Internet Map Servers and GeoPortals: OGC Standards in Action

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Topics for Today…

- A Bit of Background on Web Mapping
- What is a GeoPortal?
- Who is the Open Geospatial Consortium?
- XML, GML, WMS, WFS
- Some Examples of OGC Standards in Action

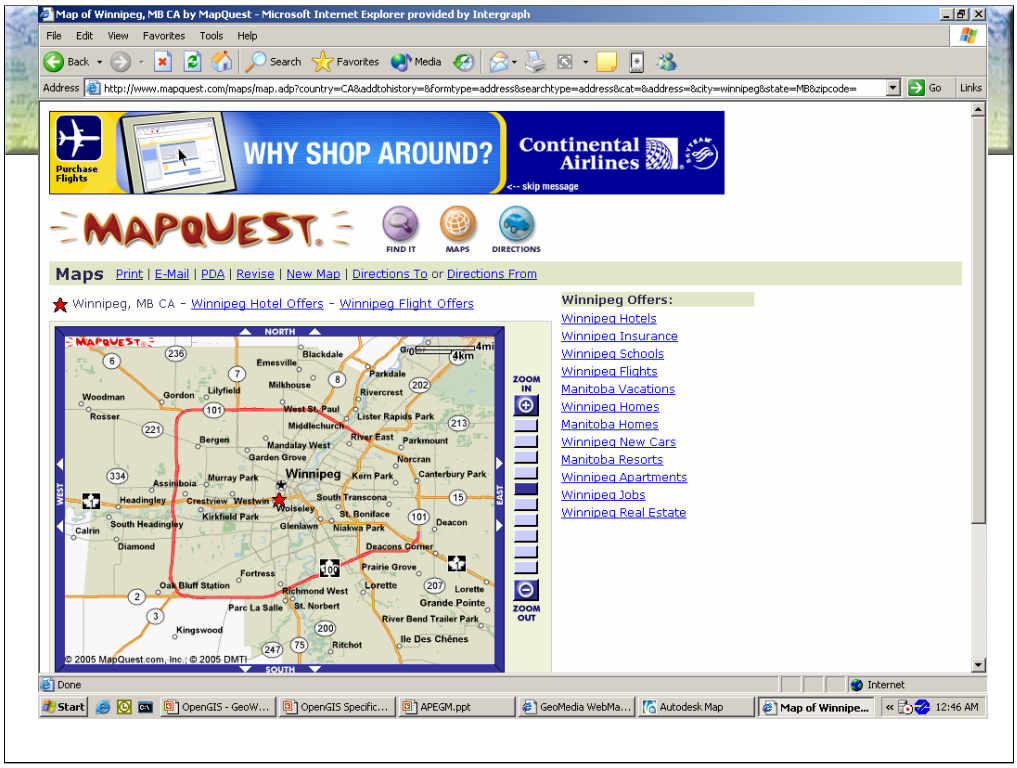
In the Age of Instant Gratification…

The Internet has changed the way we interact with information:

- **We want Instant Response to a Search Request (i.e. Google)**
- **10 Second Rule (Users will only wait 10 seconds for a response)**

Mapping in the Web is no different – people are demanding:

- **Real-Time or near Real-Time access to Spatial Information, downloaded to their desktop**
- **High Speed, High Accuracy, High Functionality**


Map of Winnipeg, MB CA by MapQuest - Microsoft Internet Explorer provided by Intergraph
File Edit View Favorites Tools Help
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Address http://www.mapquest.com/maps/map.adp?country=CA&addtohistory=&formtype=address&searchtype=address&cat=&address=&city=winnipeg&state=MB&zipcode=
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Maps Print | E-Mail | PDA | Revise | New Map | Directions To or Directions From
Winnipeg, MB CA - Winnipeg Hotel Offers - Winnipeg Flight Offers
NORTH
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EAST
SOUTH
ZOOM IN
ZOOM OUT
Winnipeg
Blackdale
Emesville
Parkdale
Milkhouse
Rivercrest
Lilyfield
Gordon
Woodman
Rosser
West St. Paul
Lister Rapids Park
Middlechurch
River East
Parkmount
Bergen
Mandalay West
Garden Grove
Norcran
Assiniboia
Murray Park
Kern Park
Canterbury Park
Headingley
Crestview
Westwin
Wolseley
South Transcona
Kirkfield Park
St. Boniface
South Headingley
Glenlawn
Niakwa Park
Deacon
Calrin
Diamond
Deacons Corner
Fortress
Prairie Grove
Oak Bluff Station
Richmond West
Lorette
Grande Pointe
Parc La Salle
St. Norbert
River Bend Trailer Park
Kingswood
Ritchot
Ile Des Chênes
© 2005 MapQuest.com, Inc.; © 2005 DMTI
Winnipeg Offers:
Winnipeg Hotels
Winnipeg Insurance
Winnipeg Schools
Winnipeg Flights
Manitoba Vacations
Winnipeg Homes
Manitoba Homes
Winnipeg New Cars
Manitoba Resorts
Winnipeg Apartments
Winnipeg Jobs
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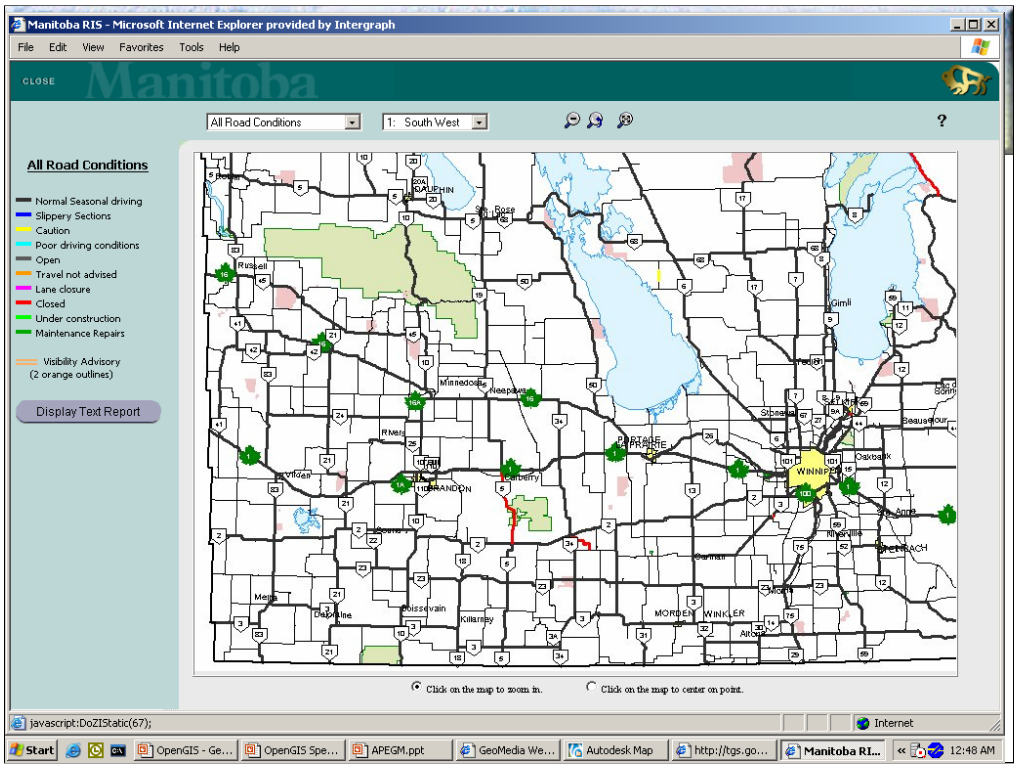
Manitoba RIS - Microsoft Internet Explorer provided by Intergraph
File Edit View Favorites Tools Help
CLOSE
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Caution
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Visibility Advisory
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Display Text Report
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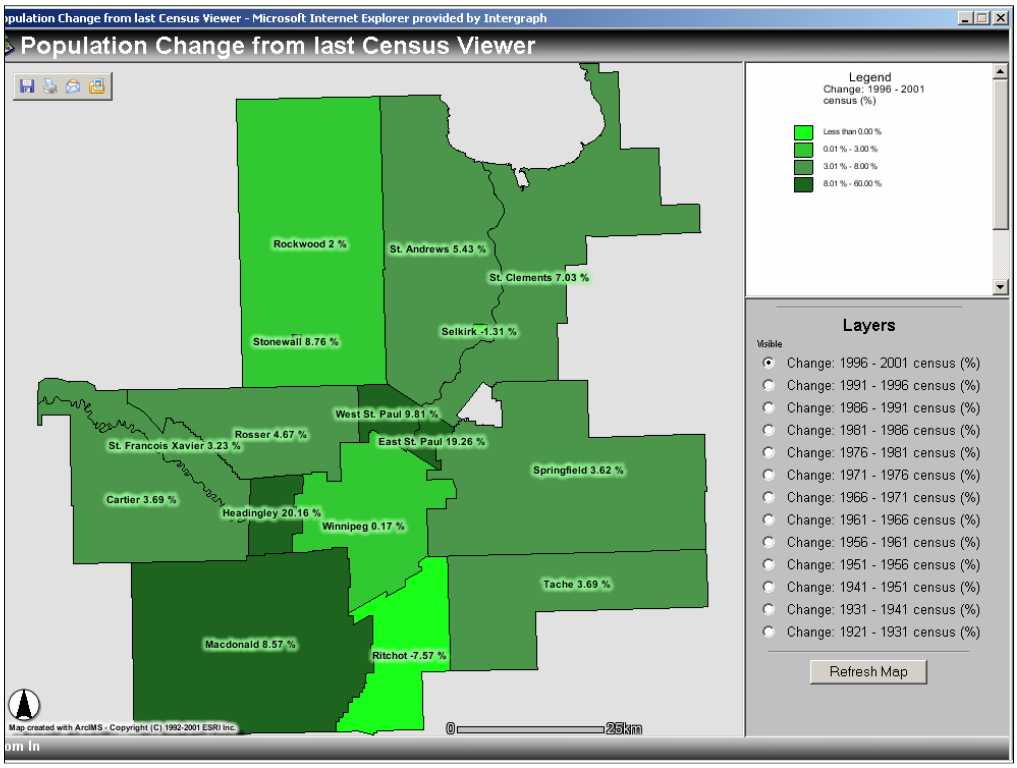
opulation Change from last Census Viewer - Microsoft Internet Explorer provided by Intergraph
Population Change from last Census Viewer
Legend
Change: 1996 - 2001 census (%)
Less than 0.00 %
0.01 % - 3.00 %
3.01 % - 8.00 %
8.01 % - 60.00 %
Layers
Visible
Change: 1996 - 2001 census (%)
Change: 1991 - 1996 census (%)
Change: 1986 - 1991 census (%)
Change: 1981 - 1986 census (%)
Change: 1976 - 1981 census (%)
Change: 1971 - 1976 census (%)
Change: 1966 - 1971 census (%)
Change: 1961 - 1966 census (%)
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Change: 1951 - 1956 census (%)
Change: 1941 - 1951 census (%)
Change: 1931 - 1941 census (%)
Change: 1921 - 1931 census (%)
Refresh Map
Rockwood 2 %
St. Andrews 5.43 %
St. Clements 7.03 %
Selkirk -1.31 %
Stonewall 8.76 %
West St. Paul 9.81 %
Rosser 4.67 %
St. Francois Xavier 3.23 %
East St. Paul 19.26 %
Springfield 3.62 %
Cartier 3.69 %
Headingley 20.16 %
Winnipeg 0.17 %
Tache 3.69 %
Macdonald 8.57 %
Ritchot -7.57 %
Map created with ArcIMS - Copyright (C) 1992-2001 ESRI Inc.
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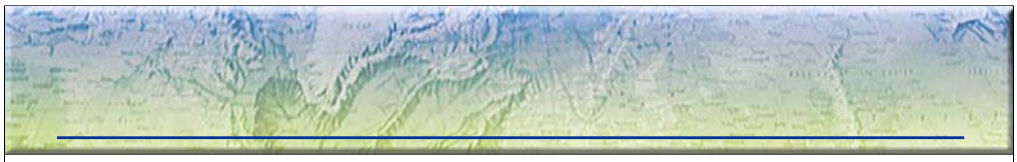


