Geo-Web services based framework for development of Mashup applications in GIS

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Geo-Information Services Technological Overview

...how it works?
Knowledge Base for GIS

Application Area:
- public admin.
- planning
- geology
- mineral exploration
- forestry
- site selection
- marketing
- civil engineering
- criminal justice
- surveying

Computer Science/MIS
- graphics
- visualization
- database
- system administration
- security

Geography and related:
- cartography
- geodesy
- photogrammetry
- landforms
- spatial statistics.

The convergence of technological fields and traditional disciplines.
GIS System Architecture and Components

External and Internal data

- Data Management: Spatial & Non-spatial data
- Model Management: Spatial model & Non-spatial model
- Knowledge Management
- Dialog Management: Attribute base query and report; Spatial query and spatial output

Major Components
- Database Server - Database Management
- Application server - Application software
- Hardware

Decision maker
Information system
Network Based Geo-Information Services

Web/application server

GIS Server

Request

Response

Data

Gateway

Web users

User 1

User 2

User 3

User 4

User n

Web clients
Network Based Geo-Information Services

Fig.-11.4. Typical architecture for Internet base geo-spatial data access
Network Based GIS- Example

- Web/Internet GIS;
- Enterprise GIS;
- Distributed GIS;
- Mobile GIS;
- ... etc many more examples.
What is Web GIS?

The integration of GIS and Internet technologies is allowing GIS professionals to solve one of the most important problems inhibiting information utility: How to provide access to information and data without burdening end users with complicated and expensive software. Internet is a perfect means of GIS data accessing, analyzing and transmission.

The World Wide Web, FTP (file transfer protocol) and HTTP programs make it convenient to access and transfer data files across the Internet. The Internet provides GIS users easy access to acquire GIS data from diverse data source in distributed environment. GIS users can use and download the data by sending the request through web browser application.
Web GIS- Basic Properties

- Web GIS technology is dynamic, for example, once any client(s) or database administrator updates the data or information at server end, it will available for all the clients on web at the same time.

- The Internet GIS can also link with real time information, such as satellite images, traffic movements and accident information by real time connection with the relevant information sources.

- The applications developed are cross-platform and accessible through any web browser.

- The Internet GIS applications can categorize into two major categories i.e. server-side applications and client-side applications. Server-side applications rely on GIS server (usually reside on a remote server) to perform all GIS analysis, while client-side applications perform GIS analysis and processing in the Web browser on the user’s local machine.
A Typical Web Client/Server Model
Full GIS Servers are Emerging

Providing Centralized GIS Services

- Standards-Based
- Cross-Platform
- IT Focused

Open Platform

GIS Server

Mapping - Visualization
Data Services
Editing
Geoprocessing Services
Catalog Services

Geo-RDBMS

XML Standards
Distributed Computing

Centralized & Distributed GIS Development and Processing
Web GIS Server Components

- **Database Server:**
  The database server may have a file based system or Relational Database Management System (RDBMS) based or a combination of files and RDBMS.

- **GIS or Map Server:**
  Map server or GIS server is a software package or program, which is responsible for rendering the GIS data into web browser.

- **Application Server:**
  An application server is a software which provides customized software applications.

- **Web Server:**
  A web server is a computer program which uses the client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), serves the files that form web pages to web users.
Web 2.0 and GIS

- Web 2.0 is referred as an interactive web application with public participation which allows participatory information sharing, interoperability, user-centered design, and collaboration on the World Wide Web.

- The integration of web 2.0 with GIS data application is known as GeoWeb 2.0.
Web 2.0 and GIS

Web 2.0 can be realized by combining several web computing technologies such as AJAX, Open API, REST, XML, XHTML/CSS, RSS/GeoRSS and other related technologies.
Service Oriented Architecture (SOA)
Service Oriented Architecture (SOA) for GIS
Differences between a Website & Web Services

**Websites**
- Provide HTML pages and forms for human users to navigate and perform functions
  - Searching, Shopping, Interaction
- Front end user interfaces through the browser

Example: [www.google.com](http://www.google.com)

**Web Services**
- NOT websites
- Operations that can be called to return information
- Invoked automatically through a program
- Publicly available and standardized for use by all programmers

Example: ?
The Open Geospatial Consortium

**Vision:**

*Develops standards for geospatial web services*

**Mission:**

*A world in which everyone benefits from geographic information and services made available across any network, application, or platform*
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.
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...
Types of Web Service Specifications for GIS

- **Catalogue Services** (Examples- CS Core, CS-W ebRIM, CS-W 19115/19119 and CS-W ebRIM for EO)

- **Processing Services** (Examples- Sensor Planning Service (SPS), and Web Processing Service (WPS), Coordinate Transformation Service (CTS and Web Coverage Processing Service (WCPS)).

- **Encoding** (Examples- Geography Markup Language (GML), CityGML, GML Simple Features, Filter Encoding (FE), GML in JPEG 2000, KML, Observations & Measurements (O&M), Sensor Model Language (SensorML), Symbology Encoding (SE), Styled Layer Descriptor (SLD), SWE Common, Transducer Markup Language (TML).
Types of Web Service Specifications for GIS

- **Data Services** (Examples- Simple Features Specification (SFS), Web Coverage Service (WCS), WCS Transactional, Sensor Observation Service (SOS), Table Join Service (TJS) and Web Feature Service (WFS)).

