national spatial data infrastructure training program

Geospatial Web Services

Introduction to Geospatial Web Services

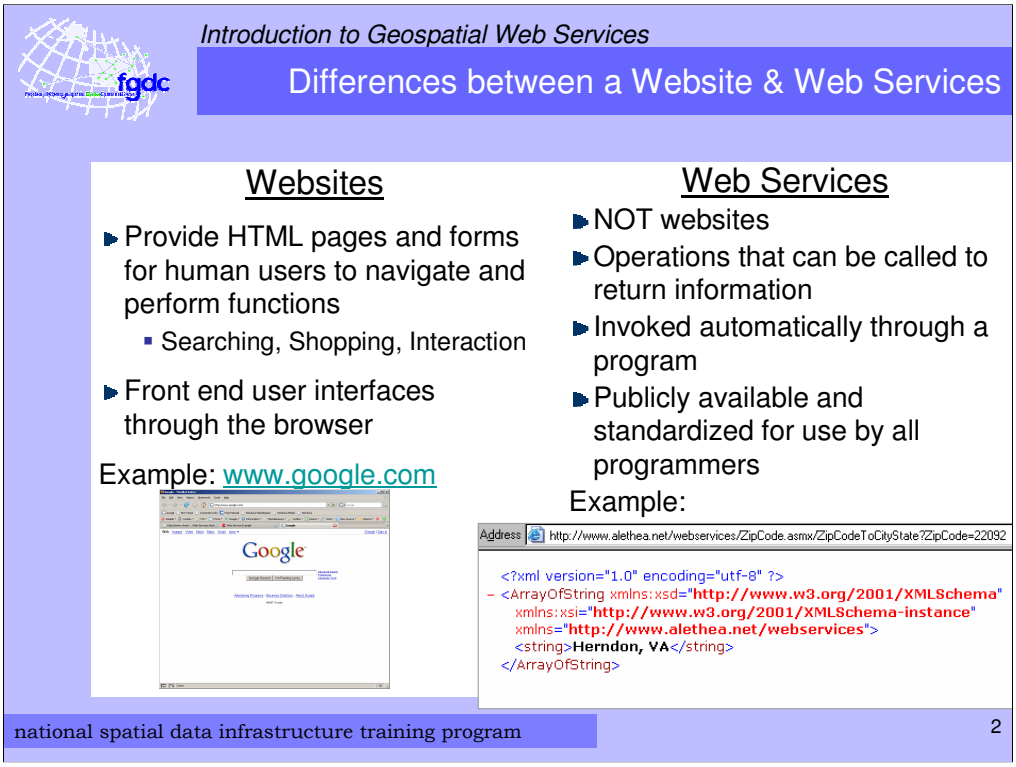
An introduction and inventory of geospatial web services and their importance to interoperability in the geospatial domain.

vers. 20070625

Learning Objectives

After completing this module the student can:

- Explain the difference between a website, a web service, and a geospatial web service
- Differentiate between types of geospatial web services and how they are used
- Explain the purpose of the Open Geospatial Consortium (OGC)



EXAMPLES:

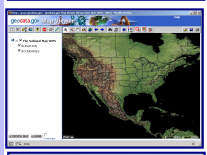
-Website – A user types in a URL into their browser or clicks on a link to open a new website.

-Web Service – A programmer initiates a call to a web service to ask for specific information for a particular zip code. The web service returns an XML answer of the city and state for that zip code.