- **These are good examples of “traditional” internet map sites – very functional and focused on a specific task.**

- **However, how do I make use of these data in my own application? I need some mechanism to share these data…**

What is a GeoPortal?

GeoPortals are web sites that facilitate browsing, viewing and procuring spatial databases online.

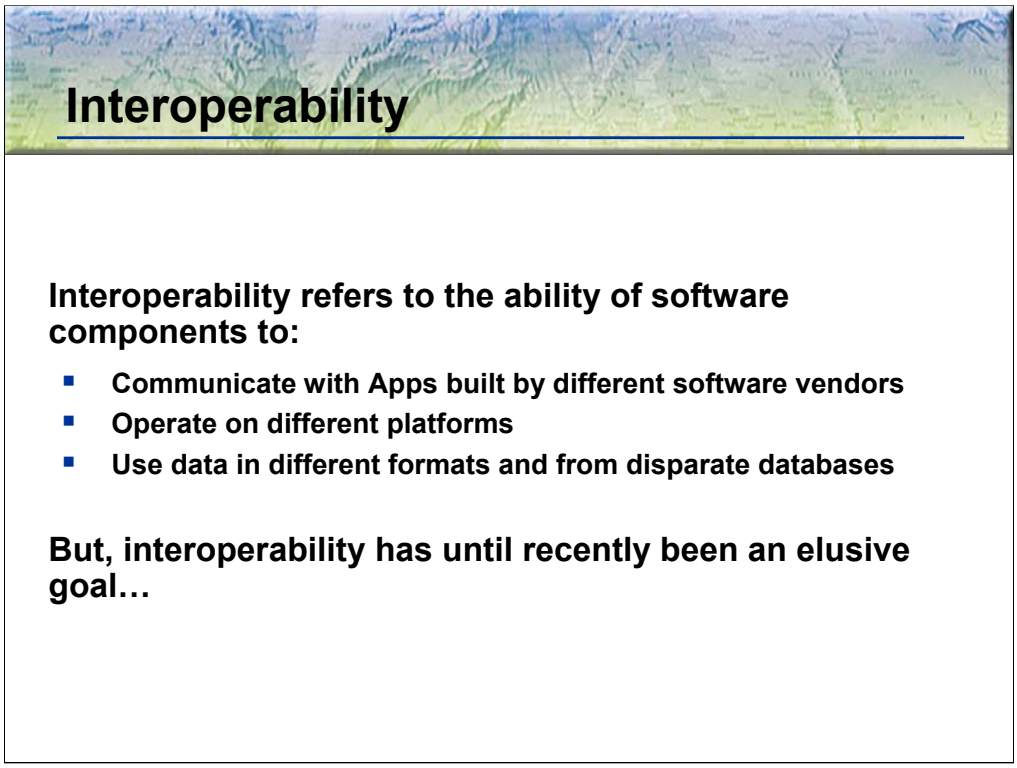
What Makes a Good GeoPortal?

Data Interoperability

Proven Speed & Scalability

Spatial Analysis and Download Capabilities

Easy and Open Development Environment



Interoperability refers to the ability for software components to integrate even when they are written by different software organizations or vendors. Thinking about interoperability in a broader context than software, we find that interoperability of “components” has been addressed in a variety of technologies and industries, for example, CD formats. It would be absurd if a Sony CD player would play only CDs made by Sony or if a Zenith CD player would play only CDs made by Zenith. In the same manner, automobiles do not require tires from a specific manufacturer. But interestingly enough, this degree of interoperability does not exist in the GIS industry (and IT industry in general).

Adaptor plugs

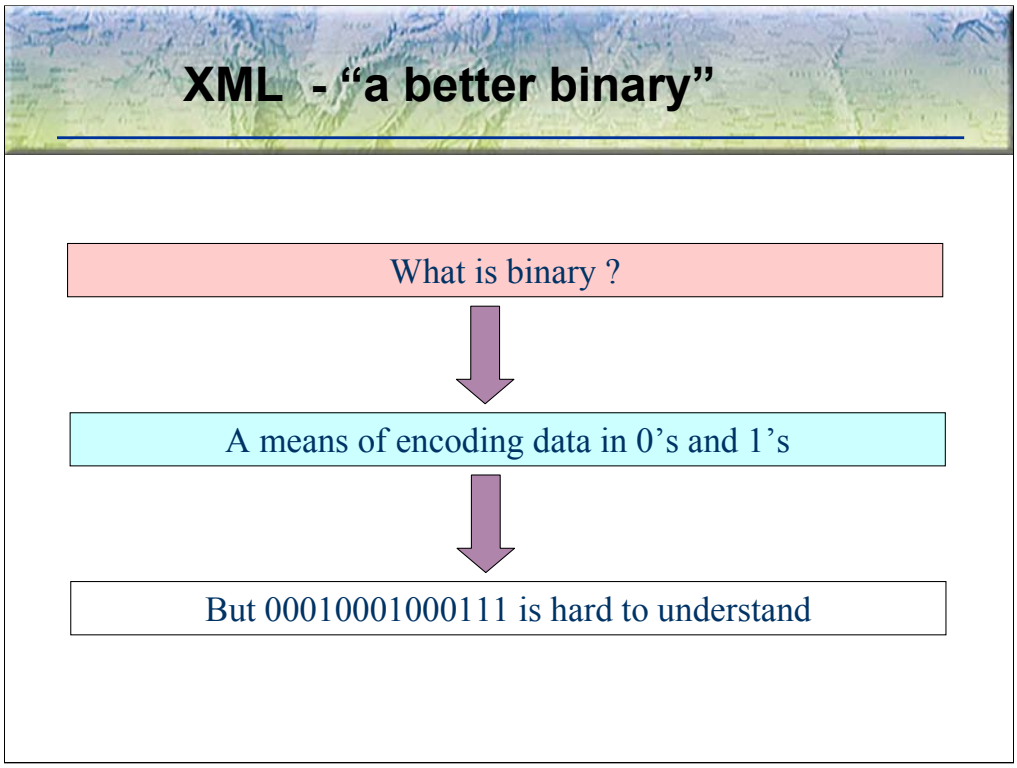
Here is a good example of a solution to an interoperability problem.

