GEOGRAPHY INFORMATION SERVICE BASED ON APPLICATION SERVER

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ABSTRACT:

Geographic information service is widely needed nowadays. This paper focused on the research of Geographic information service that based on the application server. First, we gave the conception of Geographic Information Service, and introduced the application server technology, which is the base of this paper. After that, a model of Geographic Information Service based on application server is put forward. Then, we analysed the characteristics and key technologies of the framework. Based on the analysis, we pointed out that application server is an affective way to implement geographical information service.

1. INTRODUCTION

Geographical information service, which has GIS as its core, and spatial data infrastructure as its base, provides spatial information for the public through standard network protocol under the Internet environment. It meets the needs of the public by giving spatial information and assisting the public in making decisions. Since eighty percent of man's social activity is closely related with geographical position, geographical information service accounts for a very important weight in people's daily life.

Nowadays, geographical information service is carried out mainly through the traditional geographic information system, which is developed under specific supporting environment and running environment, and is designed for particular GIS data and application. Users, therefore, can not browse the data from other spatial information system. Furthermore, each Web GIS system on the Internet now is relatively independent. It can not integrate function modules or datum from other systems. So, the program developers have to work out many specific problems such as multi-OS(operation system), multi-network protocol, system efficient and safety, etc. These problems make the system difficult to develop for GIS program developers. This article makes an analysis on the shortage of realization methods for the traditional GIS, and points out the traditional GIS at the time of pushing the geographical information service to achieve an extensive application, also meeting some problems that can hardly be solved.

Application server, as a new kind of middleware in recent years, which is considered to be one of the most exciting milestones of enterprise software technology (it is also called as "the future technology"), is intended to provide a cross platform for establishment, deployment, integration, management and execution of transactional Web application. It can solve the problems which the traditional geographic information system has met. By adopting open technology, component technology and modularized development method, the application server can be deployed in any hardware platform, any operation system, and can be distributed in heterogeneous network

environment. Additionally, Application server hides the complicated technique details and provides a simple structured programming interface with perfect function for program developers. The developers can focus on the business logic design of geographic information system. After introducing the characteristics of application server, this article put forward a model of GIS application server. And discussed the key technologies of model—load balance, database connection pool and cache memory. Based on the analysis above, this paper points out that application server will play an important part in spatial data infrastructure and will provide an ideal platform for designing, developing, deploying and managing geographical information service.

2. THE DEVELOPMENT OF GEOGRAPHIC INFORMATION SERVICE

Geographic information service grows rapidly along with the increasing development of geographic information technology and its application. In earlier days, geographic information service, which is running under single computer environment, is provided based on file management system. The narrow concept of geographic information service at that period is only related with geographers, and, obviously, has characteristic of specialty and research. In the 1980s, GIS software advanced remarkably since the rapid development of computer technology. As a result of this development, the human-machine interface is much more friendly, people can get geographic information service easily by using GIS software even though they do not understand any technology of GIS and without any background of GIS knowledge. From that time, geographic information service serves people not only professionals but also those works widely in the fields of agriculture, industry, transportation, city planning, public health, commerce and military, etc. In the late 1990s, due to the expeditious expandedness of Internet, geographic information service is used unprecedentedly. Especially after the concept of digital city was put forward, geographic information service involves in lots of human activities, even in people's daily life. And what's more, it is directly exposed to the public. Now, GIS is

converting "take the product as its centre" into "take the service as its centre". And the application server technology will further the converting process.

3. MULTI-LAYER DISTRIBUTED ARCHITECTURE OF APPLICATION SERVER

In the middle of 1980s, the C/S distributed computing technology appeared and was widely used on Internet since its convenience of using. However, it still has some shortage as follows:

1. System with high complexity. Currently, the logic of geographical information system and its representation mixes together, which makes the system difficult to develop for program developers. And also leads to a system with low stability.

2. System with less flexibility. Information technology, which is the technology base of geographical information service, develops rapidly. With new information technology appearing increasingly, geographical information technology, in order to provide better quality service to the public, should be updated accordingly. This means that the old and outdated technology should be taken by advanced ones. All these facts request the geographical information system should be renewed in time.