- **Portrayal Service** (Examples- Web Map Service (WMS) and Web Map Tiling Service)

- **Other Services** (Examples- GeoXACML, GeoRSS, Geospatial Objects, OWS Common)
Geospatial Web Service Flow - Example

User Applications

Geospatial Web Services

Data Discovery

Data Visualization

Data Access

Catalogs

Features

Coverages
Approved Specifications of OGC

- Simple Feature Access – OLE, SQL, CORBA
- Catalog 1.1.1
- Coordinate Transformation 1.1
- Grid Coverages 1.0
- Web Map Service 1.1.1 (2.0 in final edit) (WMS)
- Geography Markup Language 3.0 (GML)
- Web Feature Service 1.0
- Filter 1.0
- Style Layer Descriptor 1.0 (SLD)
- Web Coverage Service 0.0 (WCS)
- OpenLS
- OGC Web Services (Ongoing)
- Web Map Client Configuration
What Does All This Do for You?

‘Near instant’ data interoperability
- Access and exploit a wide variety of spatial data on-demand
- No more time spent translating files to your format or projection

Supports web based services architecture
- Get your GIS over the web. Choice of web-based tools
- Locate information across a distributed environment using different vendor applications, different projections

No more data configuration management
- Get your answer from the latest data when you need it
- Reduce data maintenance costs. Access and maintain only the data you care about
Mapping on the Web Today

Geo Portals are increasing day by day
Mapping on the Web Today

How can I combine data from each of these sources to answer my question?
OGC Specifications

- **CSW** - Catalog Service for the Web: access to catalog information. This standard is very important to create a spatial data infrastructure through which the discovery of geospatial data from different data sources are possible. It can work as a clearing house for geospatial data in SDI.

- **GML** - Geography Markup Language: XML-format for geographical information used for exchange geospatial data. The GML can handle both the vector and raster data in 2D and 3D domain.

- **KML** - Keyhole Markup Language: XML-based language schema for expressing geographic annotation and visualization on existing (or future) Web-based, two-dimensional maps and three-dimensional Earth browsers. Initially KML was a proprietary data standard of Google but now it is accepted by OGC as one its standard for 2D and 3D geo-visualization.
OGC Specifications

- **OGC Reference Model**: a complete set of reference models
- **OWS**: OGC Web Service Common
- **SOS**: Sensor Observation Service
- **SPS**: Sensor Planning Service
- **SensorML**: Sensor Model Language
- **SFS**: Simple Features - SQL
- **Styled Layer Descriptor (SLD)**: This specification is used to define colors (legend) for thematic data. It is an XML based standard which allows to represent various cartography contents for map including special characters and symbols.
OGC Specifications

- **WCS** - Web Coverage Service: provides access, subsetting, and processing on coverage objects. This service specification is used for raster or gridded data. If data is served as WCS then a simple URL will act as a Image data and all the Image processing related activities can performed with this URL. This is a data service specifications for raster data.

- **WCPS** - Web Coverage Processing Service: provides a raster query language for ad-hoc processing and filtering on raster coverages.
OGC Specifications

- **WFS** - Web Feature Service: for retrieving or altering feature descriptions. This is a specification for vector data sets. Once the vector data is served as WFS then all the vector operation including overlay analysis can be performed with simple URL. This is a data service specification for vector data.

- **WMS** - Web Map Service: provides map images for raster as well as vector data. This service specification is used for geo-visualization purpose.

- **WMTS** - Web Map Tile Service: provides map image tiles for map caching at client end. Used to enhance the performance of Web GIS applications.
- **WPS** - Web Processing Service: remote processing service

- **GeoSPARQL** - Geographic SPARQL Protocol and RDF Query Language: representation and querying of geospatial data for the Semantic Web
Mashup Applications in GIS
Mashup GIS Applications

- Mashups, composed of mixing different types of software and data from variety of sources to develop a user defined GIS applications in the form of software blending applications.

- Also known as ‘Neogeography’ in which non-expert users are able to exploit the power of maps (Michael Batty, 2010).
Typical Mashup Architecture - Case

- NDEM Portal
- Web Client
- Internet
- Customized query and analysis system
- PHP & .Net app
- OpenLayer API
- GPRS
- XML based Data
- RDBMS
- SQL
- Webserver (Proxy)
- Geo-RDBMS
- Local files

Services:
- ISRO Bhuvan
- ISRO Bhoomipedia
- ISRO DSC Web Services
- Other OGC web services
- Openstreet Maps
- Google Maps
- Bing Map
- ArcGIS Service
Practical Exercise

1. Access Bhuvan Geoportal and browse 2D viewer
2. Identify Area of Interest and Draw AOI
3. Download AOI as Shape file
4. Open project in QGIS and set SRS as 4326
5. Open AOI and set symbology
6. Call WMS of Satellite Image and Thematic data
7. Call WFS of Vector data
8. Install OpenLayer Plugin in QGIS
9. Call Google Maps (Satellite and Physical) and Overlay
10. Call other map services like Yahoo, Bing etc
11. Access OSM website and download the data
12. Access Geofabric website and download shape file of vector layers
13. Overlay OSM data in QGIS project
14. Understand OSM data structure
15. Extract attributes and feature from OSM data
16. Download satellite data and stack it as FCC and overlay in QGIS project
17. Connect remote server for ground truth data (like ODK)
18. Demonstrate field data collection using mobile app
19. Integrate field data into QGIS project
Thank You