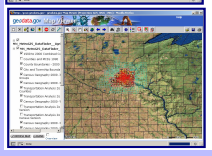
Types of Geospatial Web Services

Web based services with a focus on geospatial information

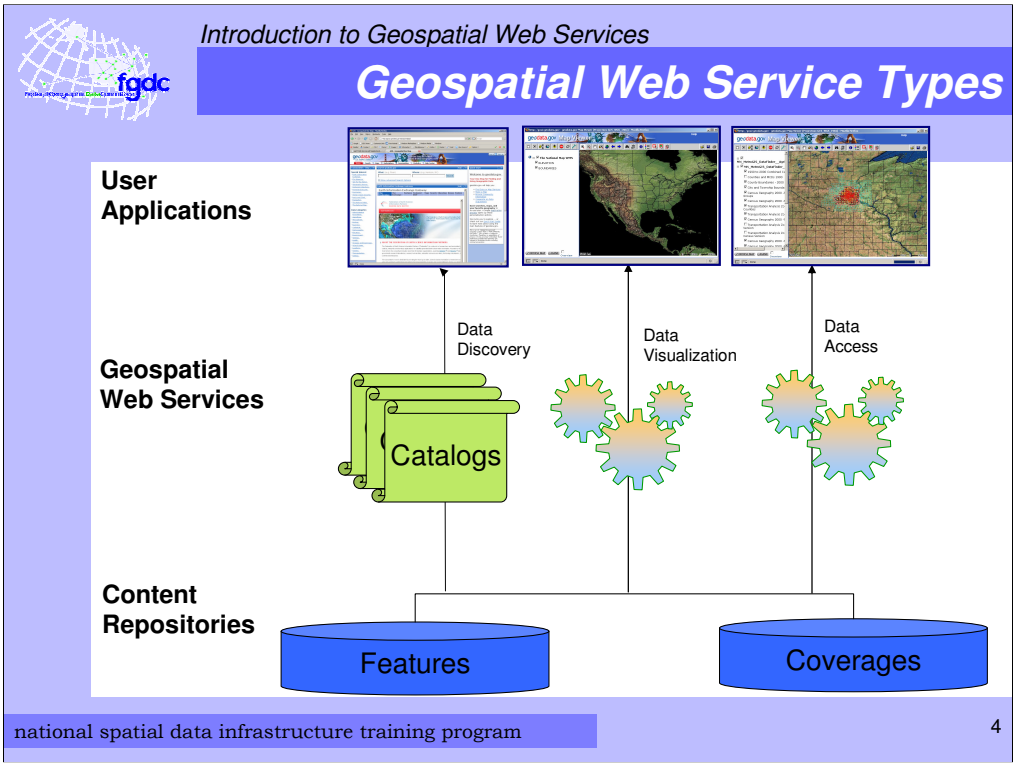
1. Data Discovery: Provide search and discovery to geospatial data and services



2. Data Visualization – Provide visualization images of the actual geospatial data



3. Data Access – Provides access to the actual geospatial data



This diagram displays how each geospatial web service type can interact with backend information to provide it service.

Data Discovery – Allows a user to search a metadata catalog that describes data. The service provides all metadata records that match and allow the user to select and view individual metadata records.

Data Visualization – Allows a user to request, display and save pictures or images of the geospatial data.

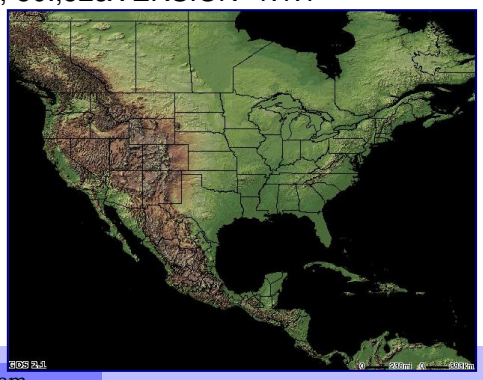
Data Access – Allows a user to request and obtain the actual data into a client that can interact with the data.

Geospatial Web Service Example

Request to a web service for an image of a map

- Web Map Service (WMS)

http://100.200.128.70/wms/process.cgi?REQUEST=GetMap&FORMAT=image/gif&WIDTH=640&HEIGHT=480&LAYERS=relief,bound&SRS=EPSG:4326&BBOX=-137,14,-50.,52&VERSION=1.1.1



This is an example of a request to a web service for an image of a map. It is an example of a Web Map Service (WMS). The URL makes a map request to the 100.200.128.70 server to generate a map in 640x480 sized GIF image for temperature data. The request also specifies the geospatial area (BBOX) in the geographic projection (epsg:4326).

