DEVELOPMENT AND DEMONSTRATION APPLICATION OF GOVERNMENT GEOGRAPHIC INFORMATION SERVICE PLATFORM

Liu Jiping, Xu Shenghua*, Wang Liang, Zhang Fuhao

Government GIS Research Centre, Chinese Academy of Surveying and Mapping, No.16, Beitaiping Road, Haidian District, Beijing, China-(Liujp, Wangliang, Zhangfh)@casm.ac.cn, xushenghua@gmail.com

KEY WORDS: Geographic information, Government information, Government geographic information services, Software platform

ABSTRACT:

Geographic information and geographic information systems technology play an important supporting role in government administration and decision-making, government geographic information services have become one of the important domains of GIS applications. In this paper, services and geographic information services lead to the concept of the government geographic information services, then the key technologies of government geographic information service platform is analyzed, and the functions, characteristics and application of the platform are introduced, finally, the future development of the platform is proposed.

1. INTRODUCTION

For political, economic and military needs, the United States, France, Germany and other major western countries have carried out the development and application of government geographic information service platform. In 1992, China began to construct the government geographic information platform for the headquarters. During the past 10 years, great progresses have been made in software development and system application, which promote the application of geographic information in government business management and decision-making and gradually form the new areas of government geographic information services. Since the new century, geospatial information and geographic information system technology continue to play an important role in the support tools in e-government and government administration and decision-making (Zhang, 2003; Liu, 2006b). The characteristics of GIS data distribution determine the development of GIS from processing tools to the geographic information services and form Societal GIS (Wu, 2006; Winnie, 2003). In order to achieve the geographic information services collaboration, OGC and ISO/TC211 proposed the concept of service chains in the geographic information service standards. According to the user control lever, the service chains are divided into user-defined chain, flow management chain and integrated chain. Considering the advantages of service-oriented architecture (SOA), such as reusable services, loosely coupled, coarse-grained, etc, SOA supports resource reuse, application integration, and business agility. Many researchers pay close attention to SOA-based GIS services, and many commercial GIS software such as ArcGIS9.1, SuperMap2008, MapGIS7 are adopt to SOA concepts (Wang, 2008). Therefore, the construction and application of service-oriented government geographic information system is an important direction of geographic information services and government management decision-making.

In this paper, services and geographic information services are introduced first, and then the functions, characteristics and key technologies of government geographic information service platform are expatiated, and finally, the application of government geographic information service platform is summarized.

2. SERVICE、GEOGRAPHIC INFORMATION SERVICE AND IN GOVERNMENT GEOGRAPHIC INFORMATION SERVICE

2.1 Service and service science

Service, in substance, creates value through the relation between provider and client. Kiyomizu (1994) divides service into intelligent and mental service, behaviour service, commercial and operational service (Wang, 2008; Liu, 2008). Intelligent and mental service will affect the behaviour service, and both are the foundation of commercial and operational service. The service value creation is a very complex process, not a very simple exchange. It is related to the communication of many subjects and departments. Service in modern society, from production to translate, relates to people, technology, in-out information and many other elements. All these elements through value creation contribute information to make service system. In 2004, The National Nanotechnology Initiative (NNI) made service science as one of the national innovative strategies in America. In 2005, IBM spark plug the service science is consisted of service science, management and engine (SSME). The status of service science is established formally (Guo, 2008).

2.2 Geographic information service

Geographic information service is a whole process, which use many subject information and technologies to mange geographic information so as to meet the people's requirements of different geography information. The process can be divided into geography data service and GIS processing function service. OGC divided geography information as follow:

(1)Catalogue service：It provides service metadata to users and satisfies users who query metadata to acquire needed geographic information service.

* Corresponding author. xushenghua@gmail.com

(2)Data service: It provides data columns in database to users including web coverage service (WCS), web feature service (WFS) and so on.
(3)Processing service: It provides data processing including net coordinate translate service and so on.
(4)Portrayal service: It provides the geographic information visualization including cartography maps, terrain display and dynamic display of time-space change. Besides, it contains Web Map Service (WMS) and so on.

