed decisions.

Users – Users are the consumers of geospatial data. Users can be broken down into four categories:

- **Suppliers:** Providers of geospatial data and Web services.
- **Developers:** Creators of applications for other user groups to facilitate interaction with the CGDI.
- **Marketers:** Sellers and supporters of geospatial applications to end-users.
- **End-Users:** Consumers of geospatial data.

Understanding Users

CGDI users include the full range of groups or individuals who participate in the CGDI. They can be represented in the following categories:

- **Suppliers** provide geospatial data and web services to the CGDI. This category of user operates at the core of the CGDI, providing the building blocks necessary to develop applications.

- **Developers** create applications that make it easier for users to interact with the CGDI. Developers base applications on Web services.

- **Marketers** sell and/or support geospatial applications, mostly to end-users. These applications are intended to meet a demand for geospatial information.

- **End-Users** consume geospatial information to make decisions. For the most part, end-users rely on applications to produce outputs for consumption.

The following figure illustrates a typical relationship between the four categories of users.
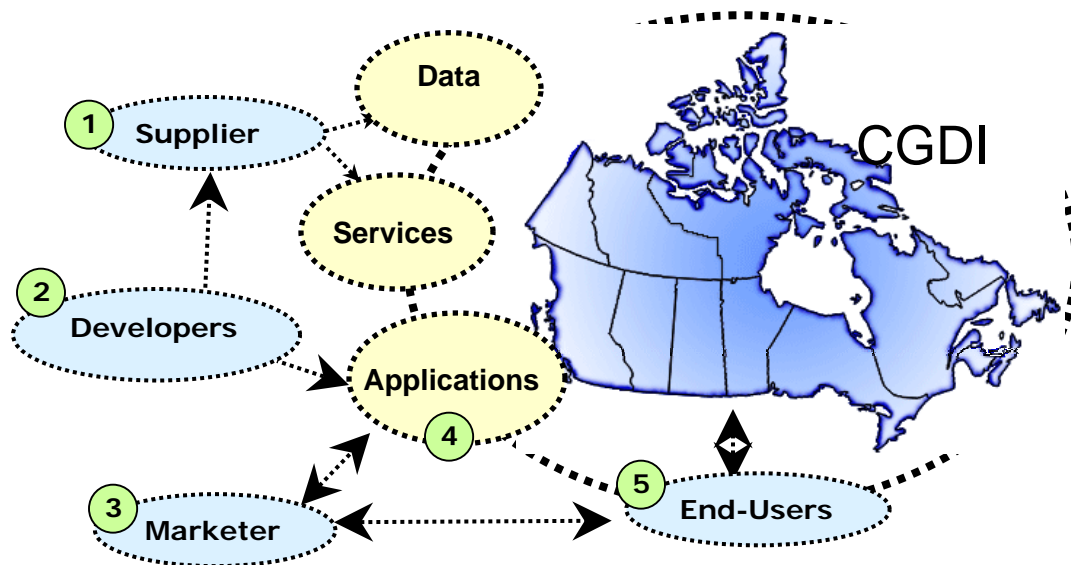
In this illustration:

1. Suppliers provide data and services to the CGDI.

2. Developers use these inputs to produce applications.

3. Marketers sell or promote applications to end-users.

4. Developers can create applications to meet supplier needs.

5. End-users can access the CGDI directly.

3. Progress to Date

Since 2000, significant strides have been made toward achieving the original Vision for the CGDI. Efforts have focused on enabling access to standards-based Web services and leveraging existing and emerging technologies and standards. These efforts were devoted to creating a general-purpose service-based platform. Overall, notable progress has been made in the following areas:

Standards and Specifications

Open standards and specifications lie at the heart of the CGDI. Working closely with international standards bodies and national working groups, GeoConnections endorsed a number of standards for the CGDI. Highlighted in the table below, these standards provide the foundation for an open and distributed network.

Function	Standards or Specifications
Visualizing data	Web Map Service
Presenting data	Styled Layer Descriptor
Storing data	Web Map Context
Manipulating data	Web Feature Service
Querying data	Filter Encoding
Coding data transport and storage	Geography Markup Language
Searching for data	Geodata Discovery Service
Describing data	Metadata for Geodata

Data

Information that supports decision making must be based on quality data, and CGDI framework data helps fulfill this requirement. This data is the set of continuous and fully integrated geospatial data that provides context and reference information for the country. Significant strides have been made in this area. Specifically, the GeoBase initiative has produced agreement on six layers of geospatial framework data and increased inter-jurisdictional cooperation. CGDI framework data will serve as the underpinning for a number of geospatial applications.

The CGDI also provides access to thematic data sets. These sets describe the characteristics of geospatial features and offer information on specific topics such as rainfall, geology or population. Thematic data attributes are geospatially referenced, so they can be tied to locations on the Earth and be used in applications.

The Atlas of Canada provides a collection of maps and related information about Canada. It offers thematic data such as freshwater and population distribution via CGDI Web services.

The GeoConnections Discovery Portal is an ideal place to discover thematic data. Searching on a particular subject (e.g., vegetation or snowfall) yields thematic results, and most thematic data sets can be distributed via the CGDI. Sharing these data sets will enable the most powerful CGDI applications.

Services and Applications

Web services provide the basis for interactions across the Internet that allow users to contribute, access and exchange geospatial data. The GeoConnections Discovery Portal enables people to find geospatial Web services and identifies those services that conform to CGDI-endorsed specifications.

Applications use one or more Web services to view, publish, edit or discover geospatial data from Web servers. Applications based on core CGDI components, interfaces and services are beginning to deliver many of the anticipated benefits to Canadians.

