CONTRIBUTION OF GEOWEB 2.0 TO BUILD A SDI SYSTEM FOR REMOTE SENSING SATELLITE DATA OF CHINA

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Abstract – GeoWeb2.0 is the geographic embodiment of O'Reilly's ideas and it is increasingly becoming a trend method to construct a GIS application. Spatial Data Infrastructure (SDI) is really GeoWeb applications. In the quest to establish the GeoWeb2.0, a free version of rich spatial Flex Viewer has been released by Environmental Systems Research Institute, Inc (ESRI). While the remote sensing satellite data of China emerge from the characteristics of multiple sources, massive distribution and diverse standards, etc, it is very necessary to build a SDI system for remote sensing satellite data in order to effectively process, distribute, use, maintain, and preserve these data. Therefore, this article finally evaluates the great contribution of GeoWeb2.0 to build a SDI system for remote sensing satellite data of China by revealing a network service system based on the frame of Flex Viewer.

Keywords: GeoWeb2.0, GIS, Flex Viewer, Spatial Data Infrastructure, Remote Sensing Satellite Data

1. INTRODUCTION

GeoWeb developments are gradually transferring from Web 1.0 age to Web 2.0 age. GeoWeb describes all the geographic content and application services that are currently available on the World Wide Web. In GeoWeb1.0, geographic contents, which include data, maps, process models and metadata, have been available on the web for many years in the form of datasets and map images that can be downloaded by ftp (file transfer protocol) or other interactive web mapping applications. However, in recent years, the range and quantity of contents have risen dramatically, and an increasing number of distributed, heterogeneous spatial information resources exist, especially for the remote sensing satellite data of China. At the same time, the effort and the funds for creating and maintaining these data are often high but the data is still not being used to its full capacity. The problems proposed above are also related with how to build a Spatial Data Infrastructure (SDI) system for remote sensing satellite data of China. In order to build this SDI system effectively, new innovative applications are required. The GeoWeb2.0 method of accessing geographic information has changed from relying on ftp to using direct access web services with a well-defined API (e.g. REST/XML) based on XML. A rich spatial Flex Viewer, which is created by ESRI, is exactly based on this method. An example for this kind of applications is the network service system described in this paper. This paper provides a comprehensive overview of technologies and methodologies related to GeoWeb2.0, all sorts of aspects about this SDI system, as well as discussion for future development strategies for the SDI system.

2. TECHNOLOGY

2.1 Web 2.0

The term 'Web 2.0' was introduced by Tim O'Reilly in a white paper (O'Reilly 2005). The GeoWeb2.0 developments are very much tied to Web 2.0. Therefore, the main characteristics of Web 2.0 (Fu, Liu, & Wang, 2008) should be emphasized to understand its nature:

· user-generated content: there is no longer any separation between information consumers and producers; there is two way communication;

· modularity: with help from the standards and interoperability, any piece of information is ubiquitous, and any system can aggregate information from several sources;

·social dimension: users are no longer isolated; they

can create links between each other to share information more intensely

2.2 GeoWeb2.0

2.2.1 The new features of GeoWeb2.0

GeoWeb2.0 is the geographic embodiment of O'Reilly's idea, and it is the next generation of geographic information publishing, discovery and use (Maguire, 2005). Table 1 shows the key differences between the GeoWeb1.0 and GeoWeb2.0.

Table 1. Differences between GeoWeb 1.0 and 2.0 (Maguire, 2005).

GeoWeb1.0	GeoWeb2.0
Static	Dynamic
Publishing	Participation
Producer centric	User centric
Centralized	Decentralized
Close coupling	Loose coupling(e.g.mashup)
Basic	Rich

2.2.2 Technology behind GeoWeb2.0

The general web technology is the backbone of GeoWeb2.0, so it should include browser client, databases, web servers, web application servers and data transport protocols, etc.

GeoWeb services can be considered as the most important part of the GeoWeb2.0 technology, while the essence of GeoWeb services is web service. Following Cerami (2002), a Web service is any service that is available over the Internet, uses a standardized XML messaging system and is not tied to any one operating system or programming language.

By using GeoWeb clients, the end users can interact with GeoWeb services. The mainstream development technologies of GeoWeb client available today include JavaScript, Flex or Silverlight, which can be used for building browser-based applications.