2.3 Government geographic information service

Government geographic information service is a special geographic information service. Base on geographic spatial data and combination of government information, government geographic information service uses geographic information web service technology to provide relational position information service for government staffs (as shown in Figure 1). Geographic information service is shown in the above core geography information service. According to the specialization of geography information service and its characters, geography information service should contain the following basis:

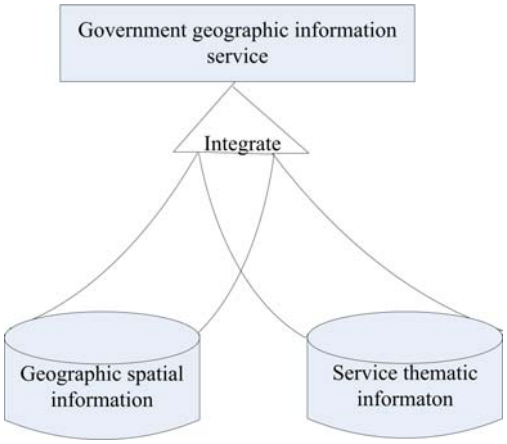


Figure 1. Government geographic information service

(1)Provide public geographic information service: It can sustain many general services such as access, query, statistics, analysis, 2D and 3D visualization based on distributed geographic information.
(2)Provide fundamental geographic information data service: Through constructing government-oriented fundamental geographic information database, It can carry out management and spatial database creation by using the visualization mode, It can sustain 4 spatial data types such as vector, raster, image and DEM and provide data supporting to spatial information operation.
(3)Provide information integration service: Based on the fundamental geographic information, it can integrate distributed/centralization, dynamic/static government information.

3. KEY TECHNOLOGIES OF GOVERNMENT GEOGRAPHIC INFORMATION SERVICE PLATFORM

The core technologies of government geographic information service platform need to be researched and developed independently because of the importance and the specificity of government management and government decision-making.

The main technology in government geographic information service platform is INTERNET / INTRANET technical system, which can be met with the need for the fusion of geography information and government geographic information, dynamic data exchanging and updating, interface diversity, have complete functional requirements，high response speed, and support for unified management and unauthorized access of data resources(Liu, 2006a). For many years, Chinese Academy of Surveying & Mapping has insisted on the development of their own copyright government geographic information service platform. At the end of the 10th five-year plan, the software which realized the basic function components and service information network has been developed to the fourth generation. The key technologies involved are as follows:

3.1 Four Layers platform architecture based on SOA

In addition to considering the basic geographic information processing needs in the design of geographic information service system architecture, the following special requirements should be focused on: since the government geographic information service should be run in the credible and security network environment, the platform architecture is established mutual trust through E-certify to hold out the electronic interaction between the public and the government and among the government departments. The system should be constructed based on the information security infrastructural facilities. A large number of government information need to be exchanged and loaded dynamically. Data layer need to be supported data maintenance, updating, converting etc. besides data storage. The architecture of government geographic information service system is composed of the data exchange layer, data management & maintenance layer, application service function layer, presentation layer and information security infrastructure layer (as shown in Figure 2) (Winnie, 2003)：

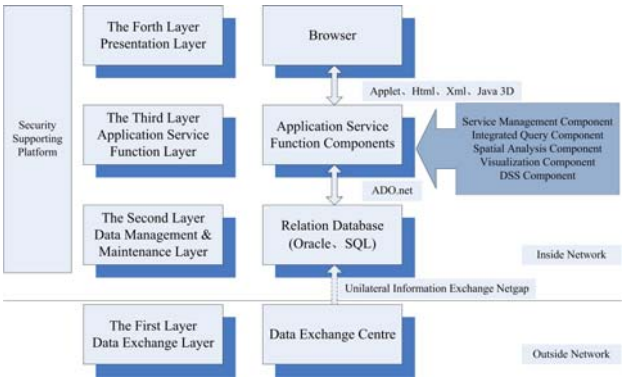


Figure 2. Platform architecture of government geographic information service

3.2 Integrated Data Model

Integrated data model, whose core is the thematic application, organizes all kinds of spatial data, non-spatial data and operation functions to meet with spatial information services for different types of government users. Fundamental units of the model can be abstracted for five parts: thematic applications, data resources, information objects, operation sets and users. The relationship among the five parts is established by the connection codes (as shown in Figure 3).

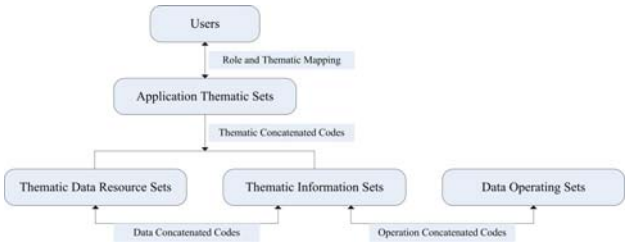


Figure 3. Integrated data model based on thematic application

3.3 Geographic information service based on function collaboration

Spatial information service based on function collaboration adopted the idea of computer collaborative work. Each spatial information service will be divided into several functions that completed by different computers, then the functions are completed by client and server through the establishment of collaborative work protocol. According to this idea, each spatial information service task exists between the client and the server independently. The request was send out by the client and completed by server functional components and client components based on the collaborative protocol (as shown in Figure 4).

