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Canada's Role in Advancing Interoperability Through the Open GIS Consortium (OGC)

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Introduction

Canadian private and public sector organizations have been leaders in the development and use of digital geoprocessing technologies since the 1960s. The Open GIS Consortium (OGC) is pleased that Canadian organizations have played an important role in the growth of geoprocessing interoperability through their participation in the OGC in the early 1990's and beyond. Canadian companies, universities and government organizations participate in the OGC, along with 214 members from 26 other countries. Together these members participate in the development of publicly available software interfaces and schemas that enable interoperability among different brands and types of geomatics software. Most of the world's major vendors of GIS, AM/FM, Earth imaging, surveying/maping, navigation and location services software are involved. The specifications developed by OGC are becoming key elements of Spatial Data Infrastructures (SDIs) around the world, including the Canadian Geospatial Data Infrastructure (CGDI). To appreciate where interoperability is today, in Canada and worldwide, its worth exploring the contributions made by OGC's Canadian members.

The early years

In 1992, two years before OGC was founded as an industry standards consortium, OGC's founders started the Open GRASS Foundation (OGF). OGF's mission was to nurture commercial activity based on the Geographic Resource and Analysis Support System (GRASS), an open source raster and vector GIS developed by the US Army Corps of Engineers. The goal was to develop a viable open source model for the geomatics industry, to provide users with greater choice, control, economy and interoperability.

Bob Moses, president of PCI Geomatics, made his company OGF's first commercial sponsor. PCI's support was critical to OGF's survival in those difficult early years. Osiris Systems of Sidney, B.C. was also an early OGF member.

Experience led the OGF principals to reorganize from a foundation to an industry standards consortium called the Open GIS Consortium, Inc. The GRASS open source model might have resulted in a robust and widely used "free" GIS, reducing software costs for some users. But it would always have competed against commercial GIS and Earth imaging systems, and it could never have provided the interoperability among these

systems that was needed by users. The open or shared interface model, if the vendors could be persuaded to work together to implement it, offered the possibility of a rich variety of commercial products communicating “transparently” across local and wide area networks.

OGC faced difficult technical and organizational challenges from 1994 to 1998:

– A distributed computing architecture had to be devised that would enable interoperability across diverse, competing distributed computing platforms, including at least OLE/COM and CORBA, with accommodations for JAVA. There was, of course, an increasing market focus on the World Wide Web.

– Most members thought it was necessary to develop a good working liaison with ISO TC/211 and other standards organizations in this technical space. The relationship with TC/211 was not strong at first, but it evolved as the two organizations sorted out their complementarity. Similarly, in the U.S., OGC’s relationship with the Federal Geographic Data Committee has strengthened over time, and in Canada, OGC’s relationship with Natural Resources Canada (NRCan) has strengthened over time.

– It was necessary to develop critical mass, recruiting and keeping enough members whose commitment was sufficient to sustain activity over several years of developing the OpenGIS Abstract Specification, before interoperability would be possible.

Through the power of the idea, the needs of user members, and the faith and commitment of technology provider members, OGC survived, agreed on a basic architecture, and began steadily building a set of OpenGIS Implementation Specifications.

Mark Sondheim of the British Columbia government attended some of the earliest technical meetings that eventually led to OGC. He was leading the development of SAIF (Spatial Archive and Interchange Format), and in 1991 he presented SAIF at one of these meetings. SAIF is of interest because it is a self-describing format based on an extensible geographic object paradigm, including a Class Syntax Notation for expressing object models and an Object Syntax Notation for representing instances conforming to the models. SAIF and these notations are clear precursors to OGC's Geography Markup Language (GML). Mark argued persuasively for an object-oriented approach based on common interfaces, helped develop the methodology for specification development and was a principal author of the first prototype OpenGIS Specification. The Feature Manipulation Engine (by Safe Software), a widely used interoperability tool, now with strong support for GML, began its life as a SAIF translator capable of model to model transformations. More recently, and with support from the Canadian GeoConnections program, led by NRCan, Mark initiated the Java Topology Suite, an open-source development (by Vivid Solutions) that implements OGC predicates and functions. He has also helped back the development (by Refractions Research) of another OGC based open-source exercise, the postGIS spatial extensions to the open-source postgreSQL database.