How is this problem being addressed?

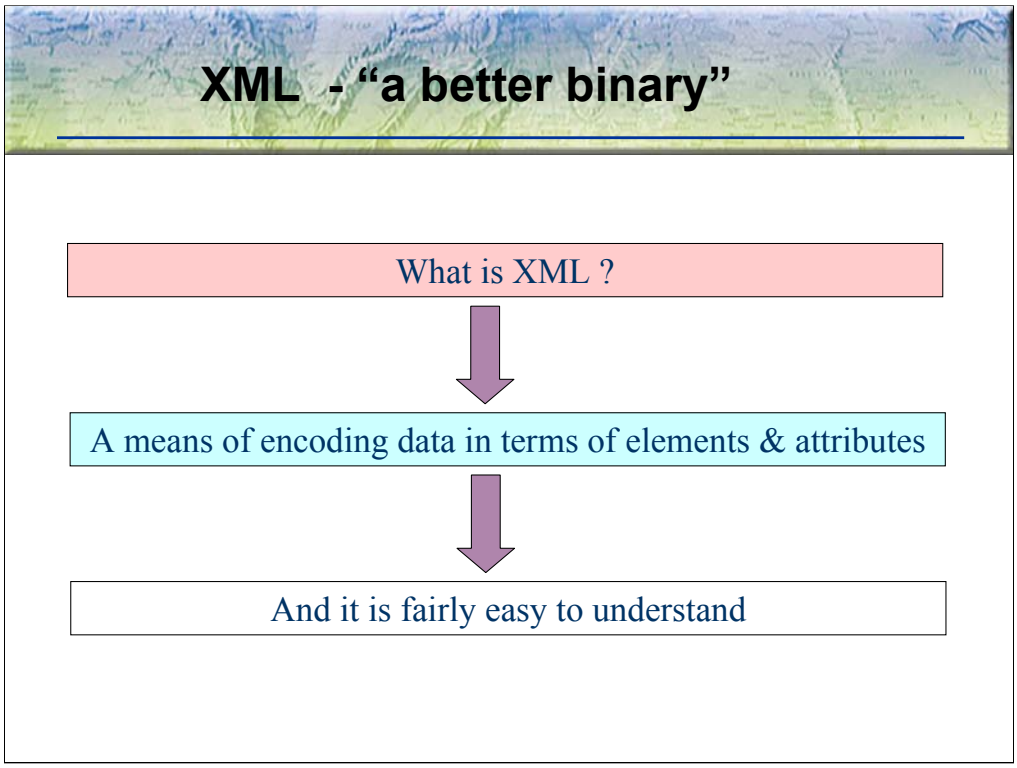
Currently, we have a world where we agree on the transmission of data in some form of binary standard

We are now moving to a world where all information exchange is XML or:

Extensible Markup Language

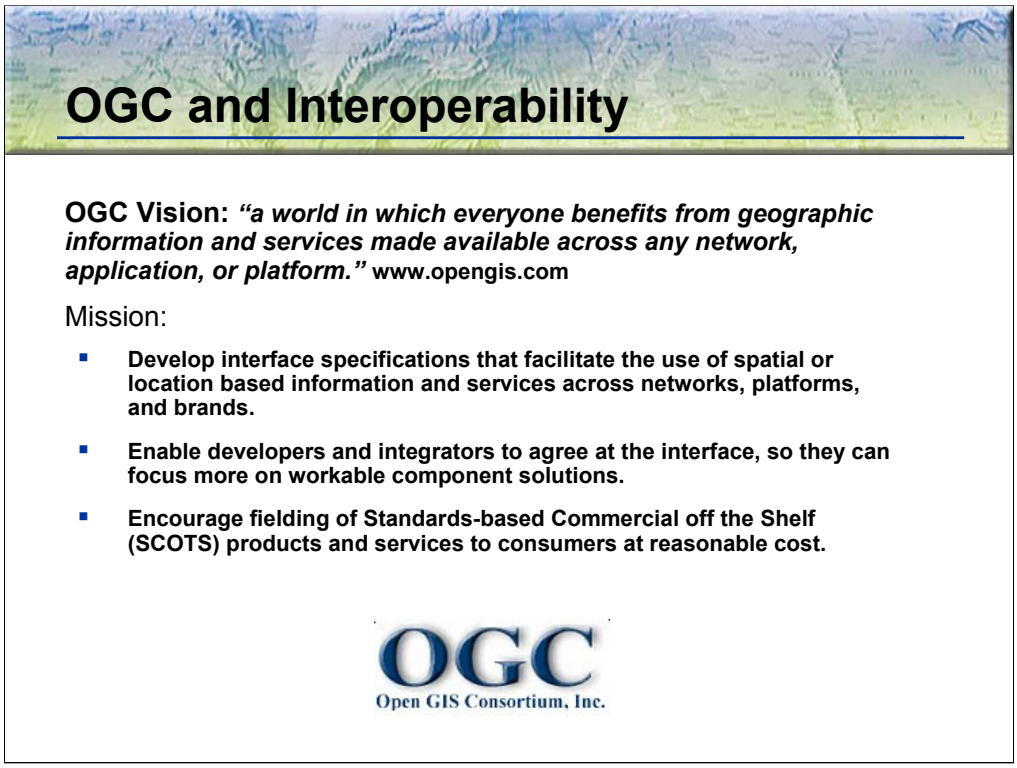


Binary encodings are suited to simple, primitive types BUT NOT to the expression of complex information!!



The key point here is that XML represents content in a flexible, extensible and largely self documenting fashion !!

On the otherhand XML is text and hence is bulky !



Interoperability is at the core of the OGC vision and mission statements:

Our Vision:

Our vision is a world in which everyone benefits from geographic information and services made available across any network, application, or platform.

Our Mission:

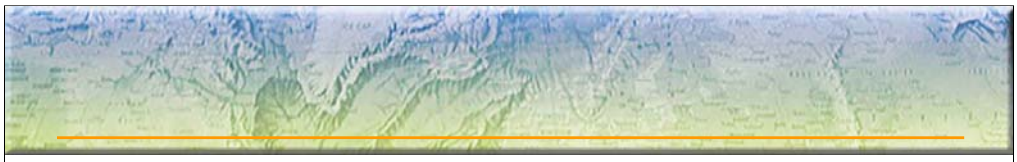
Our core mission is to deliver spatial interface specifications that are openly available for global use.

In 1997 OGC approved a series of specifications for core GIS technology, which are collectively referred to as "Simple Features."

OpenGIS® Simple Features Specification for OLE/COM
OpenGIS® Simple Features Specification for CORBA

OpenGIS® Simple Features Specification for SQL

Unfortunately, the Simple Features Specifications have 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, however, has created technology, such as coordinate systems and feature geometry, that is fundamental for the new generation of Web-based specifications.



Geometry Markup Language (GML)

Basics

Geography Markup Language (GML) is an XML grammar written in XML Schema for the modeling, transport, and storage of geographic information.

GML provides a variety of kinds of objects for describing geography including features, coordinate reference systems, geometry, topology, time, units of measure and generalized values.

