

# The Study on Web GIS Architecture Based on JNLP

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**Abstract:** By analyzing the defects of two tier and three tier client/server Web GIS architecture, this paper presents four tier client/server Web GIS architecture based on JNLP. This kind of Web GIS architecture can solve the problem of client side software publish and maintenance, and improve efficiency of Web GIS.

**Key Words:** Client/Server, Web GIS, JNLP, Java Web Start, Architecture

## 1 Introduction

Rapid progress of Internet, application of data warehouse technology and the combination of GIS and Internet have paved the ways for the web distribution of GIS spatial data, it also makes the GIS space data management and application appear the characteristic of multi-user, distribution and web. Internet has already been one of the important developing platforms of GIS, the function of GIS has been extended by Internet, and furthermore it becomes a kind of new GIS architecture. Users can browse the spatial data in Web GIS website by arbitrary node on Internet, make thematic map and make all kinds of spatial checkup and spatial analysis, thus, GIS can enter numerous households and become a kind of public instrument.

As regards for the web architecture of Web GIS, it is mainly divided into two tier and three tier client/server mode in recent years. Two tier client/server models has a lot of defects, with the large-scale development of GIS application system and the users' demand for system capacity, these defects and weakness confine the development of GIS application, but three tier client/server mode has been applied step by step depending on its distinctive advantage. This paper presents four tier client/server Web GIS architecture based on JNLP and points the applied defects of two and three tier client/server mode.

## 2 Web GIS architecture and realized technical analysis

At present, there are two tier and three tier client/server two computing mode. Two tier client/server architecture is formed by sever side software and client side software. By established web communication protocol, server and client realize spatial data transmission from sever to client, client side software accomplishes the visualization of spatial data, server only offers database service. Under the condition of computing mode architecture, client side accounts for data visit, applying commercial logic, changing the result into a kind of pattern so as to display, displaying the inside interface for user and accepting the users' input. Client/server architecture is easily configured from beginning, but it is difficult to upgrade and extend, moreover, it is based on private protocol---typically the private database protocol. The commercial and expressional logic reuse is also difficult.

Three tier client/server Web GIS mode architecture system is divided into three levels from its function logic. The first level is user interface, offers user interface function; the second level is GIS transaction processing business logic level,

offers accomplishment of all business logic and data access function; the third level is GIS spatial data storage service level, offers functional data continuous storage function. Its adopted spatial data model and data organization pattern are similar to two tier client/server mode GIS software platform, its key point of design and realization lies on how to construct good GIS software architecture and how to divide function module, especially the part of middle component.(figure 1). As Internet is an unusual structure platform, the operating system of client is not the same in three tie client/server Web GIS mode. In order to reduce the cost of client side software which is distributed and maintained under various platform , promise good reciprocation of client side and balance the web load between the client and server, most of client side programs are realized by Java program embedded in web page. Middle part in three tier client/server offers service for GIS data, it logically isolates client side from data level, thereby, it reduces the client side complexity of data access, at the same time, it enhances the security of database. So, at present time, all of more mature Web GIS architecture adopt three tie client/server architecture, see the typical three tie architecture introduced by document[2]. Among three tie architecture, client side programs are executed by dynamically downloaded from web browser to client side, client side must accomplish client side program download execution process by prosecuting each Web GIS operation, client side software can not be used in the state of offline. Because the update part of spatial date in a period of time is not so much, client side executes and browses Web GIS spatial data process time after time and has not any difference with the first execution process. This kind of simple repeated processing lead to lower system running efficiency.

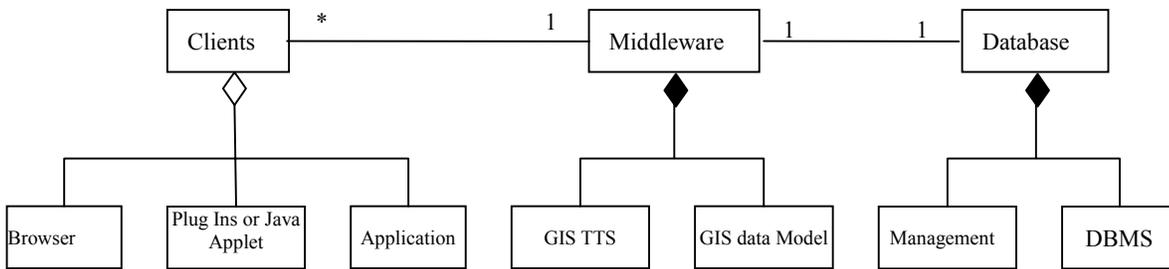


Figure. 1 Threeer tier client/server Web GIS architechure

### 3 four tier client/server Web GIS architechure based on JNLP protocol

#### 3.1 JNLP protocol intrduction

JNLP(Java Network Load Protocol) is a kind of program distribution technology, platform- spanned, safe and strong application , newly distributed by SUN corporation. JNLP can distribute application program with full function to client side, meanwhile, guarantee these program to be newest version. JNLP is realized by Java Web Start (figure 2). Java Web Start is installed at client side, but server still is standard Web server. Java Web Start accounts for the installation and maintenance of client side software. When client side needs for GIS application system, Java Web Start automatically check if he has executed the program before. If the program has already been in the system Cache, then executes it directly. If not or newer version of this program exists, Java Web start downloads the newest version of it in order to client side software is the newest version. Although the initial download speed is little slow, all files slowly store on local disk of computer after downloading. Despite the fist activation cost of application program is more than that of HTML web page, nevertheless

running application program is nearly prosecuted immediately, for resources we needed are in local computers. From this point of view, application program not only get rid of web browser so as to run directly, but also cooperate with the web page start-up, it is so called get numerous results at one stroke.

