

Oceans Management Internet Mapping Application (OMIMA): A GIS Web-Based Tool for Oceans Management

Dianne Michalak

Geomatics Consultant

4G-300 Roslyn Road, Winnipeg, Manitoba R3L 0H4

Phone: (204) 229-1016

Dianne_michalak@hotmail.com

Marta Wojnarowska

GeoArctic Ltd., Suite 1250, 815 - 8 Ave SW, Calgary, Alberta T2P 3T2

Phone: (403) 290-1320

mwojnarowska@geoarctic.com

www.geoarctic.com

ABSTRACT

The Department of Fisheries and Oceans (DFO), Central and Arctic Region in partnership with GeoArctic International Services Ltd. have successfully cooperated in a GeoInnovations 2001 project entitled “*Oceans Management Internet Mapping Application (OMIMA)*”. OMIMA is designed to provide coastal and ocean resource managers within DFO access to regional geographic data and mapping technologies as an aid to coordinated decision making and integrated ocean management. Oceans Programs Division has undertaken the collection of geospatial data for selected locations in the Canadian Arctic. The Mackenzie Delta and Beaufort Sea are an initial focus of the work, with significant oil and gas exploration and development taking place in the areas.

OMIMA provides access to the Oceans Programs Division spatial data warehouse and will maintain compliance with OpenGIS Web mapping protocols and FGDC metadata standards. The user interface is designed to facilitate maximum use by a variety of users including senior management, policy makers, scientists and GIS staff. It provides the user with the ability to browse and search the spatial data warehouse; create custom maps from diverse sources; query data attributes and access images, videos, audios, or documents in various formats; and search and retrieve metadata.

In addition OMIMA allows users to access other Web-based mapping applications such as DFO’s Oceans Program Activity Tracking (OPAT) system, developed by a different team with different Web tools, proving that interoperability among Internet mapping systems is achievable. The result is an elegant Web-based solution integrating an understanding of oceans management, web-based discovery and access of spatial data, databases, and several Web mapping applications.

Marta Wojnarowska received an M.Sc.E. in Surveying from the University of New Brunswick and has 10 years experience in geomatics. Marta is currently a Geomatics Project Manager/Coordinator at GeoArctic.

Dianne Michalak received an M.Sc from the University of Manitoba and has 4 years experience in geomatics. Dianne is currently a contractor providing geomatics support to Fisheries and Oceans, Central and Arctic Region, Oceans Programs Division.

KEYWORDS

Interoperability, Web Mapping, Internet GIS, OpenGIS

1. Introduction

The Department of Fisheries and Oceans (DFO), Central and Arctic Region (C&A) in partnership with GeoArctic International Services Ltd. have successfully cooperated in a GeoInnovations 2001 project entitled “*Oceans Management Internet Mapping Application (OMIMA)*”. Oceans Program Division (OPD) is responsible for the implementation of the Oceans Act, which came into force in 1997. The act outlines a new approach to oceans management through the development of Canada’s Oceans strategy and the supporting programs: Integrated Management Plans, Marine Protected Areas, and Marine Environmental Quality.

Recognizing that geospatial information is essential to developing a clear understanding of regional concerns, the department has begun the process of compiling and collecting geospatial data for selected locations in the Canadian Arctic. The Mackenzie Delta and Beaufort Sea became the primary focus of OPD-C&A activities due to the re-emergence of oil and gas exploration.

OPD-C&A partnered with GeoArctic International Services to participate in an OMIMA pilot project and provide a testbed for the development of new Web-GIS tools for GeoArctic's *SDM-geo* software. GeoArctic is developing a Web Mapping Service (WMS) Authoring Toolkit to publish geospatial data to the Internet in a project supported by a Natural Resources Canada funded GeoInnovations initiative. The toolkit will conform to OGC specifications, in particular to the OGC Web Map Service Interface.

