Integrating WebGIS with WFS and GML

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Abstract

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. With the advancement of technologies and internet it allows for the emerging of GIS to be considered as a WebGIS. In order to build a WebGIS for connecting to geodata sources we need commonly acceptable standards for understanding of Web interfaces. OGC standards (WMS and WFS) for Web services interfaces and data interchange are used in WebGIS. For Data access and exchange, the OGC (Open GIS Consortium) WFS is used to access and manipulate feature-level data. The main advantages of this approach are interoperability and feature-level data sharing. Web services technologies with WFS make use of XML database to store geospatial data as GML. In this paper, we analyzed different interfaces provided by WFS like GetCapabilities, DescribeFeatureType and GetFeature and integrate it with Geoserver open source GIS to limit access of data and transactions.

Key Words: WEBGIS, geospatial web service, WFS, GML, SVG, Geospatial Information and OGC.

1. Introduction

Availability of spatial data in digital forms integrated to a database refers to as Geographic Information System (GIS) which inclined towards interdisciplinary applications [4]. GIS can be recognized as an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display many forms of geographically referenced information. With the advancement of technologies and internet it allows for the emerging of GIS to be considered as a WebGIS. The originally GIS systems has been evolved along with the technology development to a personal desktop of GIS, and to currently WebGIS services, which include the applications of Internet GIS and mobile GIS. Access to spatial data over the Internet is growing rapidly. Web-based GIS could provide interactive mapping and spatial analysis capabilities to reduce the problem of data ownership and analysis. WebGIS provide functions for displaying and navigation of maps and functions for querying of geographic data using both spatial and non-spatial. These functions can cover only some of GIS functionality. For capturing, storing and manipulating with geospatial data we need more traditional application environments. GIS with a set of “Web interfaces” may be purposes distribution of geospatial data for Web presentation. To design the model of a WebGIS that is open for connecting to a range of different geodata sources we need acceptable standards for understanding of these web interfaces. Open Geospatial Consortium (OGC) (Open Geospatial Consortium Inc., 2004) interface specifications for building Web services that enable retrieval of custom maps (Web Map Service Implementation Specification, 2002) and querying of geospatial entities (Web Feature Service Implementation Specification, 2002) seem as a quite reasonable choice [3]. Web GIS involves authoring geographic knowledge, including data, models, workflows, and maps, and then serving those resources to other users. Web GIS harnesses the power and reach of the Web and integrates the rich knowledge resources of GIS—authoritative databases, models, and spatial analysis. Web GIS
goes far beyond simple visualization and mapping everyone. Over time, Web GIS will become a fundamental part of the infrastructure of society.

2. Implementation

Developing a WebGIS is more than simply buying the appropriate hardware and software. Several strategies have been proposed to provide successful implementation. The implementation strategies have been scientifically assessed and modified. Figure 1 shows the Web GIS development cycle, which is described with major phases starting with the initiation and ending with maintenance of the WebGIS system [4].

Figure 1 Development Framework of WebGIS

This system consists of three district components: a server application, a client interface, and a data repository. It is conformed to a multi-tiered layered architecture typical of server-side Internet application.

Figure 2 Multitiered Layered Architecture

The prototype system of WebGIS has a client and a backend-processing as a server, in order to speed up processing a huge volume of GIS datasets. The system has a multiple-layer architecture consisting of three parts – browser, map server and database server [7].

Figure 3 Open source prototype system for web mapping

Server for constructing Web Feature Services (WFS) which are based on Geoserver. The map clients in and provides access to full geographic knowledge to browser deploy multi-media graphic technologies: Java applet – jBox, SVG, and Flash SWF. The interopereation between client and web server can be implemented in both the GEOSERVER CGI interface and the OGC WMS Interface.

3. OGC Specification

The Web Feature Service (WFS) developed by the Open GIS Consortium (OGC) provides geographic data encoding in Geographic Mark Language (GML) on feature level. GML is an XML based encoding standard for geographic data on data level. GML describes the world in terms of geographic entities called features. The WFS specification defines interfaces for data access and manipulation operations on geographic features. Since GML becomes more and more important in data exchange, transfer and storage, an integrated system which contains WFS will be an important part of Web GIS frameworks [7]. The OGC Web Feature Service allows a client to retrieve geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Services. So it is necessary to transfer the GML files to vector graphics which can be easily accepted by general users.

4. WFS

A WFS server publishes feature-level geospatial data to the web. Instead of returning an image, as GeoServer traditionally does the client obtains well defined information about specific geospatial features of the underlying data, at both the geometry and attributes levels. An OGC specification uses XML over HTTP as its delivery mechanism and GML, which is a subset of XML [3]. The WFS specification defines interfaces for data access and manipulation operations on geographic features. Through these interfaces, a web user or service can combine using and managing geospatial data the feature information behind a map image from different sources.