From an end-user perspective, significant developments have occurred in the viewer client applications that display graphics from map servers. Substantial advances have also taken place in the discovery client applications that let people search for geospatial data.

Data providers have also benefited from technology advances. For instance, these organizations can now use publisher and editor applications to select how to distribute their data to users and how to add, remove or update shared data.

Relationships

The CGDI has fostered relationships and partnerships with collaborators from public, private and academic sectors. For example, members of CGDI advisory groups come from a cross-section of organizations. Consequently, advisory groups are able to leverage expertise and contributions from a wide variety of stakeholders.

As well, the Canadian Geomatics Accord creates a framework for federal, provincial and territorial collaboration on geomatics issues. The Accord is a key federal-provincial-territorial partnership agreement and has successfully focused on collecting, distributing and maintaining geomatics data more efficiently.

Policies

Significant strides have been made in the area of policy. Extensive cross-country consultations in 1999-2000 provided valuable policy input that helped shape the CGDI's current form.

In recognition of the importance of policy development, CGDI stakeholders worked at solving the difficult policy issues involved in enhancing access to government geospatial data. Policy development focused on creative consensus-building approaches to address the following areas:

- Enabling increased access to and use of government geospatial data in the public and private sectors
- Resolving copyright, licensing and distribution issues that inhibit data sharing and use
- Promoting inter-agency geospatial data-sharing arrangements
- Defining roles and responsibilities for various public and private interests in developing and promoting policies
- Expanding public and private partnerships
- Enhancing government efficiencies in collecting, maintaining and distributing geospatial data

- Exploring alternative or complementary mechanisms or both for financing data development, maintenance and dissemination

4. Environmental Analysis

To deliver the desired value, the CGDI Roadmap must do more than simply point to a destination; it must also describe how to reach this destination. The CGDI exists in a complex world. Diverse stakeholders push and pull the CGDI in different ways. The external and internal environments of the CGDI need to be explored to understand the opportunities and challenges the CGDI faces.

4.1 Technological

The Internet
A dominant force in our economy and society, the Internet has now integrated into day-to-day life. As a result, people increasingly expect access to a wide range of transactions 24 hours a day, seven days a week. The popularity of broadband access in Canadian businesses and households has only increased these expectations. The CGDI is built on an Internet architecture.

Open Standards
The most relevant geospatial data standards are those from ISO/TC211, Open Geospatial Consortium (OGC) and Internet-related bodies such as the World Wide Web consortium (W3C). The rapid growth of Web service standards and specifications will tremendously impact geospatial data infrastructures. Canada should continue to develop international specifications while maintaining partnerships and relations with international standards organizations. This tack should ensure that the geospatial needs of Canadians are continuously satisfied.

Web Services
The emergence of XML as the standard for interoperability has paved the way for Web services. The adoption of Web services offers tremendous opportunities for the CGDI. The Geographic Markup Language (GML) is an evolving international standard that provides a framework for handling geographic information in an open and non-proprietary way. To leverage Web services and a service-oriented architecture, investments should continue in research and development, particularly in the areas of GML enabled technologies.

Global Positioning System (GPS) and Wireless Communication
GPS applications are becoming increasingly sophisticated, requiring accurate and updated data to ensure their relevancy and marketability. GPS application developers would benefit from accessing framework data through an open distributed geospatial infrastructure. For example, service providers would likely be highly interested in offering a tourist application that both combines GPS technology with framework road network data and includes automatic updates through the CGDI.

The emergence of wireless communications allows individuals to access and provide data and information anytime, anyplace using a broad range of technologies. To keep pace with the growing wireless trend, the CGDI should dedicate resources to developing and endorsing wireless standards and specifications. Special consideration may be given to wireless security measures to mitigate the risks of unauthorized access to any secured areas of the CGDI.

Mainstream Vendors

Geospatial technology is moving into the mainstream. Two online geospatial mapping services, Mapblast and Mapquest, are examples of popular Internet applications. As well, large IT firms such as Microsoft and Oracle have become more engaged and penetrated the geospatial industry from different angles, such as offering geospatial database and dissemination software products. This development could significantly change the industry in the next few years.

4.2 Governance

The CGDI is governed, through GeoConnections, by an inter-departmental management board and advisory nodes. GeoConnections advisory nodes have cross-sector membership that enables them to leverage expertise and contributions from all stakeholders. The federal-provincial governments as well as industry comprise a large part of the membership. Involving municipalities in CGDI initiatives could lead to a more balanced stakeholder representation.

Reducing the number of advisory nodes may increase efficiency and reduce potential overlap and duplication among the committees. Linking the nodes to national priorities might also be considered. New models for governance and shared sustainability need to be discussed.

The Canadian Council on Geomatics (CCOG) is the major federal-provincial-territorial consultative body for geographic information management. CCOG provides a forum to exchange information on programs, to consider common operational issues, to discuss proposed legislation relevant to geomatics and to develop and promote national geomatics standards. The Inter-Agency Committee on Geomatics (IACG) has taken the lead in guiding federal and provincial governments and the commercial sector to advance the CGDI.

Depending on the governance model, various delivery approaches should be considered for a follow-on initiative to coordinate CGDI activities:

1. Government centred
2. Public-private partnerships
3. Fully public
4. Fully private

4.3 Legislative

The CGDI architecture should consider the impact of the Privacy Act and Public Safety Act.

The Privacy Act protects the privacy of personal information held by government institutions. The Act also provides individuals with the right to access that information. Security and authentication initiatives for the CGDI would benefit from adhering to the provisions of this act and monitoring compliance.