GML includes

- **Geometries and Coordinate Reference System (based on EPSG)**
- **A temporal reference system**
- **A Units of Measure (UOM) dictionary**

GML 3.0

GML models various resources required to describe geospatial information:

- **Features (including coverages and observations).**
- **Coordinate Reference Systems**
- **Units of Measure**
- **Values (as values of feature properties)**
- **Topology and Geometry (as values of feature properties)**
- **Temporal (as values of feature properties)**

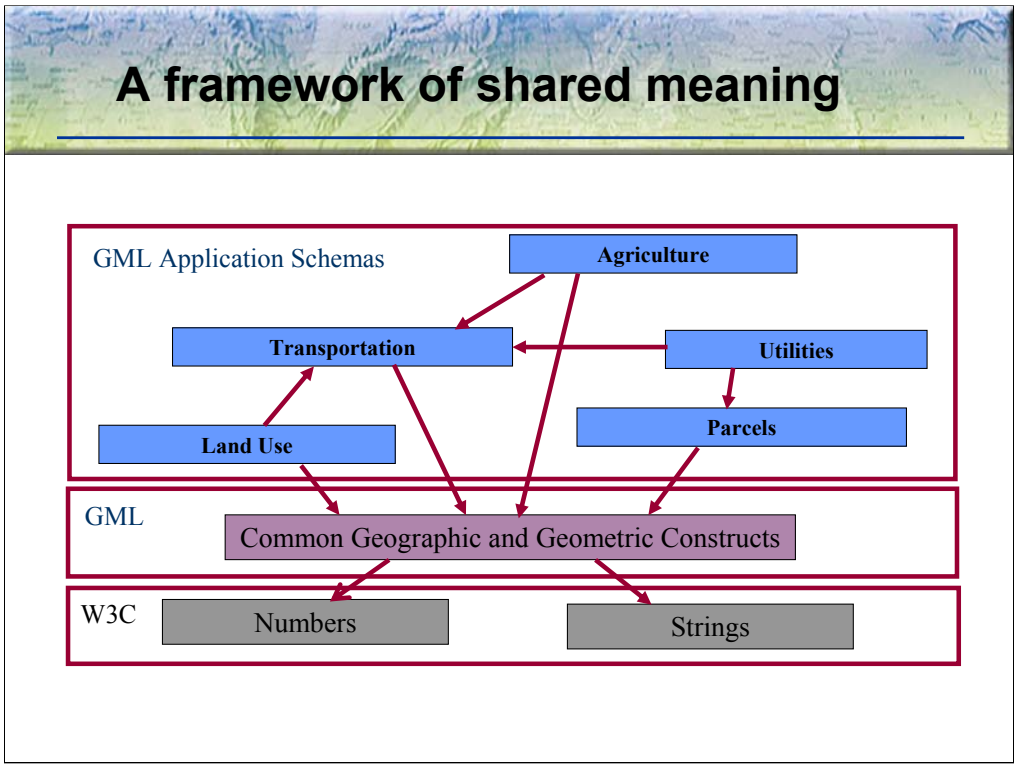
GML 3.0 Applications

GML contains a family of schema definitions

Most applications will make use of only a subset of the schemas described in the full specification

For example, the temporal schemas are used only if the application is concerned with time dependent feature properties or dynamic features

Application schemas may extend or restrict the types defined in the GML base schemas to define appropriate types for an application domain.



In order for any of this to work – we need frameworks of shared meaning – and we need this in an operational manner. We call the group of people, organizations and systems that have a shared framework of meaning – that is a common vocabulary – an Information Community

We might start with the sharing of elementary constructs like numbers, strings, dates.

On these we build geographic constructs like the notion of a feature, geometry (points, lines, polygons) etc.

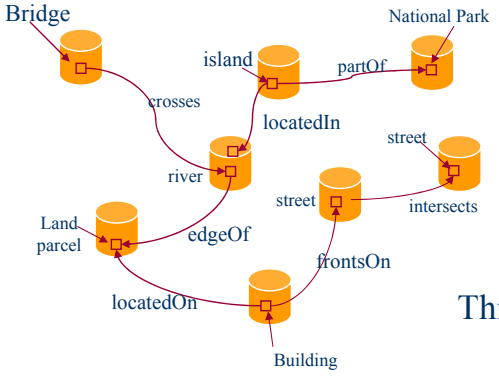
On these we build more domain specific constructs like those for transportation etc.

These constructs build on one another.

In operational terms – in concrete implementation terms we can see this as:

1. Primitive Types from W3C
2. Geographic Types from GML/G-XML.
3. Vertical domain types from GML Application Schemas

Local Data integrated with Regional, National and Global Data



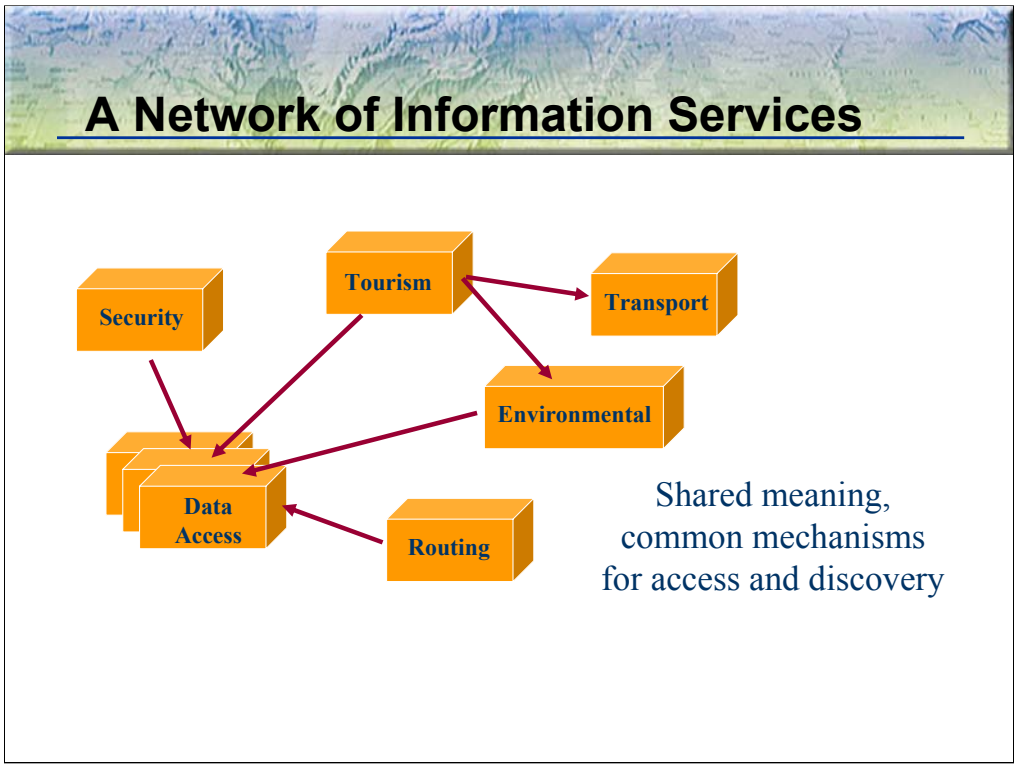
Spatial relations span jurisdictions

Spatial relations span databases

This demands standardization

In the "real" world objects are related to one another. Since our descriptions of these objects are fragmented across many databases, reflecting the real world, requires that we be able to construct spatial relationships that span jurisdictions and which span databases.

In order that we be able to have spatial relationships that span databases we must have a common framework of standards for describing geographic objects and the relationships between them. This is like the World Wide Web. Web pages are described in a standard way (HTML) and we can associate one web page with another using hyperlinks, regardless of where the associated pages are located.



Shared meaning – implies not only shared and interconnected data – but also sharing of information services.

Information services are "shareable" if we have common means of discovery.

Information services are "shareable" if we have common means of modeling and representation.

Information services are "shareable" if we have common modes of access.

So our concept of a Geo-Web involves:

1. Shared framework of meaning through common vocabularies.
2. Shared spatial relationships that reflect real world relationships.
3. Shared access to services for data access and data processing.

OGC Web Mapping Interfaces

Common interfaces have been defined to allow clients to connect, query, and display data from various Web servers

Interfaces are implemented via http communication and XML encoded messages

Web Map Server (WMS)

Web Feature Server (WFS)

OGC Open Web Services use XML as the key technology to communicate geographic information between heterogeneous systems. Defining web mapping standards is certainly now the focus of their efforts.

These standards provide ways to connect, query, and display mapping data over the web.

In particular, two of these standards are of particular interest—the Web Map Server or WMS, and the Web Feature Server or WFS. We will explain these in more detail as we proceed.