2. Background

Since the inception of the OPD-C&A GIS Laboratory and spatial data warehouse, there has been a constant demand for mapping services. Maps have been used to understand management issues, communicate with the Northern communities, provide updates to senior management and support integrated management planning. Mapping and dataset requests are typically submitted by non-GIS users. The basic need of most of these users is to visualize data. The technical demands of GIS and the need for specific GIS software prevent these users from accessing data and creating a personalized map. Developing maps to meet the specific user's needs requires expertise in GIS and therefore maps have been produced by a GIS expert with knowledge of ArcView GIS. To support particular projects, a resource analyst was also trained in map creation using ArcView.

In addition to creating maps, requests for the datasets have also increased. The OPD-C&A GIS Lab is responsible for maintaining the spatial data warehouse, disseminating the Landsat 7 Ortho-image collection to other DFO offices and obtaining the Mackenzie Delta orthophoto data collection. As the demand for maps and GIS data continues to grow, there is a need to explore new technologies.

A solution to these challenges is the latest developments in Web-based mapping. Web-based GIS applications can provide interactive mapping, facilitate browsing and searching of the existing data collection and access to selected information. At OPD-C&A the functionality of Web-based mapping is aimed at an audience of non-GIS users. With very little training, these users can work with basic GIS query and visualization tools in an Internet browser. The provision of a web-based mapping application can provide users with greater and more timely access to data and the tools to display appropriate layers and access information needed.

3. Web-Based Solutions

From the user perspective, the required functionality of Web-based mapping is relatively simple. The user only needs to choose their preferred Internet browser whereas the developer must design the appropriate tools for the intended audience and prepare the data. The needs of the identified user group must be matched to an appropriate Internet map server software.

There are various Internet map server software packages that form the basis for GIS Web-base applications. Consider DFO as a user group. As a federal department, it's responsibilities span from coast to coast to coast. Each division within the department has specific responsibilities, for example, Canadian Coast Guard, Canadian Hydrographic Services, Science, Oceans Management, Fisheries Management and Habitat Management. Various applications and expertise are found in each division. Often different tools and methods exist between regions in any one division. As a result, projects across the five DFO regions use different technological solutions.

On the East Coast, MapInfo's MapExtreme has been used to provide access to fisherman traditional knowledge datasets. DFO headquarters in Ottawa developed the Oceans Program Activity Tracking System (OPAT) to provide information on Oceans Programs using Autodesk's MapGuide (<http://www.ncr.dfo.ca/canoceans/>). Habitat Management in the Great Lakes area used ESRI's ArcIMS for delivering regional habitat datasets through Intranet. The Pacific region developed a coast habitat Atlas for British Columbia (<http://www-heb.pac.dfo-mpo.gc.ca/english/maps.htm>).

The challenge to DFO is integrating the individual solutions into a department wide solution. However, today an organization is not limited by the need to standardize to one software solution to achieve interoperability. The OMIMA pilot project is implementing emerging OpenGIS standards that create the potential to move from one software environment to another relatively seamlessly. OGC standards currently under development will allow all systems that are OGC-compliant to communicate. Users will be able to find appropriate servers through the registry services to discover datasets served by these servers. Datasets from various servers in different formats will be integrated and overlain in one common view, providing that the client side of the software has ability to read the different data formats.

4. OMIMA Implementation

The two partners are located at different physical locations, DFO-C&A in Winnipeg and GeoArctic in Calgary. To facilitate project management, GeoArctic hosts:

- a secure collaborative workspace for project reporting, contact information, and access to development versions of the software components.
- a mirror site to mimic DFO-C&A's system environment for development and testing of WMS and OMIMA.

The development team members and the project managers attended several design meetings to determine initial specifications and design documents. OPD-C&A was further responsible for development of specific user requirements for OMIMA. Realizing the necessity for user feedback, GeoArctic developed a working prototype of OMIMA to illustrate the concept of web-based mapping. OPD-C&A provided sample datasets, which were setup up as an Internet web-base application. A secure, password-protected access was granted to selected DFO members. The prototype provided developers an excellent media to communicate the concepts and application of OMIMA.

Further development proceeded in a parallel manner. OPD-C&A team commenced organization of the selected geospatial data from the spatial data warehouse into several thematic projects using *SDM-geo* software. *SDM-geo*'s FDGC metadata editor was used to create FGDC-compliant metadata. Projects focused on oil and gas, environment, management and cultural aspects of the Mackenzie Delta and Beaufort Sea region, and Landsat 7 ortho-images for Canada.

