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OpenGIS: Locating IT

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Mapping and GIS Solutions

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Abstract

This paper outlines the latest developments within the Open GIS Consortium, especially with regard to the Open Location Services Initiative Testbed. The purpose of this testbed has been to refine the requirements for the location-based services standards necessary to provide a common platform for adding location as a useful attribute to such important applications as Asset and Workforce Management. This is particularly important as utility organizations seek to manage assets and their maintenance in a more efficient manner and equip their field staff with the information they need while servicing those assets.

Introduction

GIS in the utilities industry has grown out of the hand-drawn asset maps used by field crews to build and maintain outside plant. Initially introduced as a Computer Aided Drafting system to increase the efficiency of manual drafting staff, the addition of database attributes and GIS functionality to enhance the intelligence and usability of the system meant that the GIS became more useful in-house, where the computer facilities existed to use the technology. The benefits fell into three categories:

- Access to up to date information,
- Managed direct update,
- GIS analysis tools.

Meanwhile, field users still had to rely on paper maps as they always had. The only benefit to the field users was that the field maps, now being computer generated, were more up to date and of uniform cartographic quality. The benefits derived from the GIS technology were mainly being realized in-house. However, with the development of mobile computing devices and communications networks, the benefits of this technology can now be realized in the field.

The introduction of GIS technology brought with it another problem – incompatibility between organizations. Under the manual drafting system, information in the form of paper maps could be easily shared between organizations. With the introduction of proprietary computer based GIS, information from organizations with systems from different vendors could not be easily shared.

In the absence of standards and in the spirit of competition, GIS followed the general Information Technology trend of building proprietary systems that provided features that differed from their competitors. This resulted in organizations having their preferred brand of proprietary GIS. This did not cause a problem while the GIS was a standalone system. However, four trends, two business focused and two technology focused, conspired to upset this cozy arrangement.

Firstly, organizations that had traditionally been large government-owned monopolies, were broken up, sold off, and merged. This resulted in new organizations comprising a number of departments and divisions with incompatible GIS.

Secondly, GIS vendors went out of business, leaving their customers with unsupported systems that became very expensive to port to another system.

Thirdly, the general Information Technology industry was moving to standardize hardware and software to reap the benefits of customer choice, longer production runs and the elimination of needless reinvention of the wheel.

Fourthly, as GIS has moved more into the database environment, there has been a greater need for integration with other IT systems.

Faced with the expense of having to change GIS vendors, GIS user organizations have realized that they will in the future, probably have to change their systems again, but

next time, the system they move to ought to be one that is open, interoperable and vendor independent.

For these reasons, the Open GIS Consortium was formed in 1994 to cooperatively establish the standards upon which these future systems would be built.

OpenGIS Consortium

The members of the Open GIS Consortium are drawn from a variety of interested parties, including academics, users of spatial data and software and the data vendors, GIS vendors, and database vendors who supply them.

It is the mission of the OGC to define standards for use in the GIS industry to allow any data or software module to be used interoperably between vendors of that data or software.

To this end, the OGC began by approving, in 1997, a series of specifications for core GIS technology, which are collectively referred to as “Simple Features.” These are as follows:

- OpenGIS® Simple Features Specification for OLE/COM
- OpenGIS® Simple Features Specification for CORBA
- OpenGIS® Simple Features Specification for SQL.

However, the approach of defining a common data model, inherent in the Simple Features Specifications, has not delivered value in terms of interoperability. More recently, the OGC focus has shifted towards Open Web Services. The research leading to the Simple Features Specifications has resulted in definitions for essential components such as coordinate systems and feature geometry fundamental to the new generation of Web-based specifications. OGC Open Web Services follow the W3C use of XML as the key technology to communicate geographic information between heterogeneous systems.

To fulfill its mission, the OGC has established a number of initiatives to focus on various aspects of interoperability and has run a number of Testbeds to test and refine the standards proposed by those initiatives. Two of the key initiatives have been the Web Services Initiative and the Open Location Services Initiative.

OGC Web Services Initiative

The OGC Web Services Initiative (OWS) has been conducting a series of testbeds for producing a set of specifications required for providing a standard environment for sharing and using geospatial information. The testbeds run so far have been:

- OWS1.0 – resulting in the Web Map Server specification
- OWS1.1 – resulting in the Web Feature Server specification
- OWS1.2 – (in progress) – refining and extending these specifications.

OGC Web Map Server

While there are thousands of Web sites around the world, providing map and image data, they do not work together. Data from different sites cannot be registered, merged, and displayed on a single client. The goal of the OGC Web Map Server specification is to allow the seamless integration of unlimited sources of geospatial data accessible over the Web. Common interfaces have been defined to allow clients to connect, query, and display data from various Web servers. These are as follows:

- Get **capabilities** - Provides information about what a server can do, what data layers it can serve, formats available, etc.
- Get **map** - Provides maps as pictures (GIF, JPEG, PNG, etc.)
- Get **feature_info** - Provides information about specific features on the map

These interfaces are sent from the client to the server via standard Web protocols. The response is sent back to the client in the form of an XML document. The data content and tags delivered in the XML document conform to the standards defined by OGC. OGC Web-compliant servers are servers supporting these interfaces. Note that these request/response pairs do not yet comply with general Web Service conventions, so will need further specification.

OGC Web Feature Server Interfaces (WFS)

Web Feature Servers are capable of delivering data to clients in object form, as opposed to picture form. Web Features Server Interfaces were developed as part of the Web Mapping Testbed 2 during 2000.