Geospatial Web Service Example

Request to a web service for attribute information for a specific point

- Web Feature Service (WFS)
  http://100.200.128.70/geoserver/wfs?request=GetFeature&version=1.0.0&typeName=massgis:GISDATA.TOLLBOOTHS_POLY

```
<?xml version="1.0" encoding="UTF-8"?>
<wfs:FeatureCollection xmlns:wfs="http://www.opengis.net/wfs" xmlns:gml="http://www.opengis.net/gml" xmlns:massgis="http://massgis.state.ma.us/featuretype" xmlns:xsi="
        <gml:boundedBy>
                <gml:Box srsName="http://www.opengis.net/gml/srs/epsg.xml#26986">
                        <gml:coordinates xmlns:gml="http://www.opengis.net/gml" decimal="." cs="," ts=" ">46372.21687076,875108.58939714 239087.47029824,903573.651823
                </gml:Box>
        </gml:boundedBy>
        <gml:featureMember>
                <massgis:GISDATA.TOLLBOOTHS_PT fid="GISDATA.TOLLBOOTHS_PT.1">
                        <massgis:OBJECTID>1</massgis:OBJECTID>
                        <massgis:ID>0</massgis:ID>
                        <massgis:OWNER>Massachusetts Turnpike Authority</massgis:OWNER>
                        <massgis:DISTRICT>1</massgis:DISTRICT>
                        <massgis:LOCATION>MassPike Exit 1</massgis:LOCATION>
                        <massgis:TOWN>West Stockbridge</massgis:TOWN>
                        <massgis:ROUTES>90/41</massgis:ROUTES>
                        <massgis:MPO>Berkshire</massgis:MPO>
                        <massgis:SHAPE>
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                        <massgis:TOWN>Lee</massgis:TOWN>
                        <massgis:ROUTES>90/20</massgis:ROUTES>
                        <massgis:MPO>Berkshire</massgis:MPO>
                        <massgis:SHAPE>
```
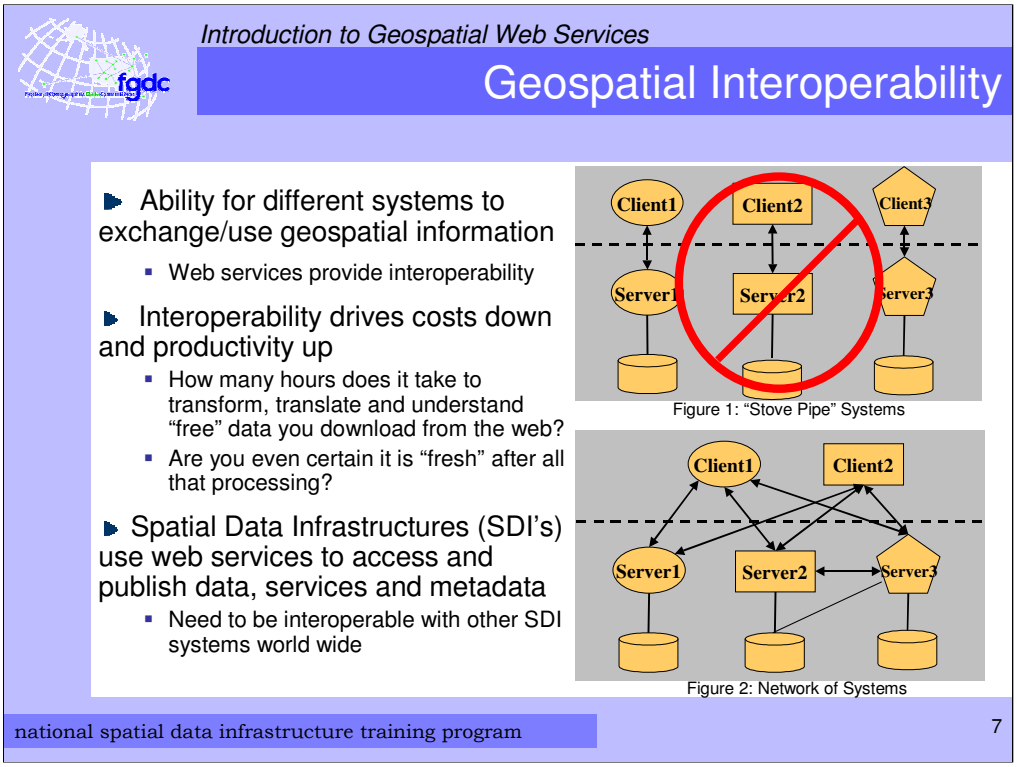


This is an example of a request to a web service to obtain attribute information. It is an example of a Web Feature Service (WFS). The URL makes a data request to the 100.200.128.70 server to return the attribute data to the client in XML format. Most WFS clients will read the XML data and open the geospatial data for analysis.

