GeoConnections – Canada's Geographic Information on the Internet

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ABSTRACT The GeoConnections program is building the Canadian Geospatial Data Infrastructure, an important resource for Canadians and one that will make a valuable contribution to realizing the vision expressed in the Digital Earth.
KEY WORDS Canadian Geospatial Data Infrastructure (CGDI), GeoConnections, National Atlas of Canada.

1. Digital Earth

The sweeping long-term vision of the Digital Earth is known in Canada but has yet to attract the excitement that has appeared elsewhere. Nevertheless, the federal and provincial governments of Canada are devoting considerable resources under several broad topics that would be components of the Digital Earth. While some might seek a coherent, coordinated and sustained plan of action, the concept is much more organic in the way it will grow, adapt, and embrace other initiatives. As such, it is hard to predict precise outcomes, timetable and impacts.

Perhaps the most visible program at present is "Connecting Canadians" (http://www.connect.gc.ca/). Two of its many facets are particularly relevant in the context of the Digital Earth. The first covers the technological services needed to be connected; the second relates to the content and services to which Canadians are connected.

"CANARIE" (http://www.canarie.ca/), a joint venture of the federal government and major telephone companies, has built a high speed Internet backbone for Canada. This network, known as CA*net II, is connected to other similar networks around the world. As important as the technology, is the support being given for the associated applications research, demonstrations and pilot projects.

More local in its application, the government is working in an array of partnerships to bring Internet access to all Canadians. This includes providing network connections and the computer equipment to all schools as well as other public facilities (e.g. libraries and community halls) throughout the country. In practice, the physical installations are nearly complete and, in a second round, sophisticated information server technologies are being installed in many schools in which the server receives frequent updates of relevant content from a satellite data link.

Complementing these internet connections are a number of programs which foster the collection and structuring of content both vertically and horizontally. Such sites on the World Wide Web are know as portals. Examples of vertical portals are http://strategis.ic.gc.ca/ for business and http://www.schoolnet.ca/ for education. Examples of horizontal portals are easier to find: most government departments and industry associations offer a great deal of information related to all dimensions of their mandates. The rest of this presentation deals with GeoConnections (http://www.geoconnections.org) a program which is developing Canada's access to geospatial information on the Internet. In the terminology used above, GeoConnections is building a horizontal portal to geospatial information.

2. Canada's Geospatial Heritage

Canada, it has been remarked many times, has too much of geography and too few people. Canada is known traditionally as an exporter of wood products, metals, energy and agricultural products. In large measure, it is these (as well as trapping and fishing) that have driven the exploration and development of the nation. As always, the physical (and environmental) geography interact with the economic, social, and cultural geographies to give the land its complexion.

Geospatial information was recognized as being an essential element for the development of the nation and Canada has had programs for the systematic mapping from its earliest days. It has had fur traders who, with the local knowledge of the Indians, traced the river systems, railway surveyors who laid the way for the settlement of the West, and

geologists who sought mineral deposits in the North. Following the Second World War, complete airphoto coverage was acquired and systematically converted into base maps. New mapping and analysis tools (analytical photo plotters and geographic information systems) were pioneered.

With this heritage, Canada is building the Canadian Geospatial Data Infrastructure (CGDI). GeoConnections is the funding program which contributes explicitly to the development of the CGDI. CGDI addresses the creation and use of framework data sets, information discovery and access, partnerships for data acquisition, the policy environment and encourages the use of international standards.

In many respects, the National Atlas of Canada has always been a representation of the geospatial information infrastructure in Canada. The 1st Edition of the National Atlas of Canada was published in 1907. A version of the 5th Edition became one of the first pubic interactive mapping tools on the World Wide Web (the Web) in 1995. The 6th Edition (http://atlas.gc.ca), rolled-out in August 1999, exists only on the Web.