In addition, web services should be self-contained with a XML grammar (such as WSDL -Web Services Description Language) and discoverable with a simple 'search' mechanism (such as registries), illustrated by Cerami. Meanwhile, the emergence of the REpresentational State Transfer (REST) service made the requirement for using standardized XML messaging relaxed. REST is an architectural style that emphasizes scalability of component interactions, generality of interfaces, independent deployment of components, and intermediary components (Fielding, 2000). Clients communicate with RESTful services via standard http protocol calls (i.e., GET, POST).

Finally, it is necessary to provide a directory of available web services to access them. A services-oriented architecture (SOA), which is a distributed enterprise system built from loosely-coupled, interoperable web services, is widely accepted by the GeoWeb2.0 development in the past few years.

2.3 Spatial Data Infrastructure (SDI)

GeoWeb2.0 has played an important role in the evolution of the SDI concept. An SDI can be seen as the integration of the 'technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data throughout all levels of government, the private and non-profit sectors, and academia' by the US Federal Geographic Data Committee (www.fgdc.gov). SDIs are really GeoWeb applications for cataloging and accessing geographic web services (Maguire, 2005).

2.4 Flex Viewer

Flex Viewer is a client framework based on ArcGIS API for Flex, and it is also a RIA application that really reflect GeoWeb2.0. The Sample Flex Viewer is architected to help develop and deploy GeoWeb2.0 applications that can completely utilize the server side spatial services. The server side services could be provided by the ArcGIS Server and ArcGIS Online.

Flex Viewer provides users a simple way to access geospatial services. As illustrated in Figure 1, a geospatial service could come from the hosted SaaS (Software as a Service) type of providers such as ArcGIS Online, ArcGIS Servers or web data sources such as GeoRSS feeds, KML files, JSON/REST data, etc. The data consumed within the Flex Viewer could be the data set at server side or could be operational dynamic data generated from mobile devices

such as field engineers' laptops or smart phones.

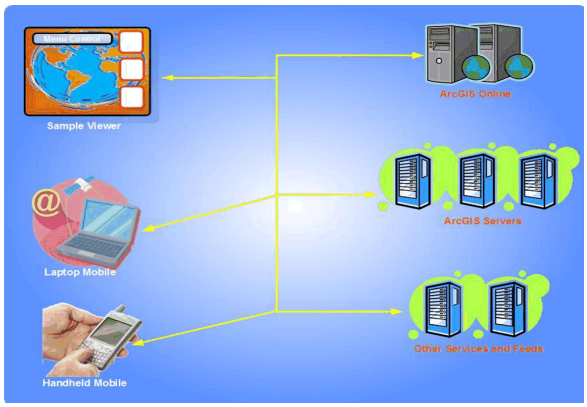

Figure 1. Architecture of Flex Viewer (Moxie Zhang, 2008)

3. EXAMPLE OF USE: A NETWORK SERVICE SYSTEM BASED ON THE FRAMEWORK OF FLEX VIEWER

As a national institute, that possesses nearly the whole remote sensing satellite data of China, how to effectively administrate these data is a key problem. It is important to build an efficient network service system to help with setting up National Spatial Data Infrastructure (NSDI). To complete it, Flex Viewer is rebuilt and the main query function is realized to meet the NSDI's need. In system, the spatial data are provided in the form of standard web interfaces, such as REST or WMS. In the meanwhile, Flex Viewer is adopted to handle these standard web interfaces via standard communication protocol. The following sections will illustrate it in detail.

3.1 System Architecture

The architecture of this network service system is based on "Client Layer + WebGIS Server/GIS Application Server + Data Layer". As we see in Figure 2:

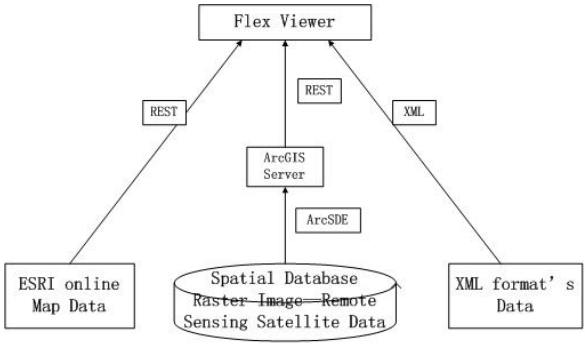

Figure 2. Architecture of Flex Viewer

Client is a component that is running on the cline machine, and it operates the component based on Flex Viewer through Adobe Flash plug-in embed in the browser. Connection between the client and map server is archived through the use of ArcGIS API for Flex.