3. System with low expansibility. Sometimes, users need more services but current geographical information system can not provide. In order to meet these new requests, geographical information system must be easily expanded. However, at present, the only way to meet these requests is to re-build the whole system, which is a difficult and time-consuming task for program developers. In this way, when the geographical information service system is expanded, the new system and the old can not be integrated. With the development of computer technology, B/S architecture that composed three layers— representation layer, business logic layer and data layer— gradually replaced the C/S architecture. It separate representation layer from business logic layer. Inasmuch as its abilities of platform crossing, balance loading and its portability, B/S architecture is very suitable to be employed in distributed computation environment. And application server, in this architecture, is an idea tool to implement the business logic layer that takes charge the process of business logic.

Application server, which is considered to be one of the most exciting milestones of software technology since the relational database and has become very popular in the last few years, solves the problems in applying application to web computing environment and provides a platform that support the development, management, deployment, integration, and execution of web applications. The position of application server on Internet is showed in figure 1.

As it adopts component technology and modularized development method, application server facilitate developers adjust system functions by expanding or cutting down components according to the needs of users. This makes the system easy to be developed and maintained, and also enhances the system stability. Application server, by partitioning user interface, business logic and back-end service off from single complex logic, provides a modularized method for developers to construct, deploy and maintain enterprise web application. And it is also provides a high performance for web user accessing. With a simple structure and an efficient programming interface that application server provided, developers can concentrate their minds on the business logic layer designing,

without any consideration of the complex technique details on system layer. Additionally, business logic, which provides different functions for users, exits in a form of component on application server. Thus, it can be reused easily.
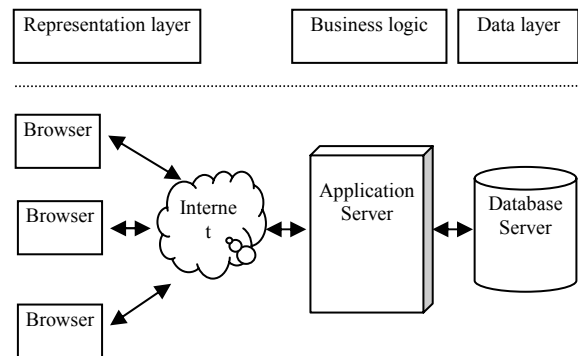

Figure 1. The position of application server on Internet

4. MODEL OF GEOGRAPHIC INFORMATION SERVICE BASED ON APPLICATION SERVER

GIS Application server, which is framed by broken line in figure 2, is the kernel of this model. It specializes in GIS function processing that has been separated from representation and data layer, and provides session connection, load balancing and access controlling for GIS components.
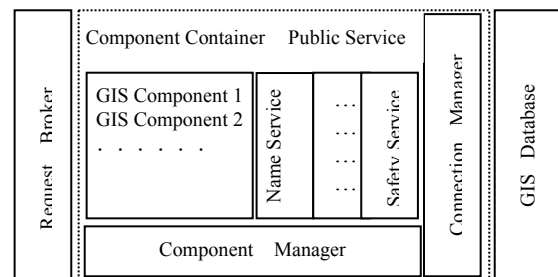

Figure 2. The model of geographic information service based on application server

This model is characterized by its high expandability. When a new geographic information service is needed, developers simply need to deploy a new GIS component, which either is designed by developers themselves or is buy from other company or is inherited from previous GIS component, into GIS application server.

Request broker is in charge in request sending and response receiving. It is an agent to realize the communication between user and GIS application server. When a user proposes a service request, request broker sends the request and its parameters to GIS application server, and receive response returned from GIS application server, and forwards the response to user. This procedure is processed in the background. For users, it is not necessary to know where and how the GIS components execute their requests.

GIS component, which is the key element of GIS application server, realizes geographic information service. It encapsulates

geographic information service and provides a standard interface for users. By calling the interface, users can obtain geographic information service. Each GIS component that is hosted on GIS application server executes a geographic information service function, such as map searching, terrain analysis and so on.

Component container, which is a system layer GIS component based on, provides space, running environment and system service for GIS component. It is also responsible for the communication between users and GIS components. All the GIS components run on component container. And as the system service is provided in system layer, developers don't need any consideration about them. And what they need to do is the geographic information service logic designing.