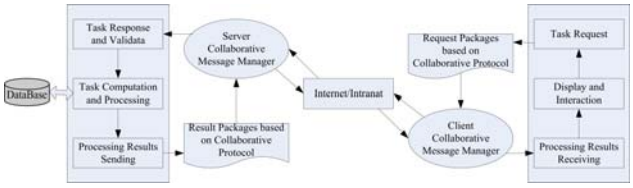


Figure 4. Collaborative pattern between client and browser

3.4 Integration with mixed information publication and OA technology

Using the AJAX, it realizes the management and publication of geographic information according to sites, pages, columns and items through WYSIWYG (What-You-See-Is-What-You-Get) page layout. Considering the operating habits of government business, it gets spatial information services through full text search and uses the web site type management instead of the GIS specialized operations. Basic geographic data, E-business data and thematic data is seamlessly integrated through multi-source data fusion. The interactive transparency between server and client is increased by integrating service and model through web services. A unified user interface layer is the interface that the users interact with integrated software platform. Application integration is achieved through the HTML/ASPX page, .Net framework controls, ActiveX controls and other page components.

4. MAIN FUNCTIONS AND TECHNICAL CHARACTERISTICS OF THE PLATFORM

4.1 Main functions

Main functions of the platform include:
(1) Spatial data management tools. It achieves spatial data management and database creation by the visualization method and supports four types of spatial data such as vector, raster, image and DEM. Spatial data is stored in Oracle, SQL Server and other large relational database. The functions include entire library browsing, maps editing, attributes batching, place name plotting extracting, visualization setting and so on.
(2) 3D terrain visualization platform. The system is based on the terrain database, remote sensing image database, place name database and thematic data. In the network environment, it realizes the functions of 3D terrain display, query and analysis with the characteristics of large-scale, multi-level and high-speed.
(3) Integrated information management tools. Its functions include spatial data configuration management, integrated information maintenance, thematic data maintenance etc. Web pages, relational tables, multimedia and other types of non-spatial information can be displayed independently or be associated with spatial information. The system can support information importing, editing and database creation, so that to provide the establishment and maintenance of thematic data. Depending on the applications, Users can add, delete and modify all types of thematic information and operations.
(4) Information publishing and web management. It supports multi-site operation and information publishing. Its style management functions could update the basic information, the style layout, columns and items. The main functions include columns management, items management, information publishing and the query index establishment of content management, and user access control based on users, roles, authority.

4.2 Technical characteristics

Technical characteristics of the platform include:
(1) Diversity of information organization mode. It realizes the geographic information integration with the government information as the carrier, In addition to with the geographic information as the carrier.
(2) Solve massive spatial data access efficiently by levels of data cache technology. The service efficiency is improved with four layers of data buffer mechanism among database layer, persistence layer, spatial information service layer and the client layer.
(3) Global 3D grid data management. Based on the HTTP communication protocol and the OGC open standards, global 3D terrain visualization is realized based on quadtree by multi-layer software architecture of both B/S and C/S.
(4) Multi-level "site-style" government information publishing and the spatial services based on the full-text search. The government information management architecture replaces the GIS system-level architecture. The site management and operation mode replaces the GIS professional operation. GIS components can be used as columns or items to form multi-level Web site. The integrated publishing of geographic information services and full-text retrieval is achieved. “Article-Chart Interaction” is realized by the integration with the text extraction technology and GIS technology.
(5) Object-level coupling with government Information and geographic Information. Government information commonly expresses messages with the style of text. By the Java applet plug-ins or .Net plug-ins, geographic information is packed as an independent object which can be embedded anywhere in the text message. Object-level integration of the text message and geographic information is realized, and can be used as the integration with government Information and spatial information.