Web Map Service (WMS)

OGC Web Map Service Interfaces

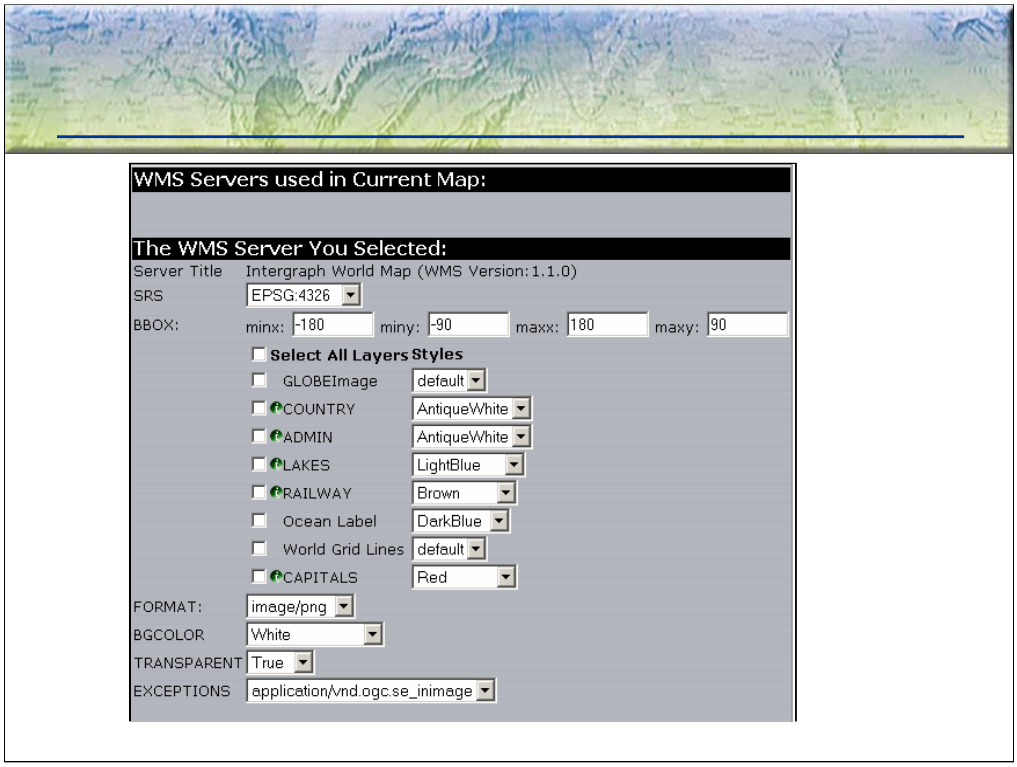
- GetCapabilites
- GetMap
- GetFeatureInfo

GetCapabilities Interface

Provides information about what a server can do, what data layers it can serve, formats available, etc.

http: //www.server.org/wmt/mapserver.asp? WMTVER=1.1.1&REQUEST=capabilities

Response is encoded in XML


WMS Servers used in Current Map:
The WMS Server You Selected:
Server Title
Intergraph World Map (WMS Version:1.1.0)
SRS
EPSG:4326
BBOX:
minx: -180
miny: -90
maxx: 180
maxy: 90
Select All Layers
Styles
GLOBEImage
default
COUNTRY
AntiqueWhite
ADMIN
AntiqueWhite
LAKES
LightBlue
RAILWAY
Brown
Ocean Label
DarkBlue
World Grid Lines
default
CAPITALS
Red
FORMAT:
image/png
BGCOLOR
White
TRANSPARENT
True
EXCEPTIONS
application/vnd.ogc.se_inimage

GetMap Interface

Required Map Service interface

Provides clients of a Map Server with pictures of maps

Key parameters

- **LAYERS**
- **STYLES**
- **SRS**
- **BBOX**
- **FORMAT**

GetMap Request Example

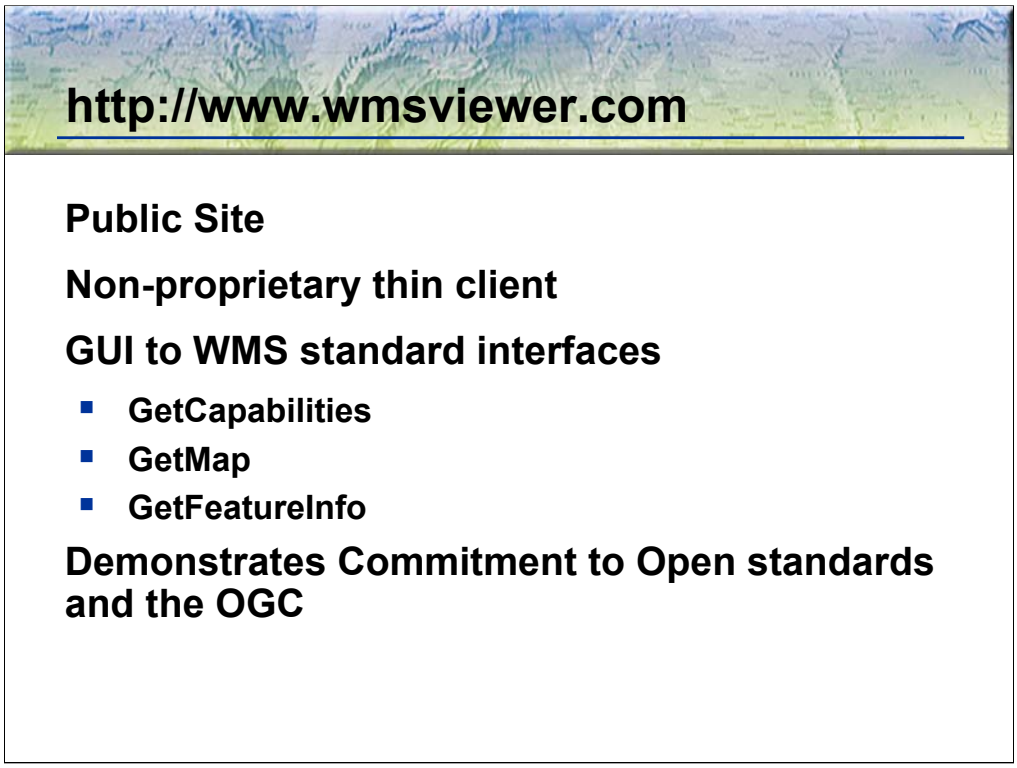
http://b-maps.com/map.cgi?VERSION=1.1.0&
REQUEST=GetMap&
SRS=EPSG:4326&
BBOX=-97.105,24.913,78.794,36.358&
WIDTH=560&
HEIGHT=350&
LAYERS=BUILTUPA,COASTL,POLBNDL&
STYLES=0XFF8080,0X101040,BLACK&
FORMAT=image/png&
BGCOLOR=0xFFFFFF&
TRANSPARENT=TRUE&