The newly formed Public Safety Act contains provisions that will increase the Government of Canada's capacity to prevent terrorist attacks, protect Canadians and respond swiftly should a significant threat arise. Those involved in emergency

response and disaster management need geospatial information to make quick and effective decisions. This act will help reduce the barriers regarding the implementation of CGDI-relevant programs and policies.

In the United States, the National Spatial Data Infrastructure (NSDI) is established under legislation that sets out essential operational features. Legislative changes to the NSDI could impact the CGDI's international partnerships.

4.4 Legal

The geospatial industry is increasingly concerned with issues such as data ownership, data quality and product reliability. These issues could be explored to determine, for example, if municipalities retain the rights to data that they have contributed to the geospatial infrastructure. The rights and responsibilities of all CGDI user communities need to be defined.

Guidelines can be further communicated to outline the legal accountability of CGDI data providers for damages or losses caused by data sets that contain substantial errors. Data users, rightly or wrongly, may also believe Crown copyright and licensing restrictions limit their ability to use government geospatial data.

4.5 Human Resources

In 2000, the Canadian geomatics sector employed 22,000 persons in the private sector and close to 5000 in government and educational institutes. By the end of 2004, the private sector alone was expected to employ some 32,000 people. All indicators point to continued growth in the geomatics sector.

The CGDI could work closely with academic institutions to ensure that existing and prospective employees gain the knowledge and competencies required to meet the current and future needs of the Canadian geospatial industry.

Internally, if the CGDI is to put greater emphasis on service, then resources need to be made available to provide an appropriate level of service to the user community.

4.6 Financial

New sources of funding will need to be investigated because the GeoConnections initiative's funding is scheduled to end in March 2005. CGDI stakeholders need to analyze governance models that offer the best prospects for sustainable funding. Many potential funding sources exist: government (funds from taxation), private sector (fees charged to customers), public sector (fees charged to customers) or indirect (fees from advertising, sponsorships and other indirect methods). A combination of one or more of these models might be a possible alternative.

4.7 Government Priorities

The federal election of June 2004 led to a new government agenda that offers direction to the CGDI. A marketing and communications strategy should consider how the CGDI fits into the new federal priorities.

The recent Speech from the Throne outlined seven areas of focus for the federal government:

1. A Strong Economy
2. The Health of Canadians
3. Children, Caregivers and Seniors
4. Aboriginal Canadians
5. Canada's Cities and Communities
6. Our Environment
7. A Role of Pride and Influence in The World

Although the CGDI could possibly contribute to all these priorities, three or four should become focal points. The economy, health, cities and the environment are natural CGDI contribution areas, and Canada should look to these areas to engage new users and communities of practice.

Government priorities should be examined at provincial and municipal levels as well. An understanding of potential partner priorities can help identify areas for collaboration and opportunities to contribute to the CGDI.

5. Stakeholder Analysis

The success of the CGDI has been founded on strong partnerships with external and internal stakeholder communities. The CGDI should continue to emphasize these partnerships in the future. The following section of the roadmap looks at each stakeholder community, its current role, and its projected future impact on the CGDI.
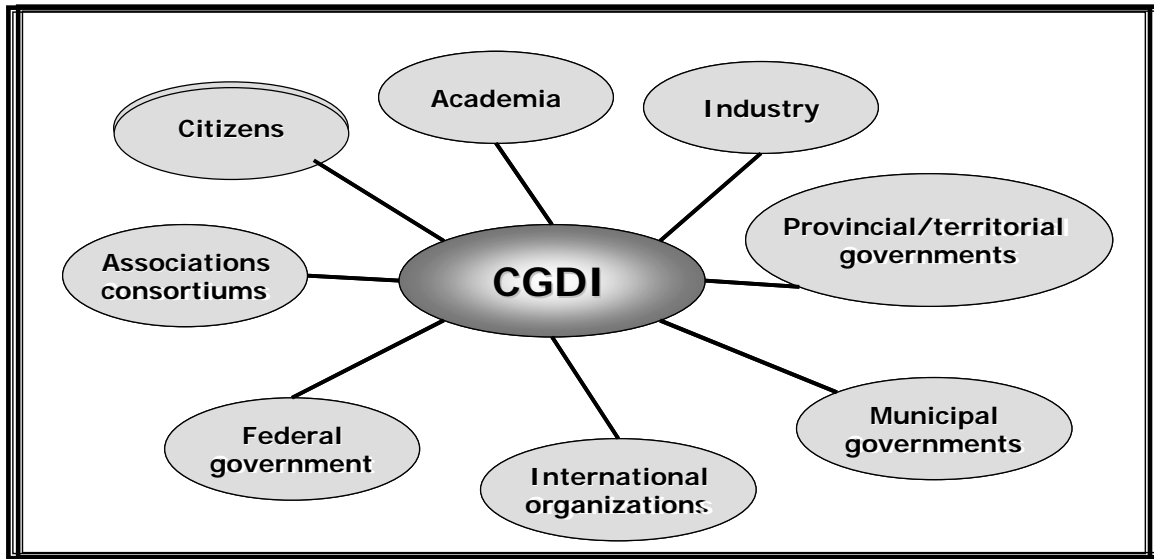
5.1 Associations / Consortiums

Description of Role: Geospatial associations and consortiums encourage members to work together and collaborate. These organizations also distribute information on opportunities, stakeholder involvement, procedures and policies of interest to their members.

Impact on CGDI: The CGDI will be able to efficiently promote advancements in technology and geospatial data sharing across sectors by leveraging relationships through associations and consortiums. The goal is to increase the number of persons using the CGDI and contributing to it. Associations can also provide important feedback and guidance on policies and may play a role in the future governance models for the CGDI.