GeoArctic's team started development of the WMS Authoring Toolkit. The toolkit includes OGC-compliant Web Map Server and OGC-compliant WMS View Clients. Web Map Server is used to serve data organized in *SDM-geo* projects. The backbone of WMS is *SDM-geo*, Image Web Server and OpenSource map server software. Image Web Server is a commercial product developed by Earth Resource Mapping. Image Web Server was selected as a part of the toolkit to provide a solution to serving large raster images across the Web. Images up to 10 gigabytes in uncompressed format were successfully tested in the Internet environment.

A View Client is a program that is executed from an Internet browser like Internet Explorer. Two types of View Clients are developed. A 'Thick' View Client performs work on the client side (user's computer) and thus unlimited simultaneous users can be supported. A 'Thin' View Client relies on the server to perform work. This provides the option for more powerful functionality on the server side, however, the number of simultaneous users affects the performance of the server.

When a user accesses OMIMA with Internet Explorer, the View Client sends an OGC-compliant request to WMS to check the datasets available from that server. A list of all the available datasets is loaded to the Client Tree View. The user can select data layers from the list to display. This action triggers another OGC-compliant request to the server and the selected layers are displayed in the map view. Figure 1 illustrates this general concept.

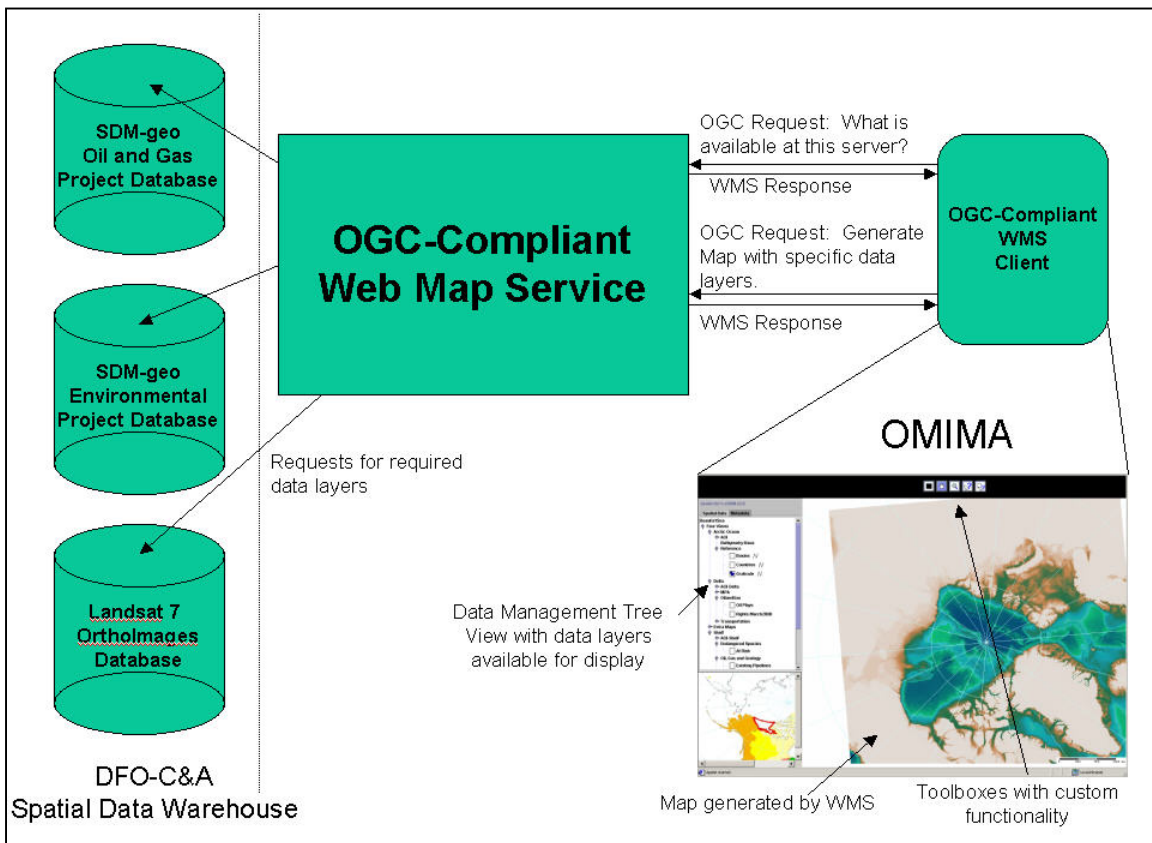


Figure 1. Conceptual Architecture of OMIMA

OMIMA can simultaneously access several *SDM-geo* projects. Toolboxes with functionality specific to each *SDM-geo* project will appear with the appropriate data layers. Vector and raster datasets are both integrated in the map view. OMIMA also provides access to various document types (reports, photographs, and databases) and querying and display of attributes. In addition to these basic functions, custom solutions were designed to meet the needs of specific users. For example, the ability to animate satellite tracking of sea mammals was incorporated to meet the needs of beluga whale and seal scientists.

OMIMA is scheduled to be installed at DFO-C&A location at the end of September 2002.

5. Benefits of OMIMA

Several factors were considered during the development of OMIMA:

- GeoArctic's *SDM-geo* software accesses selected geospatial data within a spatial data warehouse. *SDM-geo* is commercial spatial data manager software used to organize and catalogue geospatial data into projects, create FGDC-compliant metadata, and publish projects for distribution and use with desktop GIS software. *SDM-geo* has been used to provide quick access to the National Topographic Database tiles, including custom symbolization for use with ArcView 3.x. Additionally, *SDM-geo* also functions as a simple Internet map server. Projects organized with *SDM-geo* can be published as an html page with an embedded Java GIS applet for access via the Web.