3. A Window Through the National Atlas of Canada

Like many complex information communities on the Web, CGDI has many entry points (http://www.geoconnections.org) and presents many views of itself. To the Web user, CGDI offers three services as part of the National Atlas Information Network:: a discovery tool, a visualiz-ation tool and service for delivering free data. These services are interoperable and the integration is being improved rapidly. The discovery tool (http://ceonet.ccrs.nrcan.gc.ca) is an example of the state-of-the-art in the management and searching of geospatial meta-data. The design of the National Atlas Information Network is presently being changed to put the visualization tool in front of the discovery tool. This unusual architecture will permit the user to exploit the information resources (geospatial data frameworks and attributes) of the National Atlas of Canada (http://atlas.gc.ca) as the first step of the search process. For example, it will be possible to phrase a query of the type: please give me thumbnail images and base maps for all locations in Canada where burrowing owls occur within 100 km of protected areas as defined by the World Wildlife Fund (WWF). The search would begin by creating a 100 km buffer around the protected areas (a geospatial framework, WWF designation is an attribute). This would be intersected with the ecozones (a framework) containing the range of the burrowing owl (an attribute). This would yield an oddly shaped set of polygons within a specified region of Canada. Using these polygons as a parameter, the discovery tool would be invoked to search known data bases (possibly sending searches to collections around the world) for the appropriate satellite and base map coverages. The data bases would return thumbnail imagery to the discovery tool which in turn communicates with the user's browser. If the base maps were available free of charge, the current implementation of the delivery tool (http://geogratis.cgdi.gc.ca) would determine the datum, projection, format and delivery mechanism preferred by the user, perform the transformation and notify the user the product was available.

This is an exceptionally powerful set of tools that will make possible assemblies of information that in the past could only have been completed after many months of work.

4. Building a Solid Foundation

The Canadian Geospatial Data Infrastructure makes extensive use of two principles to speed its development and ensure the interoperability of the various systems, services and data sets.

The first is the adoption of international standards. Although robust and well accepted standards do not exist for all aspects of a geospatial information infrastructure, Canada has attempted to use the most suitable, best supported and most widely used standards from the international community. For example, the discovery tool is based heavily on thinking developed over many years in the Earth observation community (http://gcmd.gsfc.nasa.gov/ceosidn/) and was built to be interoperable with the Federal Geographic Data Committee's clearing house (http://www.fgdc.gov/). Similarly, as the Global Spatial Data Infrastructure (http://www.eurogi.org/gsdi/) becomes better understood As improved standards come available, *e.g.* those originating from the International Standards Organization Technical Committee 211 (http://www.statkart.no/isotc211/) or from the Open GIS Consortium (http://www.opengis.org/), the existing Canadian tools will be adapted and extended. Beyond this, it is recognized that certain Canadian data bases will need to contribute to and be interoperable with international data bases such as are being built by member of the International Steering Committee for Global Mapping (http://www1.gsi-mc.go.jp/iscgm-sec/).

The second is the implementation of geospatial data frameworks. The concept of a framework is well understood and many exist but few are in

general use. As a first step, the Geomatics Canada created a data alignment layer from the National Topographic Data Base. This is a collection of readily identifiable points in the landscape to which other features (in other data sets) can be referenced. GeoConnections catalyzed the assembly of a uniform representation of the Canadian road network from the data holdings of Geomatics Canada, Elections Canada, Statistics Canada and Canada Post. GeoConnections is in the process of moving other geospatial frameworks (*e.g.* administrative boundaries, census divisions, electoral boundaries, ecozones, protected areas) out of the domains of the specialists who created them. Other agencies, perhaps with less expertise in geospatial operations, will be encouraged to add their information to these frameworks, usually as attribute tables. Custodians see this approach as a help in maintaining the data bases. The greatest benefit is that it simplifies the geometric alignment of the various data sets and encourages contextual and semantic interoperability. With sufficient data attached to a framework, and the relationships between frameworks established, it becomes much easier to carry out analytical tasks (*i.e.* integration, complex queries, modelling).

It is readily apparent, that GeoConnections can only succeed if there are effective partnerships. A great deal of effort has been expended to demonstrate the reciprocal benefits to the partners as well as the larger benefits to the infrastructure itself. A spirit of cooperation and advances in technology permit these partnerships to work in ways that would have been remarkable only a few years ago. For example, an agreement has just been put in place for an industry association to maintain, directly, the railway network, in the National Topographic Data Base in return for access to the entire data base.

5. Social and Economic Benefits

A geospatial information infrastructure makes it possible to realize many of the benefits claimed for geospatial information and geographic information systems for decades. The geomatics community has, over the years, developed data bases with increasing sophistication and demonstrated very important applications. Those that were successful were usually in an environment in which all the steps, from data capture to reporting, were controlled within a single organization. That is to say, the integration external data sets was promised but exceedingly difficult in practice. The list of impediments is well known and well used.

Implicit in the building of a geospatial information infrastructure is the concept of interoperability. The greater the degree of interoperability of data bases, the larger the number of interoperable services working on the data or chained one to another, the more valuable the infrastructure in as much as the geomatics professional is able to exploit the full potential of the information and the analytical tools.

Benefiting from the contribution of the geomatics professional to the geospatial information infrastructures, connected citizens may explore the geographic aspects of their economic, environmental, social and cultural surroundings. They can find the data, tools are available, and guidance is offered. This permits many more people to be engaged independently in the process of informed decision making and open government.