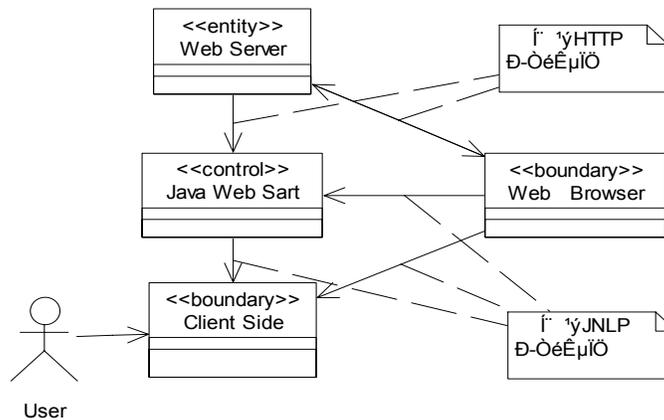


Figure. 2 JNLP Java Web Start architecture UML Class diagram

Java Web Start is a kind of solving scheme facing Web application program. Using GIS client side application program substitute for client software based on HTML, it makes user interface with high interaction at client side, it can compare with traditional application program (eg Word and Excel etc.), it demands low web bandwidth; GIS client side program need not join with Web server when click every time, it can slowly store the information downloaded. Thus ,Java Web Start can realize better interactivity with low connection and bear usage of offline. At the same time, client side software web security design is very consummate, following sandbox security. It can prosecute resource access with authorized permission once pass through security authentication, nevertheless virus problem does not exist.

### 3.2 High Efficiency Web GIS architecture design based on JNLP protocol

four tier client/server Web GIS architecture structure based on JNLP protocol is mainly designed for solving the defects of three tier architecture, it consists of client level, top Web service level, GIS transaction level and database level. Compared with three tie client/server architecture, it adds first level top web service level. This top web service level accounts for application program maintenance at client side and the slow storage of static data. Its architecture structure shows as figure 3

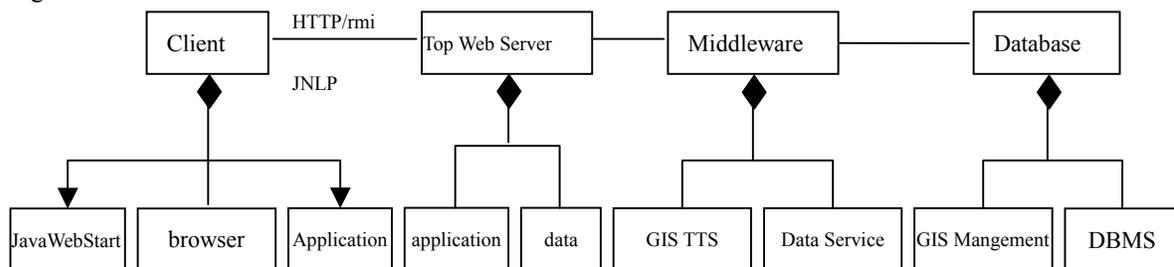


Figure. 3 Four tier client/server Web GIS architecture UML Class diagram

the protocols used between client level and top web service level are http、JNLP and rmi three kinds. By Java Web

Start protocol, client level downloads and installs the Java application program, which stored at the top web service level. After acquiring Java application program at Web GIS, client joins with GIS transaction logic level server by TCP/IP protocol, server depends on the requirement of client, acquires data from database level, then transmit the data to client side application program, client side extends class package by JNLP protocol and makes the acquired data down in local Web Start cache, so as to make the client side use the Web GIS data content he concerns in the state of offline. Meanwhile, it can reduce the burden of data server which accounts for application program distribution and reduce unnecessary web transmission.(figure 4)