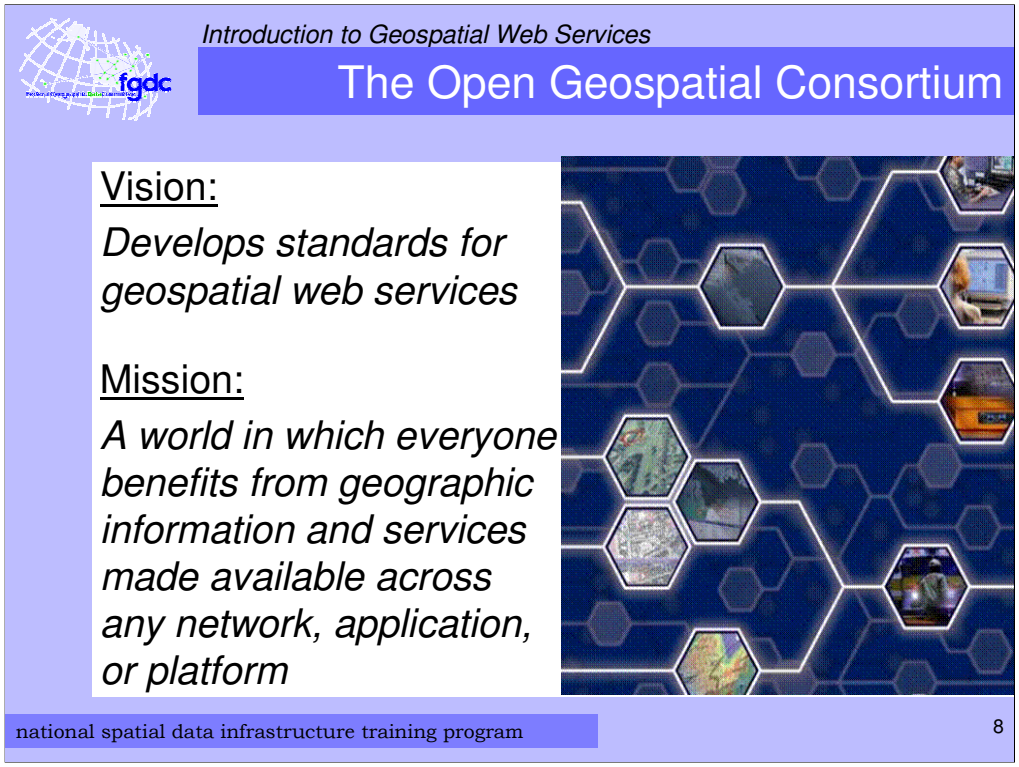


Open standards-based architectures allow systems to talk to each other. This approach has emerged as a key to integrating distributed information sources (eliminating "*stove-pipe*" systems). Standards-based, component architectures allows distributed systems to be built so that components plug together seamlessly. This also means that the distributed systems can be easily upgraded and expanded.

Figure 1 shows three client/server "*stove pipes*," where the user must run three different client applications in order to access the data and functionality provided by three different server implementations. In this situation, there is very little interoperability or reuse of client and server implementations. Because data are often accessible only through a given server, there is very limited ability for a user to transparently access data of interest from outside a fixed client/server stack.

Figure 2 shows several client/server systems that are interoperable. This means that there can be reuse of client and server implementations. In this case, we have at our disposal a variable and potentially large set of servers from multiple vendors and organizations.

These interoperable systems are important for geospatial interoperability in the development of Spatial Data Infrastructures (SDI's)



As a response, the OpenGIS® concept and dream began due to:

1. The user's need to integrate geographic information contained in heterogeneous data stores whose incompatible formats and data structures have prevented interoperability. This incompatibility has limited use of the technology in enterprise and Internet computing environments, and the time, cost, and expertise required for data conversion have slowed adoption of geoprocessing across all market segments.

2. The larger community's need for improved access to public and private geodata sources, with preservation of the data's semantics.

3. Agency and vendor needs to develop standardized approaches for specification of geoprocessing requirements for information system procurements.