GIS services come from the server side in the domain or cross-domain. The GIS application server in the domain is using ArcGIS Server, which publish the local map services using REST API. Whereas the client-side realizes the REST interface of map services by using map component based on ArcGIS API for Flex. Microsoft's IIS is used as the container of server to deliver all of these services to server side.

Data layer is to access the data in this system. The data can be divided into two categories: spatial data and non-spatial data. Spatial data are stored in the Oracle database that adds the spatial data engine – ArcSDE, which is used for managing spatial data. While the non-spatial data are directly stored in Oracle database. Flex viewer accesses these two types of data separately using the REST interface and XML interface.

3.2 Data Used In System

Spatial data include ESRI's online map layers, national geographic base data and remote sensing satellite data of China from many sorts of satellites, such as SPOT, LANDSAT, ENVISAT, etc, received by the Remote Sensing Satellite Ground Station.

Non-spatial data include all of the metadata of remote sensing satellite image and other relative attribute data.

3.3 System Functions

This network service system is designed to provide the user with comprehensive query functionality supported with interactive map browsing. The query conditions offer diverse searching capabilities while aiming at searching for image data derived from different satellites.

These query conditions include the taken time of image data, the spatial extent that the data cover, and the remote sensing satellites the users want to query. The taken time are divided into continuous time and discontinuous time. Besides, there

are also five means for users to set their spatial conditions. In order to set the queried area by graphic on the map, the users can draw point, line, rectangular and polygon, select the administrative divisions, set the latitude and longitude of the area and upload the shape files that the users define themselves. At last, according to satellites the users choose, there are also some advanced query conditions. For example, if the user wants to query the data from SPOT 2, the sensor mode of satellite and incident angle can be chose. Figure 3 shows a screen snapshot of the system query page.

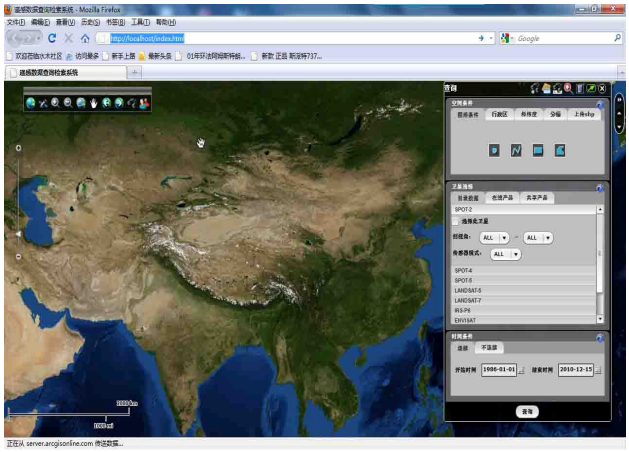

Figure 3. System Query Page

Once the image data are queried out, they can be shown on the map in the form of graphics. The user can click on these graphics with mouse, and then the metadata information of the image data can be shown in a new pop-up window. If the queried data meet the users' requirements, they can be downloaded once this SDI system is registered.

4. DISCUSSION

Performance and scalability are important issues that should be considered. In this SDI system implementation, we depend on ArcGIS Online for the presentation of the spatial data, which we cannot consider optimal to some extent. For example, the services of image data published by ArcGIS Online or ArcGIS Server are still relative slow. To improve performance, a client-side cache needs to be implemented to store previously retrieved data. Alternatively, the performance of database should also be taken into account on the server side. Oracle Real Application Clusters (RAC) has been implemented in this system to bear the server-side burden caused by a large number of the users' visits.

5. CONCLUSION

As an introduction to GeoWeb2.0 development, a comprehensive overview of technologies related to the topic has been provided. Furthermore, the development of a network service system as a broad information technology approach illustrates feasibility with regard to new, innovative development for an SDI system. Organizations, especially the public administration, can benefit from this approach to more effectively manage their information resources and provide services for other related sections.

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