Figure 4 WFS Specification

The main interfaces provided by WFS are: GetCapabilities, DescribeFeatureType and GetFeature, as well as the more advanced Transaction, LockFeature and GetGmlObject operations [3]. GeoServer’s WFS also is integrated
with GeoServer’s Security system, to limit access to data and transactions. It also supports a wide variety of WFS output formats, to make the raw data more widely available.

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GetCapabilities</td>
<td>Return the service capabilities such as the version, the name and the content</td>
</tr>
<tr>
<td>GetFeature</td>
<td>Return the features offered by the server</td>
</tr>
<tr>
<td>DescribeFeature</td>
<td>Return the feature type</td>
</tr>
<tr>
<td>LockFeature</td>
<td>Prevents a feature type from being edited</td>
</tr>
<tr>
<td>Transaction</td>
<td>Edits existing feature types by creating, updating, and deleting.</td>
</tr>
<tr>
<td>GetGMLObject</td>
<td>(Version 1.1.0 only) - Retrieves element instances by traversing XLinks that refer to their XML IDs.</td>
</tr>
</tbody>
</table>

Table 1: The main operations of the WFS server

5. GML

GML is an XML-based markup language that is used to encode information about real world objects. In GML these real world objects are called features and they have geometry and non-geometry properties. GML has three main roles with respect to geospatial information [3].

• First as an encoding for the transport of geospatial information from one system to another.
• Second as a modeling language for describing geospatial information types.
• Third as storage format for geospatial information. Typically in any management related tasks like environmental management, natural resource and so on one needs to examine and explore data from several sources, use of simulation models, develop scenarios, assess impacts and provide support for decision makers. For these management related tasks use of XML-based languages for data exchange is an improvement on non XML data formats because the XML format is partially self-documenting and provides common methods for parsing files, obtaining their structure and transforming them to alternative formats. GML (as an XML-based language) is well suited for encoding the geospatial information sent to and from geospatial Web services.

WFS_Capabilities version="1.0.0"
xmlns="http://www.opengis.net/wfs"
xmns:work="d:"
xmns:it.geosolutions="http://www.geo-solutions.it"
xmns:cite="http://www.opengeospatial.net/cite"
xmns:tiger="http://www.census.gov"
xmns:sarwar="http://D:"
xmns:sde="http://geoserver.sf.net"
xmns:topp="http://www.openplans.org/topp"
xmns:fs="http://www.openplans.org/spearfish"
xmns:nurc="http://www.nurc.nato.int"
xmns:ogc="http://www.opengis.net/ogc"
xmns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.opengis.net/wfs http://schemas.opengis.net/wfs/1.0.0/WFS-capabilities.xsd">
<Service><Name>WFS</Name>
<Title>Geoserver</Title>
---

<FeatureType>
<Name>work:vill_bound</Name>
<Title>vill_bound</Title>
<FeatureType>
<Name>work:vill_bound</Name>
<Title>vill_bound</Title>

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As a modeling language, GML provides different types of objects for describing geospatial information, including geospatial features, coordinate reference systems, topology, time, units of measure and generalized values. GML spatial and non-spatial relationships can be used in modeling using real world objects. As a storage format GML is a plain textual file format which can be managed using any database management system. In view of the fact that GML is based on XML, the same technology for managing XML data can be used to manage geospatial data stored in GML. On the whole XML databases are used to control XML data. GML has important feature in geomatics to the scope that many organizations adopted this format as their main geospatial storage and exchange format. Below Figure 6 shows simple layer previews which consist of Name, Title, SRS and LatLongBoundingBox. Name is the name of workspace, Title is the layer name, SRS is Spatial Reference System and LatLongBoundingBox is the minimum and maximum latitude and longitude defined area.

Figure 6 Coding of GML shows WFS features

6. Conclusion
In this paper a geospatial web service (Basic WFS) using XML database system and Web Services Technologies is described. Since GML is based on XML, the XML databases can be used to manage geospatial data. Developing WFS with the use of Web services technologies make use of XML database to store geospatial data as GML, provides spatial data and access interoperability among various geospatial processing systems. Web services technologies are foundation of cross-platform application-to-application communication, functionality of the implemented geospatial Web service can be simply added to any geospatial platforms. With GML, the real world spatial information can be described in feature level and it is easy to exchange or integrate data among different data providers. At present more and more geographic information are offered as GML. The methodology used in this paper presents an effective way to use the service provided by Geoserver, and makes it easy for users to obtain visualized geographic information.

7. References