5.2 Federal Government

Description of Role: The federal government is generally responsible for:

- Leading and coordinating geospatial initiatives nationally
- Coordinating geospatial activities of federal agencies
- Liaising and coordinating with international agencies
- Providing, directly or indirectly, national-scale databases
- Providing a national electronic network to facilitate access to federal data and linking this network to provincial and territorial networks

Impact on CGDI: The federal government will need further encouragement from communities of practice to use the CGDI in policy and decision making. Federal departments should consider the CGDI for all major programs requiring access to geospatial data. The federal government could also focus on building relationships with international organizations, and fostering the growth of the Canadian geomatics industry abroad.

5.3 Provinces and Territories

Description of Role: The provincial and territorial governments are generally responsible for:

- Coordinating geospatial activities within their geographic areas
- Leading their geographic areas
- Liaising and coordinating with local government agencies
- Providing, directly or indirectly, provincial and territorial databases
- Licensing data to assist in developing and maintaining national databases

Impact on CGDI: All governments will benefit from using the CGDI in policy and decision-making. A key point is that the provinces and territories will play an important role in engaging municipalities and helping provide data to the CGDI. Provincial and territorial governments will also need to play a role in providing data and services in the interest of a national geospatial program.

5.4 Municipal governments

Description of Role: The municipal governments are generally responsible for:

- Coordinating and leading geospatial activities within their geographic areas
- Liaising and coordinating with provincial-territorial authorities
- Providing, directly or indirectly, municipal databases

Impact on CGDI: Municipal governments need to increase their involvement in and contributions to the CGDI, in order to share their valuable data sets and to make use of data from other organizations. This increase will require a closer working relationship with provincial and federal representatives to ensure their contributions to the CGDI.

5.5 Academia

Description of Role: Academic institutions conduct geospatial research often through partnerships with private and public sector organizations. In addition to providing research services and geomatics expertise, academic institutions also train prospective geospatial experts through learning and development programs.

Impact on CGDI: The CGDI must continue to foster relationships with academia and to support academic research. Commercialization of research should promote future research and could develop opportunities for Canadian industry. Academia can also evolve into key users of the CGDI to further their research and to identify new service needs.

5.6 Standards Organizations

Description of Role: Standards organizations strive for interoperability by contributing to the development of global geospatial standards. They work closely with government, private industry and academia to create open and extensible software application programming interfaces for geographic information systems (GIS) and other mainstream technologies.

Impact on CGDI: Standards organizations will continue to have a considerable impact on the future of the CGDI. Maintaining strong partnerships with standards organizations will help harmonize digital geographic information. A continued commitment to building upon CGDI-endorsed specifications will ensure that the infrastructure remains open and interoperable.

5.7 Industry

Description of Role: Industry organizations market a wide variety of products and services to meet the geospatial needs of consumers, developers, professionals and educational institutions.

Impact on CGDI: Industry organizations need to recognize the value of the CGDI and leverage the data and services to produce applications that better meet end-user demands. The CGDI should respond to industry requirements and provide an opportunity for industry to communicate its needs. Industry adds a key value proposition to the CGDI by leveraging its geospatial information and creating new applications and services.

5.8 Citizens

Description of Role: Citizens have both an indirect and a direct stake in the CGDI. On one hand, citizens are affected by the decisions that governments and other stakeholders make using the CGDI. Alternatively, citizens may use geospatial applications or services for their own work or leisure.

Impact on CGDI: Citizens will benefit from the CGDI, but the average citizen will likely have little direct impact on the CGDI.

6. Achieving the Vision

This section of the report looks at the ties between the vision and mission of the CGDI and the corresponding goals and tasks needed to achieve the vision. The mission contains a series of six operating and organizing objectives. Each of the operating objectives has a series of goals associated with it. This roadmap document looks at these goals and determines what needs to be done to achieve them. This analysis will serve as the foundation of the CGDI's future operational plans.

6.1 The Vision of the CGDI

This Vision will help set the needed mission, goals and objectives for achieving the CGDI of the future. It is an overarching touchstone against which to chart CGDI progress.

The Vision of the CGDI is:

To enable access to the authoritative and comprehensive sources of Canadian geospatial information to support decision-making.

The image below depicts the relationship between the Vision and the Guiding Principles of the CGDI.
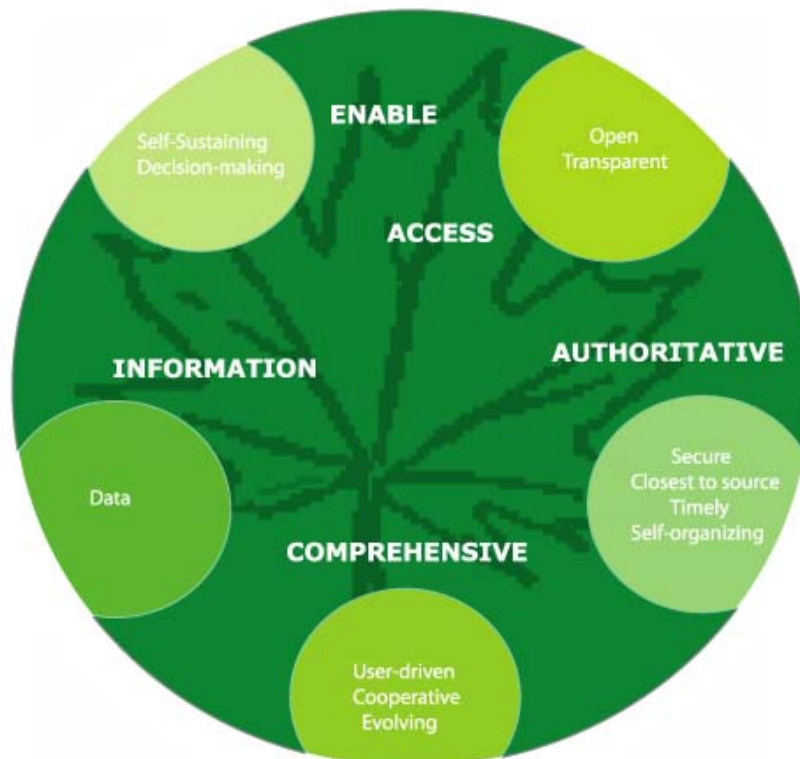
Five key terms within the vision tie it directly to the Guiding Principles of the CGDI:

1. Enable
2. Access
3. Authoritative
4. Comprehensive
5. Information

Enable relates directly to self-sustaining. The CGDI does not create data or technological infrastructures; rather it enables organizations to contribute to the CGDI and make decisions based on information available through the CGDI.

Access builds on the principles of transparency and openness. The open standards of the CGDI are designed to provide transparent and seamless access to geospatial information.

An **authoritative** CGDI will use data that is both closest to source and based on open standards and specifications. This data should also allow contributors to self organize. In addition, an authoritative CGDI will provide timely and secure access to data.

For the CGDI to be **comprehensive,** it must be more user-driven. The CGDI must continue to evolve to meet new needs and developments, and it must continue to both build on existing partnerships and create new ones as well.

Information encompasses both data and information. The information must be accurate and accessible through the CGDI to support policy and decision making.

6.2 Mission

To achieve the Vision of the CGDI, a coordinating organization will need to:

- Enable decision making and policy development that address Canada's priority areas such as health, social responsibility, culture, the economy, 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 ongoing and sustainable

6.3 Mission Objectives and Related Goals

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 pursue targeted goals over the next five years. Note 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 that Canada properly manages its health care and social programs, culture, economy, and natural resources.
- 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, 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 is appropriate support for users with the necessary resources.

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.

7. The Roadmap Forward

Objectives and goals indicate where you want to go and what you need to achieve. They do not indicate, however, how to produce the desired results. The roadmap offers this insight by presenting a series of tasks, each related to achieving specific goals.

Technology is the CGDI's foundation, but it no longer needs to be the primary emphasis. The future CGDI will focus on nurturing users and engaging new communities of practice.
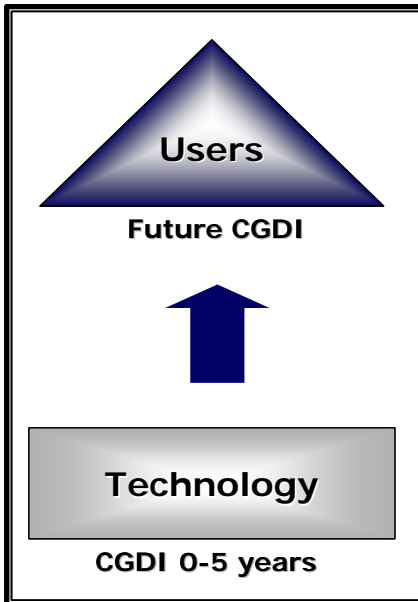
The goals of the Roadmap can be grouped into four key streams:

1. **Coordination** goals and tasks are intended to tie the other streams together with leadership, national partnerships and new models of governance.
2. **User** goals are aimed at reaching new and existing users, including decision makers and making them the drivers of the CGDI.
3. **Content** goals emphasize moving forward with new and richer sources of geospatial data and information.
4. **Infrastructure** goals are aimed at building on the successes of the CGDI and adapting to new standards, technology and tools to continue its progress.

7.1 Goal and Task Streams

The first step is to categorize the goals into the operational focus streams of coordination, users, content and infrastructure. Each goal has a series of tasks. These tasks are identified as requiring action in the short term (<18 months), medium term (1.5 to 3.5 years) or long term (>3.5 years). Individual tasks could

conceivably apply to more than one stream. The tasks have been positioned under the goal and stream they best address.

All partners contributing to the CGDI should see their roles in achieving the roadmap goals and tasks. Once implemented, each task will go a long way toward achieving the goals, and in turn the mission and vision, of the CGDI. These collective goals and tasks should serve as the foundation of the CGDI's future operational plans.

The Four Goal and Task Streams

The four goal and task streams are:

1. Coordination
2. User
3. Content
4. Technology

The following diagram shows the relationships among the streams.
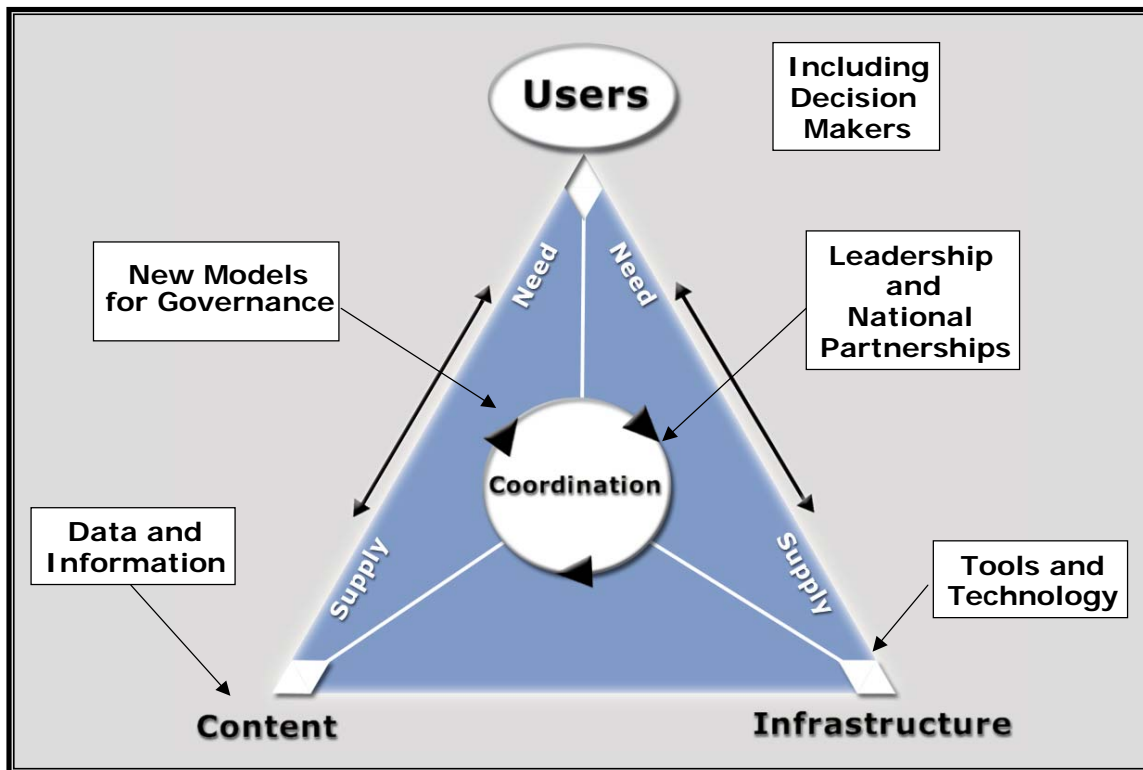
Coordination Stream

The CGDI has benefited from GeoConnections' solid leadership as well as its governance and advisory nodes. To realize the vision of the CGDI, this leadership must continue. Strong coordination and leadership will be required to keep the CGDI's wheels turning.

Goal one: Secure funding to support the future operations of the CGDI.

- Task: Develop a detailed business model for the CGDI, and focus on the CGDI's unique value propositions and sustainability. This task is the number one priority in the short term because it will present potential funding organizations with a bottom-line justification for the CGDI.

- Task: Seek funding opportunities and sources. Once the business model concepts are fleshed out, the CGDI will depend on a variety of sources of funding to move forward.

- Task: Annually audit and measure progress and identify areas for improvement. The CGDI should evaluate its progress yearly, and it should extensively assess its situation in the mid term to identify any progress gaps.

Goal two: Investigate new models of delivery with partners, thereby contributing to the CGDI's self-sustainability.

- Task: Develop new delivery models in collaboration with national partners with an aim to investigate self-sustainability. Permanent funding for the CGDI is unlikely, so it is important to investigate new models for operation that will support self-sustainability. Significant consultation and thought will need to start in the short term, as the delivery model may be a condition of future funding. Potential models include:

  - Government centred
  - Public-private partnerships
  - Fully public
  - Fully private

Goal three: Continue relationships with existing advisory groups, and create new groups where needed.

- Task: Analyze groups each year and determine gaps or overlap. A large number of advisory groups work with the CGDI. Managing these groups and participating in them can consume considerable resources, so group structure and mandate should be periodically examined. In the short term, it is important to note that no provincial/territorial or municipal-specific groups exist, although they are important stakeholders and target audiences.

Goal four: Communicate developments and create services to keep partners informed of opportunities and technology updates.

- Task: Develop and implement a communications and marketing strategy for partners and users of the CGDI, and refine and assess this strategy yearly. Marketing and communications will be important to attracting and keeping users. This high-priority, short-term task will need to be given resources and maintained in all periods.

- Task: Integrate news, updates and opportunity services into the communications and marketing strategy. This specific service should allow

for customizable and preference-driven messaging and can be undertaken in the mid-term.

- Task: Create an annual publication for the user community that presents an overview of the CGDI's development status and promotes the CGDI's benefits and current uses. This flagship publication should highlight the professionalism and quality of service embodied in the CGDI. It should be undertaken in the mid-term and be integrated into the communications and marketing strategy each year.

User Stream

The first years of the CGDI have rightfully focused on technology. The next era of the CGDI needs to focus on serving users and building a strong user community. In the past, the CGDI primarily served technical users. In the future, the CGDI will expand to also serve those who have little or no technical expertise. To appeal to these non-technical users and broaden its user base, the CGDI needs an appropriate support infrastructure.

Goal one: Drive future CGDI development based on user needs.

- Task: Each year, consult with users to find out what applications, content and training they need. This is a high-priority task that should be undertaken annually.

- Task: Improve usability and user interfaces. Usability is a high-priority, short-term objective that should be tackled as soon as financing is in place. Better interfaces that meet user needs will improve the services to the user community.

- Task: Develop a greater number of Web services. This mid-term technology task must be linked to user service needs.

- Task: Expand search capabilities. This mid-term task is required to provide a more user-friendly and expanded search capacity.

Goal two: Situate the CGDI as the primary channel for Canadian geospatial information across all sectors and levels of government.

- Task: Enable the geospatial data infrastructure to serve new users and communities of practice. This undertaking is a high-priority, mid-term task because it relies on work to be implemented in the short term.