5. APPLICATION OF THE PLATFORM

In the leadership and strong support of State Bureau of Surveying and Mapping and the e-government Office of General Office of the State Council, according to the headquarters' requirements in decision-making, the construction and migration of National Spatial Information System for General Office of the State Council have completed based on the new generation government geographic information services software platform (as shown in Fig. 5). The new version of the National Spatial Information System adopts web site information organization style, and is based on the principles of information architecture. Based on the website information management and displaying, it has achieved a variety integrated search about government information, and has built up 11 sub-systems including disaster prevention and mitigation, economic development and analysis etc. The systems have 36 application subjects such as floods and the main indicators of China's economy. It has achieved the business goals of simple and highly efficient operation, working closely with the e-government applications. The system has already been deployed on the government private network. The main characteristics of the system are as follows:

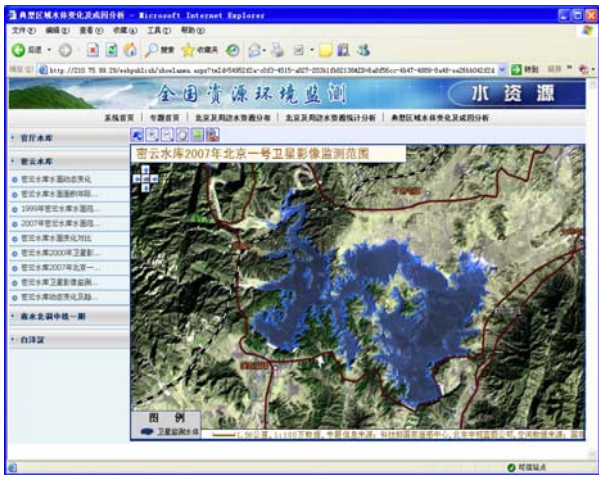
(1) Organization System. Through multi-site management system it achieves the classification and logical grouping of massive governmental resources. It has determined the organization of programs and organizational structure, and has identified the relationship between sub-sites.

(2) Identification System. The system has established a complete identity system. Each site and each web page have a clear identity, and users at any location know clearly the information collection where they have called.

(3) Navigation System. With the improved navigation system, users can switch with other information collections at any time.

(4) Search system. It has realized the full-text search function with the integration of document information, statistical information, spatial information, multimedia information.

(a) The interface



(b)Resource environmental monitoring

Figure 5. The platform

6. CONCLUSIONS

To meet e-government geographic information services need of software platform technologies and practicalities, it need to break through the limitation of GIS framework ,solve a range of issues such as information facilitate access, personalized support and high efficient running, and pass a new generation of software development practice. In this article the contents, characteristics and key technologies of government geographic information service platform are discussed in the perspective of service. The relevant technologies are verified by practice. With the increasing requirements of government management and decision-making, the applications of government geographic information services will continue to expand, and the technology will continue to develop and deepen. In the future, the construction of government geographic information services platform need to solve the following issues:

(1) Relying on public service interfaces of the national basic geographic information platform, it realizes basic geographic information service sharing and interoperability.

(2) To break through the bottleneck of event oriented geographic information intelligent search technology, it realizes government decision-making oriented initiative geographic information services.

(3) To establish a virtual distributed information management environment, it solves problems about distributed building and sharing of geographic information resources and services.

REFERENCES

Guo Chongqing, 2008. *Services Science-an emerging research field*. Bulletin of National Natural Science Foundation of China, 22(4):217-220.

Liu Jiping, Wang Liang, 2006a. *Spatial information service for E-government: the requirements, technologies and its application*. SCIENCE OF SURVEYING AND MAPPING, 31(2), pp. 54-56.

Liu Jiping, Liu Zhao, Wang Liang, 2006b. *Research on the Spatial Information Service for E-government Based on Function Collaboration*. ACTA GEODAETICA ET CARTOGRAPHICA SINICA, 35(4), pp. 299-302.

Liu Xuan, Zhang Xinghua, 2008. *Defination of the service concept of Science-based services.* Gansu Science and Technology, 24(12), pp. 59-61.

Wu Gonghe, 2006. *Studies and Implementations of Distributed Geographic Information Services*, Information Engineering University of the People's Liberation Army.

Wang Peilin, 2008. *The Discussion of the Research on Service Science*. Library Journal, 27(3), pp.2-8.

Winnie S.M.Tang， Jan Robert Selwood，2003. *GIS Web Services: A route to Societal GIS.* http://gisdevelopment.net/technology/gis/pdf/ma03022.pdf, Map Asia Conference.

Zhang Qingpu, 2003. *Government Geographic Information System*. Science Press.

ACKNOWLEDGEMENTS

This research was funded by the Science Foundation for Post-doctor of China under grant No. 20070420412, Key Laboratory of Geoinformatics of State Bureau of Surveying and Mapping under grant No. 200830, the central-level public welfare research institutes for basic Research and Development Operations under grant No. 77734 and No. 77722, and National High Technology Research and Development Program of China (863 Program) under grant No. 2007AA12Z215 and No. 2007AA12Z333.