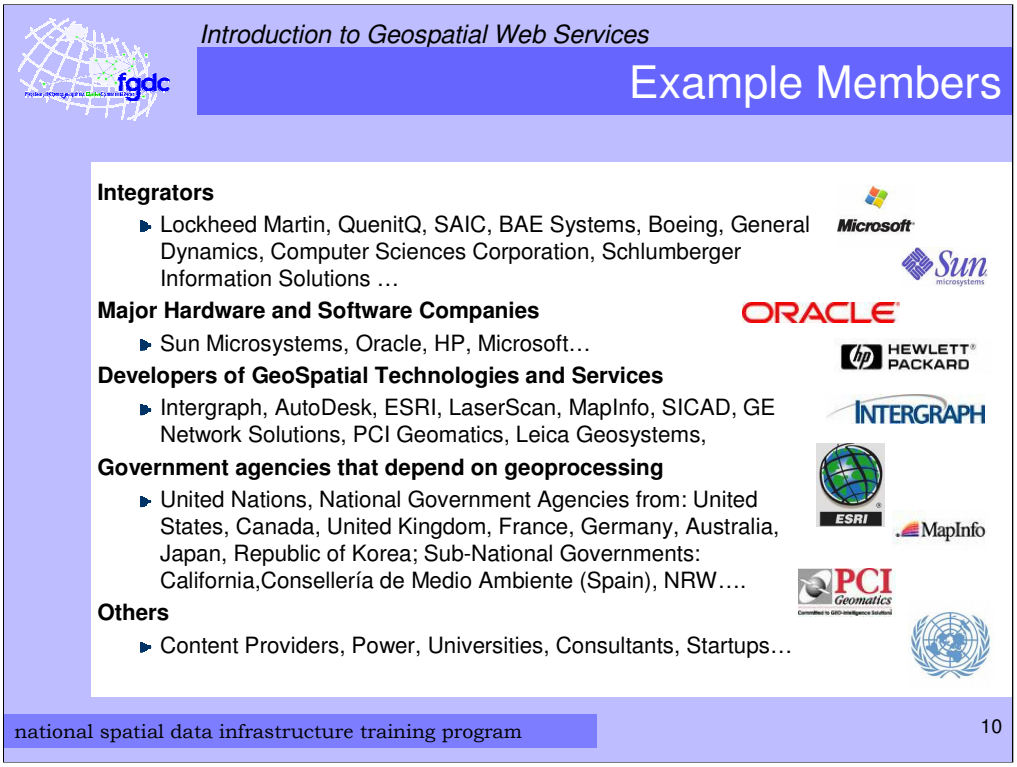
4. The industry's need to incorporate geodata and geoprocessing resources into national and enterprise information infrastructures, in order that these resources may be found and used as easily as any other network-resident data and processing resources.

5. Users' need to preserve the value of their legacy geoprocessing systems and legacy geodata while incorporating new geoprocessing capabilities and geodata sources.

From the Technology Perspective, OGC envisions the full integration of geospatial data and geoprocessing resources into mainstream

OGC Provides Interoperability

- OGC Specifications are agreed upon by a broad constituency of the geospatial community and are supported by many software vendors
- OGC links geographic data with mainstream Information Technology (IT)
- Vendor implementation in products enables the direct access and use of data produced by programs from many vendors



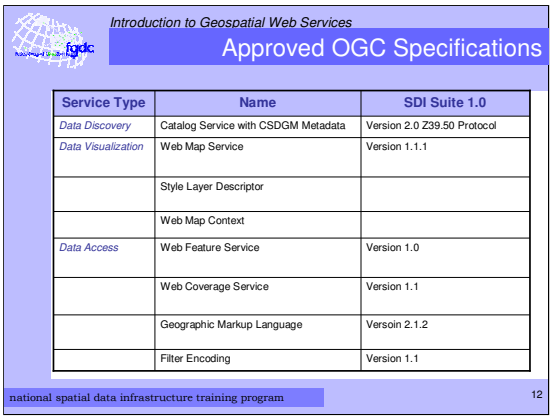
Membership has grown significantly since 1994, both in number of organizations and in the diversity of sectors and domains represented.

- Representation includes major integrators – they see that OGC interoperability helps them create enterprise solutions that include a wide range of plug and play options for their customers.
- Technology developers, from the major GIS vendors to specialized IT providers, are using OpenGIS specifications to reach broader markets, to reduce time and cost to market, and to provide their customers with flexibility.
- Technology using organizations – agencies and corporations – identify and prioritize the areas where interoperability is critically needed.