- Task: Investigate legislative and policy agendas at federal, provincial/territorial, and municipal levels of government, and link geospatial information to appropriate priorities, like emergency preparedness. This work has to start in the short term and continue on an ongoing basis.

Goal three: Ensure there are appropriate service supports for users with the necessary resources.

- Task: Create a yearly service plan to ensure that the user community has appropriate support and service. This short-term resource-planning priority will be an essential selling point of the service to new users.

- Task: Consider appointing regional or provincial/territorial CGDI representatives to encourage contributions and to serve as the principal liaison with provincial and municipal governments. Having their own CGDI regional representative that serves both a support and marketing role might ameliorate provincial/territorial and municipal relationships. This would be a mid-term task.

- Task: Consult yearly with partner and user communities. By undertaking a mix of face-to-face and electronic consultations, the CGDI can keep its finger on the pulse of its community. This short-term task must continue into the long term.

Goal four: Foster opportunity within the geospatial and user community.

- Task: Provide incentives to industry and user communities to develop the geospatial industry. Government should help to kick-start initiatives in key growth areas. In the short term, these areas need to be identified, and once financing is received, appropriate projects need to be supported and undertaken.

Content Stream

The CGDI's value depends largely on the availability of accurate, up-to-date geospatial information and data. This content should be driven by user needs and assist decision making.

Goal one: Facilitate policy development and enable decision making based on geospatial information and content.

- Task: Assess compliance with the Privacy Act especially in relation to contributed data sets. The assessment could be conducted in the short term to identify any challenges up front.

- Task: Create service standards to ensure accuracy and timeliness of data. This data will be employed by many potential users to make decisions. Standards should be researched and implemented in the short term.

- Task: In the mid term, ensure that standardized data access formats are available to help analyze data and develop applications. This technology task will underlie policy and decision making. Although data may be available, it must be in a format that end-users and application developers find easy to work with.

Goal two: Enable the CGDI to provide comprehensive federal, provincial/territorial and municipal framework data.

▪ Task: Continue to expand contributory relationships with all provinces and territories and several major municipalities. The groundwork for this task needs to be laid in the short term to ensure progress in the mid term. This long-term task is a high priority.

▪ Task: Provide more framework and thematic data from each province and territory and several major municipalities. This data should come from common priorities identified in user needs assessments. Building on contributory relationships is the ideal approach for receiving the best information from authoritative sources. This mid- to long-term goal will increase the CGDI's value significantly.

Goal three: Build on the foundation, established in 2001 with the Geomatics Accord, and look to formalize relationships at the provincial, territorial, local and international levels.

▪ Task: Create bilateral relationships with provinces and territories and partner with an aim to gain municipal contributions. Short-term strategies for fostering participation need to be investigated, implemented and continued.

▪ Task: Continue to investigate international synergies and information exchange. The value proposition of the CGDI will only increase with integration and partnerships at the international level. This low-maintenance task should be used to uphold relationships in the short term, but it should be ramped up in the mid term to foster expansion.

Technology Stream

The previous streams contained technology tasks that were oriented to leadership and service. Technology is the foundation of the CGDI and will continue to be so. The key goals of this stream will maintain the CGDI's emphasis on open standards and specifications and reinforce it with authoritative sources of information and data.

Goal one: Monitor and contribute to the work of the OGC and ISO in partnership with industry, academia and all levels of government.

▪ Task: Ensure contributions and developments in geospatial standards and specifications include input from CGDI partners including industry, academia and government. The CGDI has previously led this area but should rely more on contributions from partners in industry and other levels of government. This short-term task will continue into the long term.

Goal two: Continue to develop high-quality technological infrastructure.

▪ Task: Move further towards a more distributed systems model with less reliance on Natural Resources Canada's (NRCan) infrastructure. Today, NRCan provides many of the CGDI data sets. Models for distributed systems need to be pushed in the short to mid term.

- Task: Create a CGDI service registry that helps users discover and access services. This service registry is required in the short term.

- Task: Develop tiered security models to protect proprietary and sensitive information and data from unauthorized access. This is a mid-term task.

7.2 Major Milestones

Major milestones associated with the four streams—coordination, user, content and technology—allow progress tracking. Milestones can apply to multiple areas and have been grouped into short-, mid-, and long-term stages.

Short-term Milestones (0-18 months)

1. Funding sources identified. This critical milestone will impact the future of the CGDI.
2. Advisory group assessment performed. New groups are created, and old groups are maintained, modified or ceased.
3. User needs identified. Common priorities and specific requirements are established regarding both data and technology.

Mid-term Milestones (18-36 months)

1. Recommended governance model proposed to partners. New era for the CGDI governance structure to build on national partnerships.
2. Service plan implemented and evaluated by users. This step is essential to nurturing a vibrant user community.
3. New communications and marketing strategy implemented, used and evaluated. This step complements the service plan to strengthen and sustain user-community growth.
4. A CGDI registry service designed, created and put into operation.

Long-term Milestones (36 months +)

1. Three new federally led communities of practice using the CGDI's geospatial information for policy and decision making. This achievement will ensure momentum to solidify the CGDI.
2. Ten provinces and territories and 10 major municipalities contributing to the CGDI. This level of participation will cement the CGDI's position as the leading source for Canadian geospatial information.
3. Significant growth in industry success stories based on unprecedented accomplishments in the Canadian geospatial industry.
4. Five times the number of web services now available. If based on user needs, this service growth will add substantial value to the CGDI.
5. Greater number of international partnerships. The CGDI will benefit from cross-jurisdictional collaboration.