Ron Lake of MacDonald Dettweiler Associates (MDA) came to his first meeting in 1993. MDA was a consultant on SAIF. Ron Lake had initiated a project at MDA called Geomate, in which Don Murray and Dale Lutz were later involved. MDA was involved in SAIF because Geomate was an object-oriented GIS and photogrammetric system. Around 1994, Ron contributed to the object-oriented view of spatial information systems in OGC, offered the idea and the name of "Information Community," and helped write various parts of the OpenGIS Abstract Specification.

Orest Halustchak of SHL System House was an early Canadian participant, as well as Mark Ashworth of UNISYS System Nine.

Global Geomatics (Montrèal, Quèbec) submitted a proposal in 1996 for OGDI (Open Geospatial Datastore Interface) in response to OGC's first Request for Proposals, which requested proposals for "Simple Feature Access" in the Internet distributed computing domain. OGDI, which at that time was already quite well developed and had been implemented by a number of OGC members in some of their products (mainly for use in major Canadian government programs), enables cross-application access to data stores. It is a set of interfaces that enable a server to respond to data retrieval requests received from other applications. OGDI can pass information that matches the search criteria from a number of proprietary and non-proprietary data store types: VPF, Arc/Info, MGE, MapInfo, LaserScan, Arc/Shape, Small World, and others. Several off-the-shelf products provide this capability today. Unfortunately, this data access approach required a unique interface for each vendor's data format. This was different from the approach OGC sought, which was based on all the vendors, integrators and non-commercial developers agreeing on and adhering to a single interface specification for each of a wide number of operations in addition to data access. As this capability for interoperable processing was not present in the OGDI proposal to OGC at the time, OGDI failed to gain the consensus of OGC members.

In the intervening years, OGDI has been "wrapped" with interfaces that implement OpenGIS Specifications, so OGDI installations can now interoperate with other installations that have such interfaces. This open source software was, until November 2002, maintained by the Information interoperability Institute (3i) in Hull (Quebec).

3i was formed in 1999 to encourage the development of interoperable, open standards-based solutions to challenges in Web-based access to information, in particular geospatial information, in support of informed decision-making by end users. 3i was based on a Canadian membership comprised of private and public sector organizations closely involved in the development of interoperable products and in their integration in information infrastructures. 3i was a member of OGC and participated in OGC pilot project activities. 3i also held an annual forum in the Fall of 2001hat allowed a variety of stakeholders to learn about on-going efforts in the field of interoperability. 3i closed its operations in November, 2002.

Following attendance of early meetings of OGC by Bob O'Neil of Natural Resources Canada and Tim Evangelatos, staff from the GeoConnections program developed a

working relationship with OGC. NRCan joined OGC in the spring of 1997 and is now a Principal Member. NRCan is also the lead agency in GeoConnections, a national partnership initiative to build the Canadian Geospatial Data Infrastructure (CGDI), which will provide Canadians with access to geospatial information, technologies and services over the internet.

Board Participation

Canada has also been represented on OGC's Board of Directors, an international group of individuals who are prominent in geoprocessing and related domains of activity.

Dr. John McLaughlin, now President and vice-chancellor at the University of New Brunswick in Fredericton, N. B., served on the Board from 1998 to 2000. He is one of the world's most well-known and respected experts in land administration, land information management systems, and the use of geographic information in public decision-making.