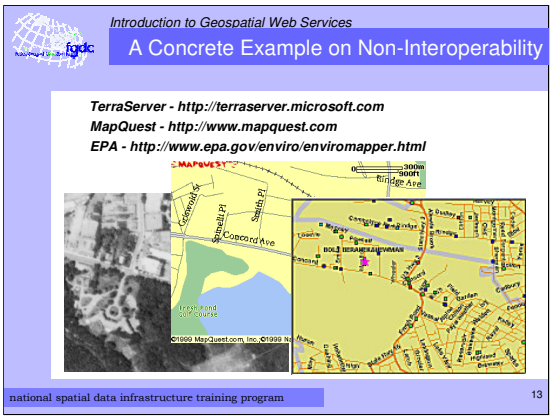
OGC and Standards Organizations

OGC collaborates and work closely with:

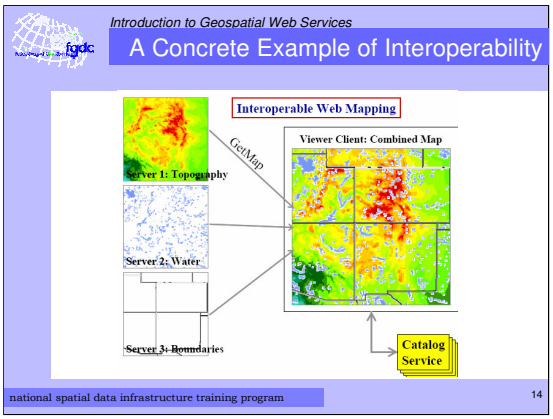
- International Organization for Standardization (ISO) TC 211 and 204
- World Wide Web Consortium (W3C)
- Internet Engineering Task Force (IETF)
- OASIS
- Automotive Mobile Information Consortium
- Open Mobile Alliance
- And others…



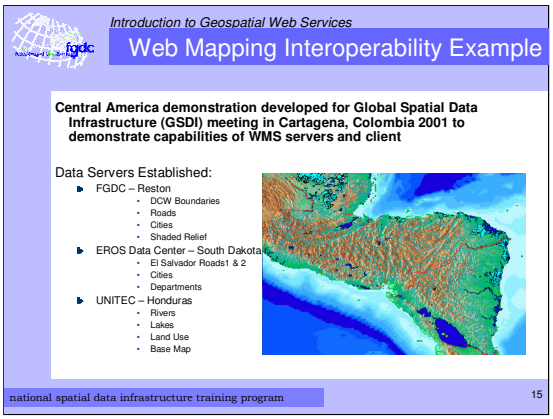
The U.S. NSDI has approved the following OGC specifications to be used in Spatial Data Infrastructure development at this time. This set of specifications have been tested to be interoperable together and are being recommended at this time. Each specification is listed with its service type and version that is recommended as our SDI Suite 1.0.



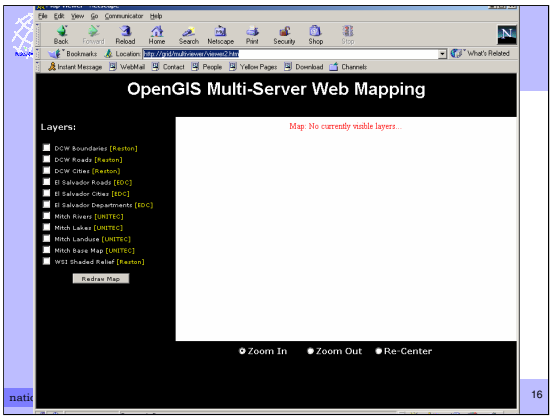
These URLs are examples of 3 different online mapping systems where maps were generated for the same location. These 3 maps were generated in 3 different browser windows and cannot be integrated and analyzed together because these systems are not interoperable.



Interoperability can be achieved by online mapping systems that are implemented using the Open Geospatial Consortium specifications. In the above example, there are 3 servers who serve their data using the Web Mapping Service (WMS) specification. This allows a client to request 3 standardized map requests to the servers and combine the images together in the client for the user.

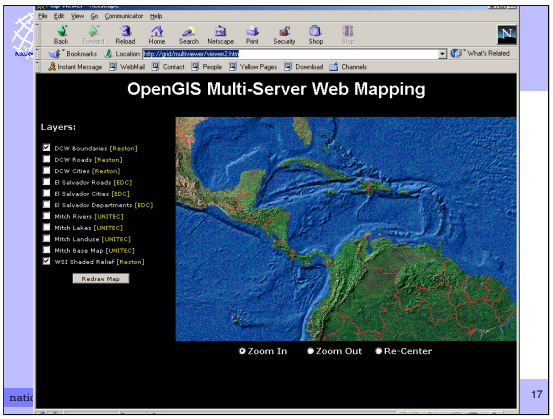


A very early demonstration of interoperability was developed for the Global Spatial Data Infrastructure (GSDI) meeting held in Cartagena, Columbia in 2001. This was accomplished by the establishment of 3 remote servers who each served different data layers for the Hurricane Mitch area in Central America. The servers were implemented using ArcIMS and Minnesota MapServer to show interoperability across different online mapping software. compiled an image of Cartagena built from data layers accessed from Federal Geographic Data Committee, USGS Eros Data Center and the Universidada Tecnologica Centroamericana (UNITEC) Hurricane Mitch data servers.