Component management unit provides a man-machine interface for developers to facilitate the GIS components management, including GIS component building, installation, startup, stop and deleting.

Connection management handles the connection with GIS database. It also maintains a database connection pool which used to release system burdens that will be taken place when multi-users' concurrent requests posted.

The public service, which is correlated to system layer, defines a series of programming interface that is used by GIS component. It is different from geographic information service which is correlated to application layer. The two kinds of service are totally different. Public service is the public portion shared by all GIS components. It provides system service for GIS component. And, geographic information service serves for users and provides them with GIS functions.

5. CHARACTERISTICS OF THE MODEL

5.1 Reliability

In this model, geographic information service is implemented by GIS component. Each of the components realizes a GIS function. They are relatively independent and do not affect each other, so the system still can provide geographic information service to users even though there is something wrong with one component. In addition, by adding more GIS application server to the system and clustering them, if there is a server fail to work, we can transfer some user requests to other machines. The system is still working.

5.2 Expansibility

In this model, component and framework technology was adopted. Therefore, we can adjust geographic information service by adding or deleting GIS component according to the needs of users. This makes the model with a high expandability. When a new geographic information service is needed, developers can meet the need just to add a GIS component that implements the service to the model. Furthermore, we can enlarge the scale of the model—by adding more GIS application server and clustering them—in case of the system insufficient when multi-users access system simultaneously.

5.3 Development Efficiency

The model introduces modularized development method, and divides geographic information service into GIS component. So, for developers, they don't need to care about the technique details of the system layer but focus on component designing. Since the components in this model are reuse modules, developers can build new service by assemble exiting components into a new component that realizes the new service. So the model provides an efficient way for developers to develop a new system.

6. KEY TECHNOLOGIES

6.1 Load Balance

Because of the heavy data processing on geographic information analysis, load balance technology is very important to GIS application server. It balances loads on every computer by distributing them reasonably, and avoiding some computer over load but others under load.

To realize load balance of the model, load assignment algorithm and the service implement techniques can be employed. At present, there are two algorithms available for load balance. One is the precise load assignment algorithm. In this method, there is a distributor. When a request is received, system first inquires distributor. Then, according to the algorithm, the distributor decides which application servers process the request. The other is statistic load assignment algorithm. In this method, the requests will be assigned to a server according to the probability and its weight which has been set in advance.

Another way to balance load is by using different service implement techniques. One technique is that service implemented based on process. Application server creates all needed process initially, when a request is received, it will be handled by a process that already exits. So, the system does not create and terminate process frequently. The other technique is that service implemented based on thread. Application server only creates necessary process, when a request is received, system creates a thread temporally and hand the request to the thread. The thread will be killed after the response of the request returned.

6.2 Cache Memory

Cache memory is used to save response of user's request. It is very essential for the model because it greatly improves system's speed and efficiency. When a request, which had been processed before, is received, the system just returns the response that has been saved in cache directly to user but doesn't need to call GIS component. Thus, the system response time is highly decreased. According to the contents saved in cache, we can apply cache memory technology to the model in two ways. One is to apply the technology in application layer, which creates cache to store web pages. The other is to apply it to data layer, which creates cache to store datum from database.

6.3 Database Connection Pool

Connecting to a database is a time consuming activity since the database must allocate communication and memory resources as well as authenticate the user and set up the corresponding security context. Establishing the connection once and then use

the same connection for subsequent requests can therefore dramatically improve the system performance. A database connection pool is a straightforward solution. It creates connection objects in main memory initially, and the connection object will be reused when a database access is needed. So, the frequent create and destroy of database connection is avoided. Therefore, the system overall performance is improved.

7. THE END

Nowadays, by issuing geographic information through the Internet is a main way for people to get geographic information service. Application server, as a operation system on Internet, provides a modularized method for developers to establish, deploy, maintain web application by dividing user interface, business logic from back-end service. It also offers a convenient using environment for web users and a quick development, high flexibility and expandability platform for service provider. The model, which based on application server, in this article is an ideal model to realize geographic information service.

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