Dr. Robert Moses, president and CEO of PCI Geomatics, recently joined OGC's Board and will begin his term in February, 2003. In addition to his 17 years of executive experience at PCI Geomatics, Dr. Moses brings to the OGC Board a wealth of industry knowledge gained through advisory positions to various Canadian government bodies. Dr. Moses serves as: a member of the Council of Science and Technology Advisors for the Government of Canada; Co-chairman of the National Advisory Board on Earth Sciences for the Ministry of Natural Resources, Government of Canada; Chairman of CRESTech (Centre of Research for Earth and Space Technologies), Ontario Center of Excellence; Chairman of the Ministerial Advisory Council on Science and Technology for the Ministry of Natural Resources, Government of Canada; member of the Board of Director of GEOID a National Centre of Excellence; and Geomatics Industry Champion for the Government of Canada Innovation Agenda.

The Emergence of Web Mapping

In 1998 and 1999 it became quite clear that the Web would become the dominant distributed computing platform for distributed geoprocessing. This was not a surprise to many of the technologists in OGC, including a number of Canadians. Indeed, Ron Lake and Mark Sondheim had participated in a project in British Columbia in the early 90's to build a distributed spatial information system. The system was migrated to the emerging World Wide Web when Mosaic became available on Windows.

The Canadian companies Compusult, CubeWerx and Galdos played a role in OGC's very successful first Web Mapping Testbed (WMT-1), along with participants from a number of other countries. This testbed launched OGC's Interoperability Program, which uses testbeds, pilot projects, and other "interoperability initiatives" to rapidly develop, test, and promote the implementation of OpenGIS Specifications. WMT-1 led to OGC's focus on implementation specifications that are dependent on the Web platform, and to OGC's promotion of the "Spatial Web" (or "Geo-Web," as some members refer to it).

Ron Lake founded Galdos Systems Inc. in Vancouver in 1992 and turned it into a full time business in June 1998, just before the Web Mapping Testbed began. From December, 1998 onwards Galdos has focused on the development of Geography Markup Language (GML) in OGC. GML has become the world standard for encoding of spatial data in XML (eXtensible Markup Language). Because XML-structured text can be parsed by virtually all Web browsers, and because applets, servers or client applications can process and present the text-encoded data in very flexible ways, GML is a very powerful geodata format. It has been adopted by the U.K. Ordnance Survey, the U.S. Census Bureau and a growing list of other organizations. Because XML is essentially a language for writing data schemas, it promises automated translation between different Information Communities' data dictionaries, and will thus play an important role in data coordination and automated data sharing. Ron Lake authored the main GML technical documents and worked with the Japanese to harmonize their early efforts and OGC's efforts. As Chair of the GML working group in OGC, he has continued to lead the GML development effort and to promote GML in OGC and in the world of enterprise computing. OGC honored him with the Ken Gardels Award in June, 2002 in London (U.K.). He was introduced at that event by NRCan's Terry Fisher.

Galdos has also been active in the development of products supporting GML and OGC Web Services, and in the development of related specifications such as the Web Registry Service (for which Galdos is lead author and editor), the Web Feature Service (for which Galdos is a member of the RWG) and the Styled Layer Descriptor (for which Galdos is a member of the RWG). Galdos has participated or is currently participating in eleven different OGC pilot projects and test beds leading to or evaluating OGC specifications.

Established in 1996, CubeWerx has developed its entire business model around developing software products responding to requirements for interoperability in Spatial Data Infrastructures. In OGC, CubeWerx was an important contributor to the original OpenGIS Web Map Server Specification. More recently, CubeWerx staff played key roles in the adoption of three new version 1.0 OpenGIS Specifications at the September, 2002 OGC Technical Committee and Planning Committee Meetings in Noordwijk, Netherlands. Peter Vretanos of CubeWerx was the editor of the OpenGIS Web Feature Server and Filter Specifications and Bill Lalonde of CubeWerx was the editor of The OpenGIS Styled Layer Descriptor Specification. CubeWerx has participated in four OGC testbeds that produced "Interoperability Program Reports" that resulted in new OpenGIS Specifications. CubeWerx also participated in four OGC pilot projects that tested interfaces based on OpenGIS Specifications and that resulted in change proposals to those specifications. In 1999 CubeWerx pioneered Web service chaining by developing the first "Cascading Web Map Server" which enables a user with a plain Web browser to access multiple map servers in a single session and flexibly overlay map views acquired from each of the servers. The Cascading Map Server has played an important role in Web Mapping Testbed 1 and in the final demonstrations of all subsequent OGC testbeds and pilot projects. Cubewerx has demonstrated that standardized services can be created which are reliable and robust.