- Get **capabilities** - Provides information about what a server can do, what data layers it can serve, available formats, etc.
- **DescribeFeatureType** - Provides information about a feature schema (or record structure).
- Get **feature** - Returns the result set of a query in GML format.
- **Transaction** – Describes data transformation operations that are to be applied to a Web-accessible datastore.
- **LockFeature** – Used to acquire a lock on a single feature or set of features.

Note that, as with the WMS interfaces, these request/response pairs do not yet comply with general Web Service conventions, and so will need further specification.

Geography Markup Language is the main vehicle for transferring geographic feature data exposed in a Web Feature Service. It is important to note that GML is also sufficient as a file format for data transfer. In other words, GML is relevant not only as a WFS data Web-delivery mechanism, but also as a file format that supports a rich encoding of geographic features.

OGC Location Services Initiative

The OGC Location Services Initiative (OLS) was established to investigate the Web services required for location-based services (LBS). While there is obviously a degree of overlap with the OWS, the OLS has begun conducting a series of testbeds for producing the set of specifications required for providing a standard environment for sharing and using geospatial information in the context of LBS.

The aspects generally specific to LBS applications are:

- Small client devices
- Narrow bandwidth communications
- Occasionally connected communications
- Search for Points of Interest
- Generation of Routes between Points of Interest

The initial testbed has defined abstract data types and schemas for five basic requests:

- Location Utilities – geocode/reverse geocode
- Directory Service – searching for Points of Interest
- Route Determination Service – “best” route between Points of Interest
- Presentation Service – generation of maps
- Gateway Service – interfaces to position determination devices

Web Services Model

The outcomes of the OWS and OLS represent fundamental examples of Web Services. The concept of Web Services has been embraced by the IT industry in general. The following is a general definition formulated by IBM:

Web Services are self-contained, modular applications that can be described, published, located, and invoked over a network, generally, the Web.

Examples of general Web Services are user authentication, stock quotes and credit card validation. All of these, consistent with the definition, can be viewed as self-contained operations which can be implemented for Internet access.

A general Web Services Model is emerging as an industry consensus driven by the major software infrastructure providers under the W3C umbrella (http://www.w3.org/). In this model, we have the following three actors:

- Service Provider: Entity that creates Web Services
- Service Broker: Entity that exposes the availability and descriptions of Web Services
- Service Requestor: Entity that makes use of Web Services

The workflow is as follows: A *Services Provider* PUBLISH(es) a service with a *Services Broker*. A *Service Requester* FINDS a web service by querying a *Services Broker*. After a service is found, the requestor BINDS (uses) to a *Service Provider*. (Source IBM)

Software infrastructure providers are converging via W3C to a standard set of technologies. These are as follows:

- XML (Extensible Markup Language), - the “lingua franca”
- SOAP (Simple Object Access Protocol), - provides message format and protocol
- WSDL (Web Services Description Language), - describes Web services
- UDDI (Universal Description Discovery and Integration), - provides directory functions

Web Services are a fundamental component of Microsoft’s .NET strategy:

Microsoft® .NET is a set of Microsoft software technologies for connecting your world of information, people, systems, and devices. It enables an unprecedented level of software integration through the use of XML Web services: small, discrete, building-block applications that connect to each other—as well as to other, larger applications—via the Internet. .NET connected software delivers what developers need to create XML Web services and stitch them together.

(What is .NET? http://www.microsoft.com/ms.htm)

IBM, Oracle, and Sun Microsystems have extensive programs to build tools for the deployment of Web Services using the J2EE software environment. J2EE has historically been an architecture for building server-side deployments in the Java programming language. It can be used to build traditional web sites, software components, or packaged applications. J2EE has recently been extended to include support for building XML-based web services as well. These web services can interoperate with other web services that may or may not have been written to the J2EE standard.

Thus, the general Information Technology industry has been developing Web Services standards for general use. The OGC Web Services standards have been developing in parallel and somewhat independently, so some work will be required to match with the general standards. In this way, OGC compatible Web Services will interoperate not just with other OGC Web Services, but also with any other general Web Service.

Conclusion

The general benefits of the OpenGIS initiatives in Open Web Services and Open Location Services are:

- Interoperability with a variety of other systems (not just GIS)
- Not being locked into vendor-specific GIS software
- Data sharing – the bulk of your spatial information comes from others
- Getting your data out to where it is needed
- Getting your data back from where it is collected
- Eliminating paperwork
- Eliminating travel time taken to get information
- Streamlining workflows
- Reducing total job time and therefore outages
- Location-enabling other applications
- Increasing the use and value of Geospatial information

A practical use of this technology would be the addition of GIS capabilities to information systems within the organization that have location-related entities such as asset management systems. When combined with the OGC Web Services, the asset management system can use the standard Web Services interface to be spatially enabled, adding location-based search, sort and analysis capabilities to in-house systems as well as provide field crews with integrated asset and work order information with maps, asset locations, connectivity and attribute edit capabilities.

Useful References

Some useful websites for further reading:

- OGC Web site - http://www.opengis.org/index.htm
- GML specification - http://www.opengis.net/gml/01-029/GML2.html
- J2EE homepage - http://java.sun.com/j2ee
- Microsoft .NET homepage - http://www.microsoft.com/net/
- W3C Web site - http://www.w3.org/
- XML specification - http://www.w3.org/TR/REC-xml
- SOAP specification - http://www.w3.org/TR/SOAP/
- WSDL specification - http://www.w3.org/TR/WSDL/
- UDDI initiative homepage - http://www.uddi.org/