GetFeatureInfo Interface

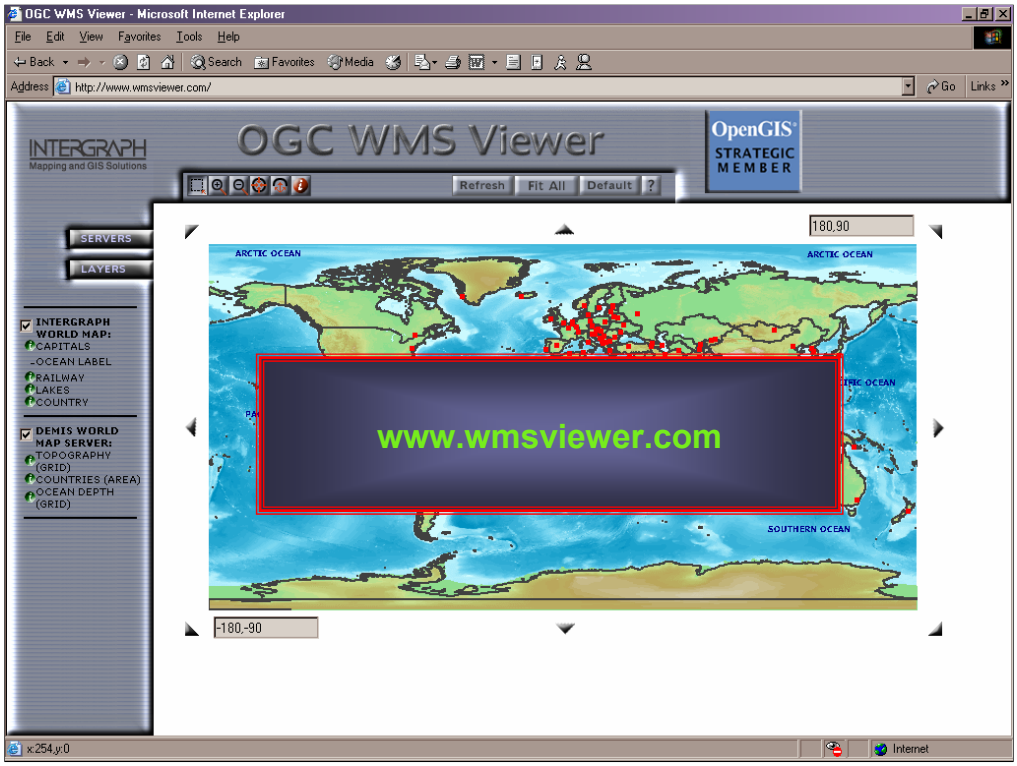
Optional interface

Asks for information about features display in the map

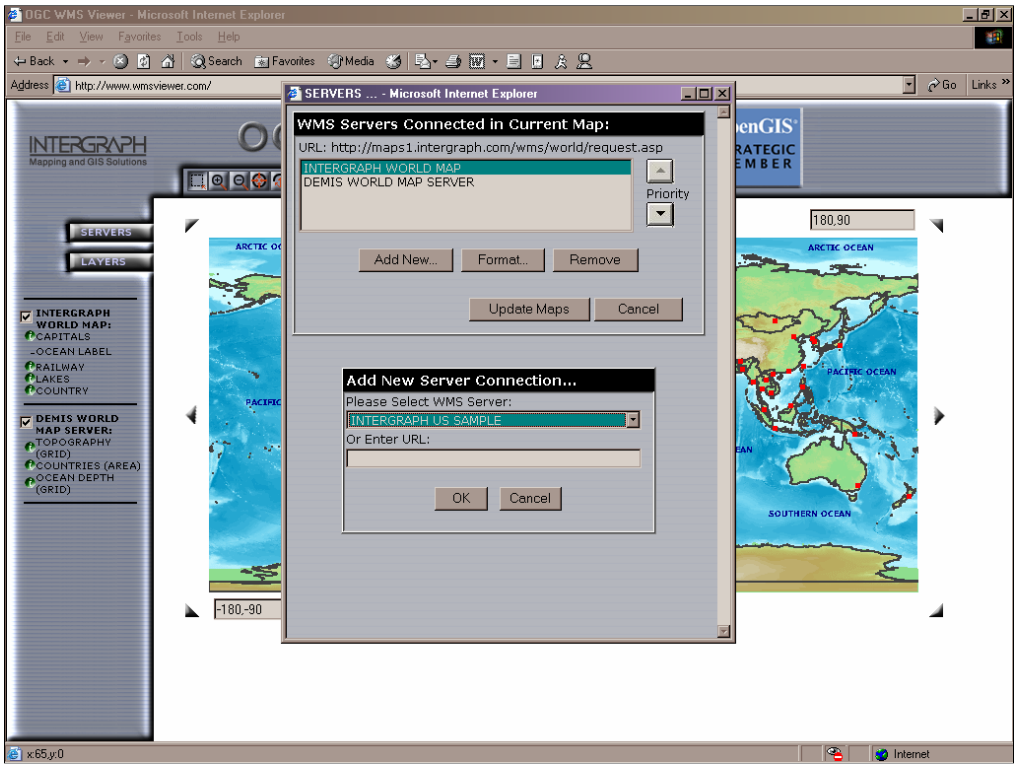
Response is free form html



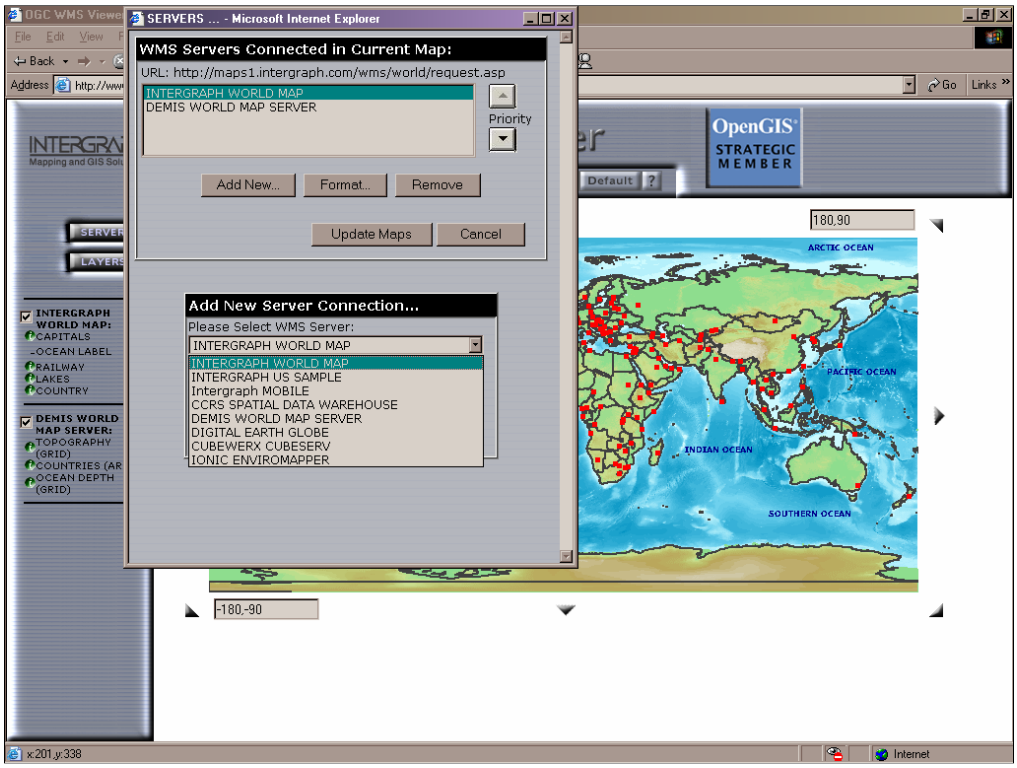
The Intergraph OGC WMS Viewer is a thin client for accessing OGC Web Map Servers. The Viewer allows you to view and use distributed geospatial resources that have been shared using the OGC WMS standard. In essence, it provides a GUI (graphical user interface) to the OGC WMS interfaces—GetCapabilities, GetMap, and GetFeatureInfo, and the files returned from issuing one of those interfaces against a WMS. It provides a user-friendly way of browsing WMS's to see what features they have available (GetCapabilities), choosing those of interest, and seeing the resulting map (GetMap). The viewer gives you the ability to request multiple maps properly geographically overlaid on top of one another. And, if the WMS and layer of interest support it, you may click on a feature to get additional information about it (GetFeatureInfo). The Viewer has been written in HTML and JavaScript using no proprietary software—coded only to the WMS interface standards.



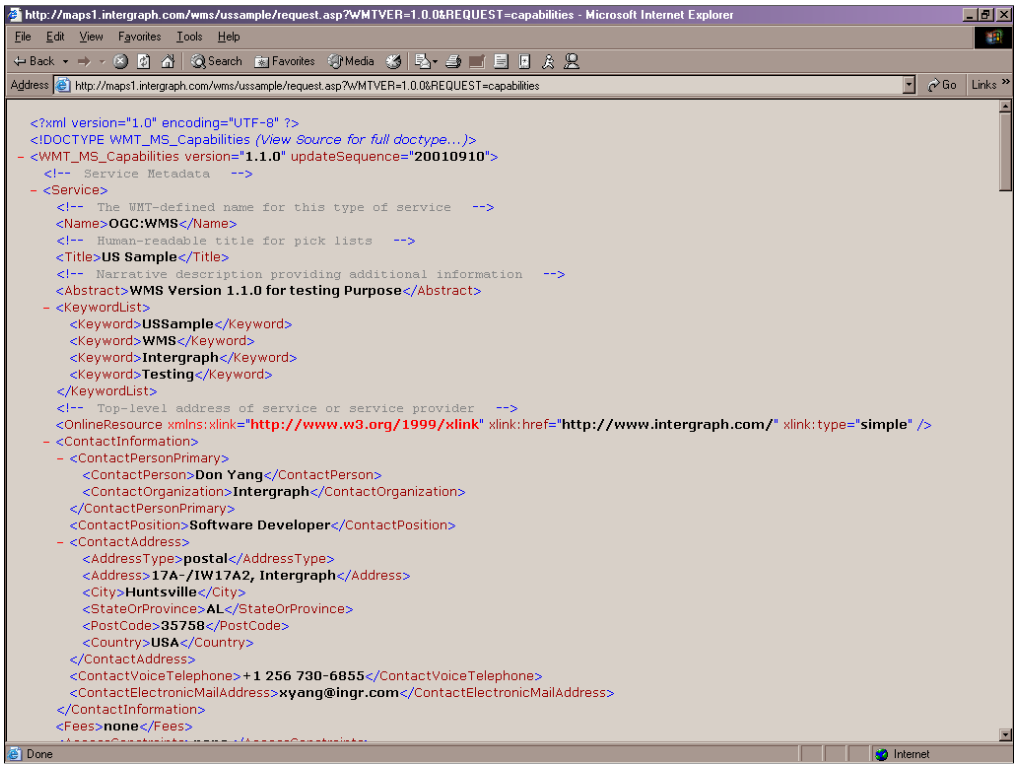
In April of 2002, we announced wmsviewer.com.