8. Final Comments on the Road Ahead

The roadmap to achieving the CGDI's vision is complex and challenging, but ultimately achievable and worthwhile. This roadmap provides an initial course to reach this objective, but the course will change over time and so will the roadmap. Nonetheless, the vision, mission and milestones outlined herein should not be forgotten or overlooked. CGDI stakeholders need to translate the goals and tasks into operational project plans for their organizations.

Despite the challenges ahead, renewed emphasis on coordination, users, content and technology will help the CGDI flourish. The future for the CGDI looks bright, and with the appropriate action, effort, and perseverance, the CGDI vision can become reality.

Appendix A: Guiding Principles

The CGDI has enjoyed successes and challenges over the past five years. At its inception, several guiding principles 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 these principles. The community also suggested that three new principles be included.

The original principles (founding principles) are listed in order of importance; the three new principles (building principles) follow in no particular order.

Founding Principles

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

2. **Transparent:** The CGDI will allow users to access data and services seamlessly in a manner that removes the complexities of the underlying technology and information infrastructure. "Seamless" implies the elimination or hiding of artificial boundaries introduced by jurisdictions or by technical issues such as scale or quality of information.

3. **Cooperative:** The CGDI will help organizations from the private sector, all levels of government and academia collaborate. The CGDI will define common technologies and standards rather than prescribe single or proprietary implementation solutions.

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

5. **Timely:** The CGDI will define and recommend technologies and services that will support timely or real-time access to information. The CGDI may define minimum levels of service for those contributing to the CGDI.

6. **Self-sustaining:** The CGDI will be sustained through the contributions of the participating organizations and the broad user-community and through being relevant to these groups.

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

Building Principles

- **User-driven:** The CGDI will emphasize the nurturing of and service to a broad user community. This approach will include user-driven developments, services, and enhancements that facilitate policy and decision making.

- **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 emphasis will increase quality and efficiency by eliminating duplication and overlap. The CGDI will need to be developed further through partnerships with municipal, provincial and territorial governments; other federal departments and agencies; as well as international sources.

- **Secure:** The CGDI recognizes the importance of openness but realizes that a need exists to secure sensitive or proprietary data. This need for security is augmented by the requirement for high stability and data reliability.

Appendix B: Glossary

Term	Definition
Application	The combined set of software programs that perform a specific function directly for a user. Further, a CGDI application is the utilization of CGDI technology (e.g., tools and/or services) and CGDI data by a given user or community of practice to address a specific issue.
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.
Canadian Geospatial Data Infrastructure (CGDI)	An Internet infrastructure composed 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 Canada's geospatial databases and make them accessible on the Internet.
Client	A software component 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).
Conceptual Architecture	An overview of the services, data, technology and institutional environment of the CGDI. It describes, in general terms, both what the CGDI will include and how it will operate.
Data	Distinct pieces of factual information, especially information organized for analysis or used to reason or make decisions. Data is usually formatted in a special way and exists in a variety of forms. Data in the CGDI comprises maps, satellite images, publications and other geospatial data provided by Canadian and international sources.

Event	An occurrence of interest to users or developers of the CGDI. Events can be things such as the adjustment of a feature in a framework data layer, a flood in the Red River basin or the release of a new specification for a CGDI service.
Framework Data	The set of geospatial data that provides the reference framework for all other CGDI data.
Gazetteer	Dictionary of instances of a class or classes of features containing some information regarding position.
Geodata	Georeferenced spatial data such as a road network or a satellite image. Geodata explicitly describes the spatial extent of a set of features or describes a measurable surface. It includes both geospatial data and geolinked data.
Geographic Information System (GIS)	A computer system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data related to positions on the Earth. A GIS can be used for handling various types of maps. These maps 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 Markup Language (GML)	An open XML grammar specification used to transfer geographic features via the Internet.
Geolinked Data	Data that is referenced to an identified set of geographic features without including the spatial description of those features. Geolinked data is normally attribute data in tabular data (such as population counts) that refers to a known framework (such as provinces), where the elements (the provinces) are referred to by their unique identifier (such as the province name). Geolinked data refers to all attribute data that is not directly attached and bundled with the geographic coordinates to which it applies.

Geospatial	Referring to location relative to the Earth's surface. "Geospatial" is more precise in many GIS contexts than "geographic," because geospatial information is often used in ways that do not involve a graphic representation, or map, of the information.
Geospatial Data	Data with explicit geographic positioning information included, such as a road network from a GIS, or a georeferenced satellite image. Geospatial data may include attribute data that describes the features found in the dataset.
Geospatial Information	Information about entities and phenomena that includes their location with respect to the Earth's surface. Frequently used as a synonym for "geodata"; but technically geodata are "dry" digitally represented facts or recorded observations, which on their own have no meaning. They become information when interpreted and put in context by humans.
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.
Interface	A specification for a set of operations that are made externally available by a component to other components. The state and functionality of a component are hidden and are 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 be used by many components or applications.
Metadata	Information about data. Metadata describes how and when and by whom a particular set of data was collected and how the data is formatted. Metadata is essential for understanding information stored in data warehouses.

Reference Architecture	A technical blueprint that identifies and defines the services that comprise the CGDI and specifies the interfaces to those services.
Registry	A listing of the individual datasets, services, or other things made available by an organization to users of the CGDI.
Server	A physical installation of a component that delivers a service and provides the realization of its operations.
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.
Specification	A document written by a consortium, vendor, or user that specifies a technological area with a well-defined scope, primarily for use by developers as a guide to implementation. A specification is not necessarily a formal standard.
Standard	A document that specifies a technological area with a well-defined scope, usually by a formal standardization body and process.