- The WMS Authoring Toolkit is developed on top of *SDM-geo* software. This development directly enhances access capabilities to the spatial data warehouse.

- The developed toolkit includes technology to provide incredibly fast access to large images through the incorporation of the commercial ER Mapper's Image Web Server software. IWS technology relies on the combination of mathematical wavelet compression algorithms and dynamic zoom to make large raster datasets appear in literally no time on the users screens.
- Recognizing the importance of emerging interoperability standards, the design of an OGC-compliant application conforms to a long-term vision of avoiding duplication of efforts within the geomatics community by enabling communication among various OGC-compliant systems. This is an open solution, implementing leading edge techniques and technologies planned with long-term use in mind.
- The project will contribute to the enhancement of the Canadian GeoSpatial Data Infrastructure by incorporating standards for metadata which enable search and discovery of data through discovery services. Particularly, there are plans to register the existing data holdings with GeoConnections Discovery Portal.
- Finally, it has been recognized that partnering with private industry on this project will benefit both government and industry. It will be a team project, rather than a single-person project, where the synergy of the team will enhance the outcome.

6. Conclusion

Being OGC-compliant, OMIMA will be able to access not only its own WMS, but also other OGC-compliant web map servers. Requests for data can be sent to other web map servers and if the format of the dataset served is compliant with the OMIMA Client, the dataset will be available for viewing in the map window.

Other OpenGIS-compliant applications are currently under the development within DFO. The Marine Geospatial Data Infrastructure office is developing a portal for marine data. The portal, also developed as OGC-compliant, provides an excellent opportunity to test both applications. Developed independently from each other, based on different software solutions OMIMA and MGDI portal will provide a perfect testbed to see OGC standards at work.

The success of OMIMA will be measured from two perspectives. The success of *developing* new technology will be determined by the ability of OMIMA to communicate with other OGC-compliant servers and thereby prove the concept of interoperability. The success of *implementing* new technology will be gauged by the effort to integrate the technology into the DFO environment. Benefits from the successful development and implementation of OMIMA will be determined by the users. Although the goal of OMIMA is to develop new technology, the hope is that it will enhance the infrastructure needed for data access and dissemination.

Acknowledgments: The authors would like to acknowledge past and current members of the Oceans Program Division and development team of GeoArctic without whom this project would not be possible. We would like to thank Natural Resources Canada GeoInnovations initiative for providing funding for this project.