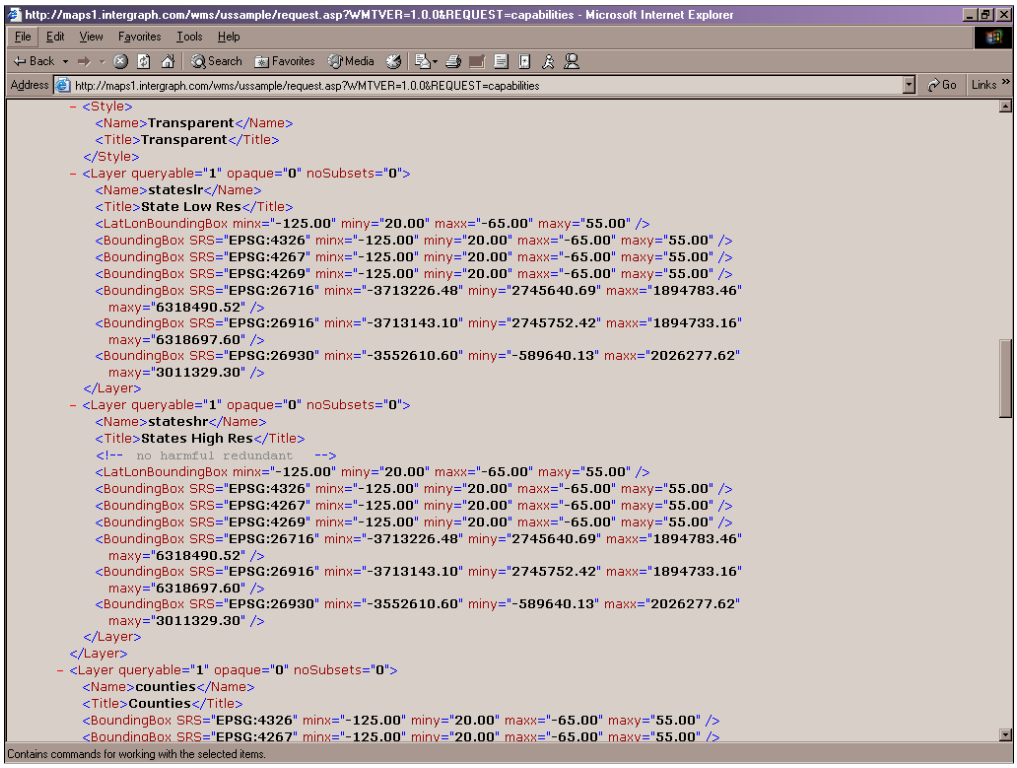
In essence, wmsviewer.com is a GUI to the WMS interfaces. When you choose the "Servers" button, you are presented with a dialog showing the WMS's to which you are presently connected and given the option of adding another one—connecting to a new one…

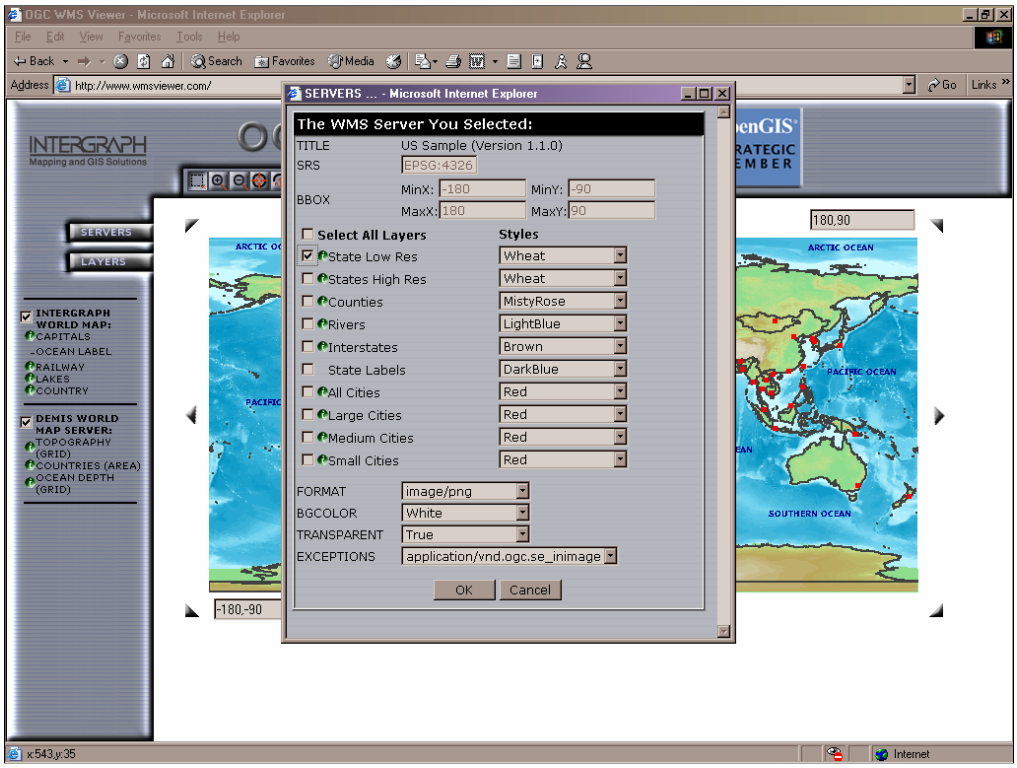


…by either selecting from a pre-defined list of WMS's, or keying in the URL of the one to which you want to connect.

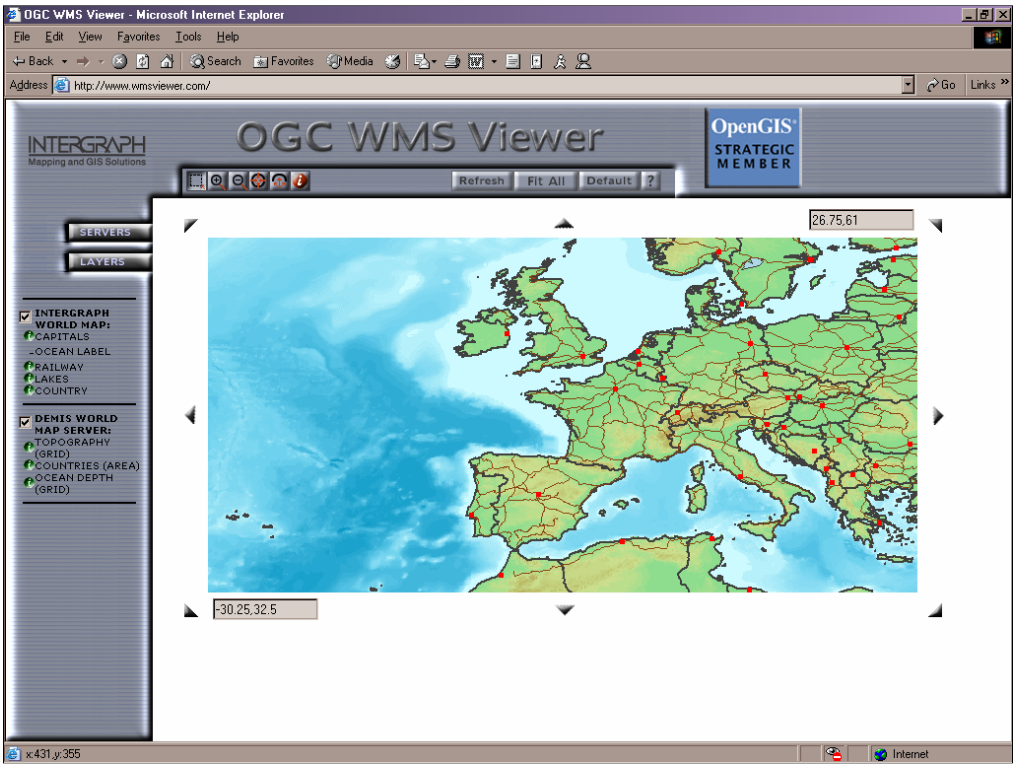


And here is an example of the xml capabilities document that it might return. While it is ascii text, it is not exactly human legible.