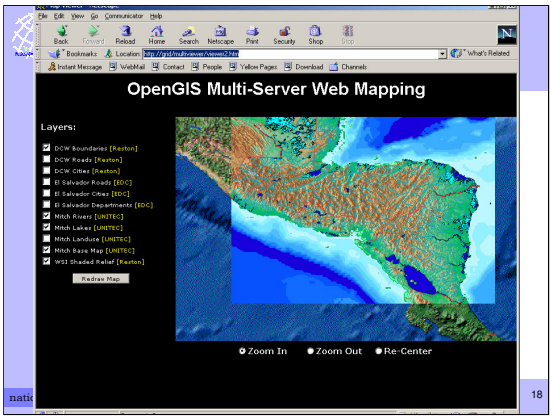


A Web Mapping Service (WMS) client was developed to run in a browser to demonstrate how these data layers from the remote servers can be brought together. The layer list on the left side of the shows the layer name with the name of the remote server in [brackets].

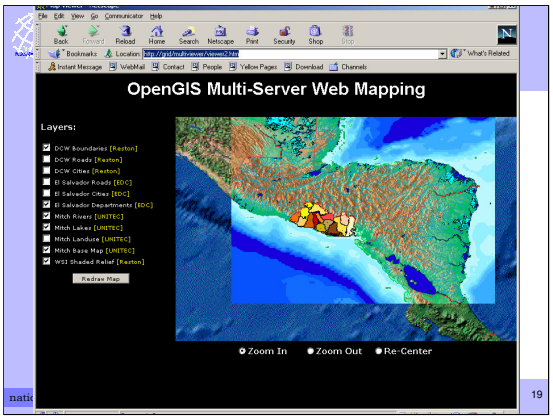
This simple client allows the user to turn the layers on/off, zoom and re-center the maps.



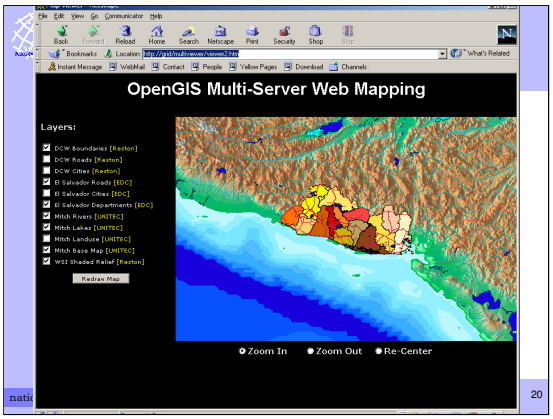
The DCW Boundaries and WSI Shaded Relief layers were turned on from the FGDC-Reston server.



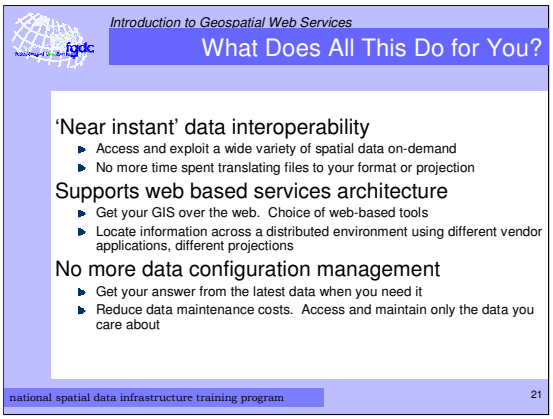
Additional layers were turned on from the Honduras-UNITEC server to show how different layers from different servers can be brought together in a single client.



In this final screen shot, the WMS viewer has zoomed into the El Salvador region and we have turned on the national layers for departments to show how the WMS specification can fully integrate and visualize data from global, regional and national data servers.



Finally, several national data layers for El Salvador were added to the client which are served from the EROS Data Center server.



In summary, interoperability is very important for the sharing, access and use of geospatial information. This interoperability can be achieved through OGC web services.

Next Module

Geospatial Web Services:

Data Visualization Web Services