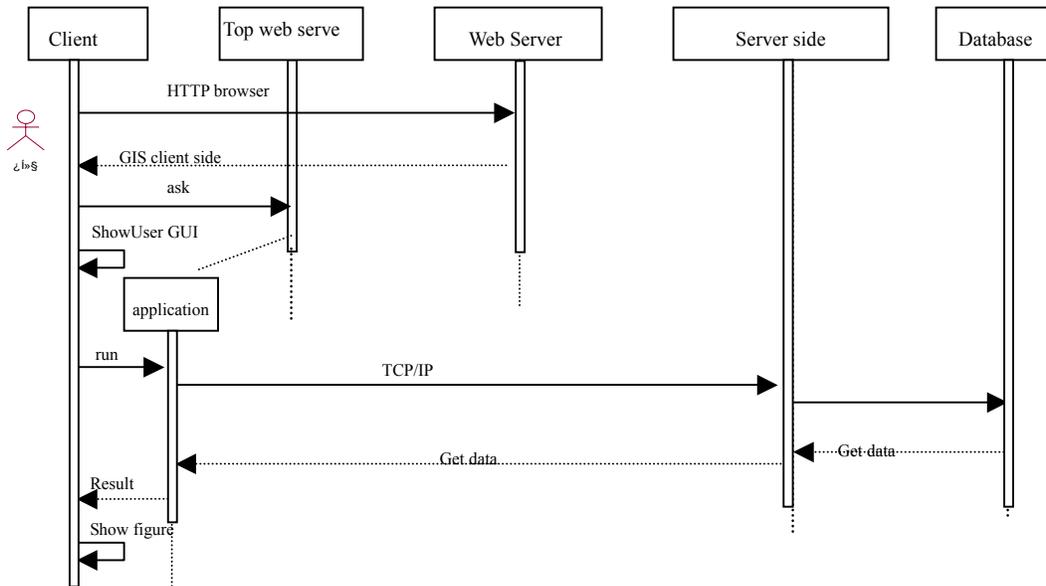


Figure.4 Four tier client/server Web GIS UML Sequence diagram

As Java Web Start is constructed on Java 2 platform, the platform offers perfect security architecture structure. Under the condition of default, application program started by Java Web Start is running under the controlled surrounding (sandbox), only manage limited visit as to file and web. So, starting application program by Java Web Start can keep the security and integrity of system. Application program can demand for unlimited visit to system. Under this condition, Java Web Start will display security warning dialog box when the application program starts up firstly. Security warning will display the source information about application program, for example, the trader who supplies application program. If you trust him, it will start up the application program. The source information of application program is decided by digital code signature.

As regards as the architecture structure, top Web server level of four tie client/server Web GIS is in the state of activity only when the client side has not installed GIS client side software, in case client acquires GIS client side software, top web server level is not in the state of activity, four tie client/server architecture dynamically switches into three tie client/server architecture. Because of adopting separation of application program and GIS transaction logic function level, the Java Web Start pattern management at client side, it makes the client side software have the ability of self-installation、 updating and repairing, the complicated computing work and display function are settled at client side, thereby the server and client side balance the load, client side may run at the state of offline and browse the spatial data content which has been displayed, reducing the unnecessary web transmission quantity.

## **4 The realization of four tie client/server Web GIS architecture base on JNLP protocol**

we can get the four tie client/server Web GIS architecture base on JNLP protocol from figure 2 and figure 3, only GIS transaction logic level and client level add the top service level, but top server is dynamic. If client has accomplished the task which top server acquires client side program, the top service level has not new version offered to client, under this condition, client side program need not construct connection with top service level, four tie client/server architecture dynamically switches into three client/server architecture. If the three tie client/server architecture is remodeled into four tie client/server architecture base on JNLP, GIS transaction logic level and database level of three client/server can not make any changes. According to four tie client/server Web GIS architecture structure based on JNLP, writer realizes four tie architecture GIS Web GIS. System running see figure 4. Introduction of realizing way as follows:

### **4.1 Database service layer**

Data server side adopts Oracle8.1.6 to manage spatial data, uses the system management tools of database itself to realize the backup management of system data. Through server middle ware using function and JDBC developed by Oracle, Web GIS client realizes data access. Database level mainly accomplishes sending data and accepts data modification from client demand. The database level platform is independent and suitable for any operation system server.

### **4.2 Transaction logic layer**

Transaction logic level adopts Java Servlet and JSP, its mainly functions are: startup corresponding flow、offer query and requirement for client、accomplish the corresponding operation at server side、offer spatial data for client side、offer corresponding modification information and data from different clients running at the same group spatial data and keep and maintain the accordance of spatial data.

### **4.3 Top server layer**

Because the JNLP protocol server side adopts standard Web server, the level only need base on the demand of JNLP text file, write brief JNLP file distributed by client side, and need not any other programming and any other software, only need to set the MIME type of JNLP file at server side.

### **4.4 Client side**

Client must install Java Web Start software at client side. client level adopts standard Java application program, accomplishes data reception from transaction logic level and zoom in 、zoom out and pan of graphics, client side encapsulated as Jar file and laid at top server level, by web browser at client side, browse the JNLP file at top service level, activate Java Web Start, make the client side software from top server automatically download and install to client, automatically create desktop shortcut by client demand. After first downloaded by first client side software, client may run client side program directly, need not start up browser.



Figure.5 Four tier client/server client

## 5 Conclusion

The four tier client/server Web GIS architecture base on JNLP protocol solves the defects of three tier client/server Web GIS architecture, offers the new technology of spatial client side application program, makes full use of hardware resources of server and client side, enhances the interaction of system, reduces the web data transmission. This architecture structure will become the one new direction of Web GIS architecture.

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