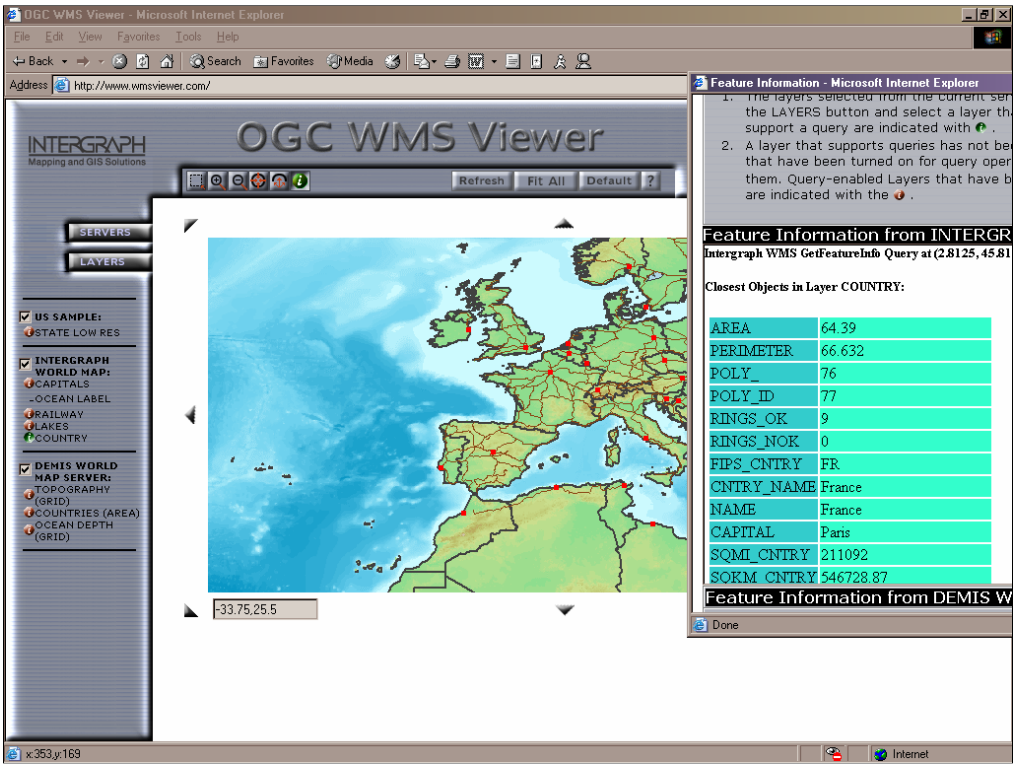

http://maps1.intergraph.com/wms/ussample/request.asp?WMTVER=1.0.0&REQUEST=capabilities - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://maps1.intergraph.com/wms/ussample/request.asp?WMTVER=1.0.0&REQUEST=capabilities
Go Links
- <Style>
<Name>Transparent</Name>
<Title>Transparent</Title>
</Style>
- <Layer queryable="1" opaque="0" noSubsets="0">
<Name>stateslr</Name>
<Title>State Low Res</Title>
<LatLonBoundingBox minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4326" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4267" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4269" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:26716" minx="-3713226.48" miny="2745640.69" maxx="1894783.46"
maxy="6318490.52" />
<BoundingBox SRS="EPSG:26916" minx="-3713143.10" miny="2745752.42" maxx="1894733.16"
maxy="6318697.60" />
<BoundingBox SRS="EPSG:26930" minx="-3552610.60" miny="-589640.13" maxx="2026277.62"
maxy="3011329.30" />
</Layer>
- <Layer queryable="1" opaque="0" noSubsets="0">
<Name>stateshr</Name>
<Title>States High Res</Title>
<!-- no harmful redundant -->
<LatLonBoundingBox minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4326" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4267" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4269" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:26716" minx="-3713226.48" miny="2745640.69" maxx="1894783.46"
maxy="6318490.52" />
<BoundingBox SRS="EPSG:26916" minx="-3713143.10" miny="2745752.42" maxx="1894733.16"
maxy="6318697.60" />
<BoundingBox SRS="EPSG:26930" minx="-3552610.60" miny="-589640.13" maxx="2026277.62"
maxy="3011329.30" />
</Layer>
</Layer>
- <Layer queryable="1" opaque="0" noSubsets="0">
<Name>counties</Name>
<Title>Counties</Title>
<BoundingBox SRS="EPSG:4326" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
<BoundingBox SRS="EPSG:4267" minx="-125.00" miny="20.00" maxx="-65.00" maxy="55.00" />
Contains commands for working with the selected items.



The wmsviewer.com takes that document and converts it into a nice dialog box and presents it to you in this fashion…showing you a list of the available layers or features, symbologies, formats, etc. You simply choose what you want, click OK, and wmsviewer.com issues a GetMap request against that WMS server.

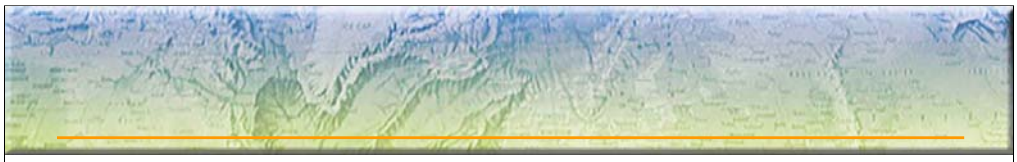


The final interface is optional, but allow you to see additional text information about a feature or features by providing an x,y location. wmsviewer.com allows you to point at a feature, it thens sends the proper x,y coordinate to the WMS.



It then returns a report about that feature.

WMS Example…



Web Feature Service (WFS)

Web Feature Server

In order to realize the full power of data interoperability, it is necessary for clients to be able to access data in object format

Web Feature Server concept emerged

GML is the enabling technology for this next step. It includes vector graphics

The next evolution, a Web Feature Server or WFS, does essentially the same thing, except that the returned map is a vector map, not just a raster image. The vector data is in GML—Geographic Markup Language, an XML encoding for map data.

OGC Web Feature Server Interfaces

OGC WFS Interfaces

- **GetCapabilites**
- **DescribeFeatureType**
- **GetFeature**
- **Transaction**
- **LockFeature**

Response to GetFeature request is formatted using GML

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.

Two classes of WFS

Basic WFS

A basic WFS would implement the GetCapabilities, DescribeFeatureType and GetFeature operations. This would be considered a READ-ONLY web feature service.

Transaction WFS

A transaction web feature service would support all the operations of a basic web feature service and in addition it would implement the Transaction operation. Optionally, a transaction WFS could implement the LockFeature operation.

Basic WFS

- *GetCapabilities*

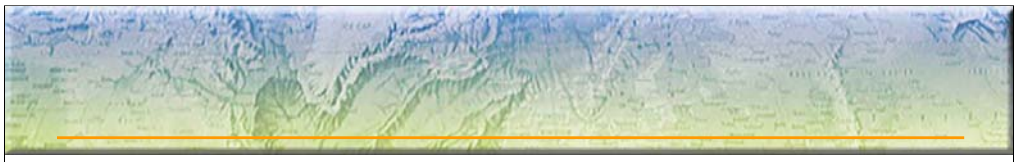
A web feature service must be able to describe its capabilities. Specifically, it must indicate which feature types it can service and what operations are supported on each feature type.

- *DescribeFeatureType*

A web feature service must be able, upon request, to describe the structure of any feature type it can service.

- *GetFeature*

A web feature service must be able to service a request to retrieve feature instances..



WFS Example…

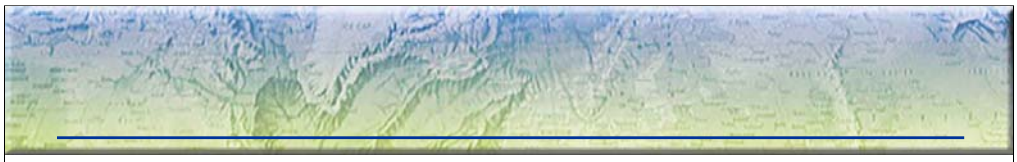
Transaction WFS

Transaction

A web feature service may be able to service transaction requests. A transaction request is composed of operations that modify features; that is create, update, and delete operations on geographic features.

LockFeature/GetFeatureWithLock

A web feature service may be able to process a lock request on one or more instances of a feature type for the duration of a transaction.



What tools do we use to build our GeoPortal?

Popular Commercial Internet Map Servers

- Autodesk Mapguide
- ESRI ArcIMS
- Intergraph GeoMedia WebMap
- MapInfo MapExtreme
- Cubewerx
- Demis Map Server
- All of these are great products and have unique capabilities… check them out

Popular Freeware Internet Map Servers

- Minnesota Map Server
- GeoServer

For the Minnesota Map Server, go to:

http://mapserver.gis.umn.edu

Get the package MS4W…

Get started with your own basement GeoPortal!

References:

http://www.w3.org/XML - XML Reference

http://www.opengeospatial.org – OGC standards

http://www.wmsviewer.com – Intergraph WMS Viewer

http://www.demis.nl/home - Demis WMS

Summary...

Web Services technology provides the infrastructure for interoperability

OGC Web Services are a revolutionary approach to Web Map Servers and GeoPortals – More than just Maps on the Web

OGC Web Mapping services are here now and are the future of GeoPortal technology - Get to know them!

OGC standard interfaces create a common protocol for information exchange within the GIS community. OGC has pioneered the Web Services Model in GIS. In particular, OGC-compliant Map Servers are taking GIS data connectivity to unprecedented levels.

Use wmsviewer.com as a gateway to WMS's. OGC web mapping services in conjunction with the interoperability model of GeoMedia GDO opens us up to a whole new level of interoperabilty among geographic data providers and users world-wide.