CubeWerx is also an active participant in CGDI. CubeWerx is a member of the CGDI System Architecture Working Group (SAWG), CGDI Technology Advisory Panel (TAP) and the CGDI Access Node. CubeWerx was a founding member of 3i.

Following its pioneering involvement in the early OGC, PCI Geomatics has continued to play an active role in the OGC Technical Committee, Interoperability Program, and for most of OGC's eight years, the Planning Committee. PCI's Louis Burry has done much of the work on Feature Coverages, and Trevor Taylor has played a leading role in an OGC-focused European Commission project GETIS (Geo-processing Networks in a European Territorial Interoperability Study) with potential for a GIMES follow up project. Also, Stephane Fellah has led in specification work on the Web Coverage Server. PCI is also a strong supporter of GeoConnections and was an active member of 3i.

In recent years Compusult Limited has been actively involved in the specification and implementation of international data and metadata standards, especially within a Web-based environment. These specifications have been used to enhance and extend the Web-based components of Compusult's e-commerce products. The company's Technical Committee Membership in OGC is evidence of its commitment to promote the interoperability of geospatial information processing systems. Four of the OGC Web Mapping Testbed projects have included software from Compusult.

Participation in OGC's Interoperability Program and Specification Program

Canadian organizations have participated in almost all OGC Interoperability Initiatives beginning with the first Web Mapping Testbed (WMT 1) and running through WMT 2, to OWS 1.1 and CIPI. NRCan has been a sponsor of the Geographic Information for Sustainable Development (GISD) Initial Capability Pilot. Interfaces implementing OpenGIS Specifications will continue to be key elements of the Canadian Geospatial Data Infrastructure (CGDI). Canadian companies continue to supply quality proposals to initiatives, resulting in Canadian organizational involvement as participants in testbeds and pilots.

Canadian companies provide technical experts who chair three of the OGC Technical Committee's working groups: the Earth Observation Working Group, the GML Working Group, and Styled Layer Descriptor Working Group.

There are 17 Canadian OGC members as of 12/12/02:

British Columbia Institute of Technology	University Member
CARIS	Associate Member
Compusult Limited	Technical Member
Cquay, Inc.	Technical Member
CubeWerx, Inc.	Technical Member
Galdos Systems Inc.	Technical Member

Geosoft Corporation	Associate Member
Laval University, Center for Research in Geomatics	University Member
MacDonald Dettwiler & Assoc.	Associate Member
Natural Resources Canada	Principal Member
Niagara College	Associate Member
PCI Geomatics	Technical Member
Safe Software, Inc.	Associate Member
University of Calgary	University Member
University of Northern British Columbia	University Member
University of Waterloo	University Member
York University	University Member

Conclusion

Canada pioneered the field of geomatics in the world. It now continues to be a world leader in geomatics in an era during which the most significant geomatics advances relate to interoperability. The organizations mentioned in this article are helping to connect the world's geodata and geoprocessing resources to build a seamless set of geographic data layers covering the Earth like layers of an onion, available for thousands of uses by a variety of user communities. Canadian companies and agencies actively help build the enabling interoperability platform, because it is this platform that:

- Enables growth in a market which Canadian companies have helped to build.
- Enables Canadian geomatics companies to discover and profit from emerging geomatics market segments.
- Provides user organizations with greater choice of software and better options for data sharing, in Canada and outside Canada.
- Enables the establishment of a Global Spatial Data Infrastructure (GSDI), or the global "Spatial Web."

OGC's members and stakeholders are indeed fortunate to have these Canadian organizations engaged in OGC's project to integrate geospatial information into the Global Information Infrastructure.