DESIGN AND DEVELOPMENT OF EMERGENCY RESPONSE GEOGRAPHIC INFORMATION PLATFORM BASED ON WEB SERVICE

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ABSTRACT:

Emergency management/Emergency service is a compelling domain for applying GIS Web Service. GIS Web Service expands the further development of GIS. A Web service is described using XML-standards like the WSDL (Web Service Description Language). Web Services, are different from Web applications, don't require people to use; but software applications to call. Thus, the Web service does not have any user interface, but the Web Service applications provide user interface. GIS Web Service can also support customizable spatial analysis functions. ArcGIS Server services can be used to develop two types of Web services: ArcGIS Server data web services and application function Web services. Via the local Web server Web Service framework, to achieve Web services of applications, but this type of Web service client is not ArcObjects application. ArcGIS Server ADF takes full advantage of Web services can be used to connect ArcGIS Server services. In the Web Service layer, using the popular WSDL (Web Service Definition Language), UDDI (Universal Description Discovery and Integration), SOAP (Simple Object Access Protocol), to descript, register and release the GIS service provided by the application service layer. For sharing geographic information resources in different places, ArcGIS Server provide some modes to find these resources, such as ArcGIS local services, ArcGIS Network Services, ArcIMS services, ArcWeb services, WMS services. Directory services generates in ArcGIS Server Manager, ArcGIS Server Manager take charge for the service requested of receiving, analysis, finding, positioning, and returned service description information to services requester.

1. INTRODUCTION

In order to cope with emergencies, there are many information systems are developed. Such as FEMIS, MMS, Advanced Emergency Response Systems, and DCV- Decision Centred Visualization. Most of these systems mainly support the functions of communication, resource managements, and situation awareness by technologies of Internet, GIS, and visualization interface. But most of the systems install on the user's computer, and cannot arrive at the goal of interoperability. Emergency management is comprised of four phases: mitigation, preparation, response, recovery. Geographic Information System (GIS) is a flexible tool that can be utilized to provide detailed situational information for response to an emergency situation within the Crisis Management Plan (CMP) framework. Emergency management/Emergency service is a compelling domain for applying GIS Web Service. The Web-based Emergency Response Geographic Information Platform (ERGIP), the brain of the Emergency Management System, is an interactive system to be utilized in the Emergency Operation Center (EOC) at the government to direct the response. The overall goal for the ERGIP application is to develop, promote, and implement geospatial data and GIS technology in support of emergency management at the EOC for mitigating, preparing, responding and recovering from a disaster. Web Service, the core technology of Distributed System, can be used in GIS in

order to implement GIS data and function's share and interoperation more efficiently. GIS Web Service expands the further development of GIS.

This paper will make three parts to describe the ERGIP's design and development based on Web Service. First of all, we will give a reason why the Web Service is used in this research and the functions of the GIS Web Service. Then, present the design of the platform server. Finally, show the effect of diversified GIS Web Service integration in the ERGIP by developing an application.

2. REASONS TO USE WEB SERVICES

In the emergency management system, traffic conditions, accident place, hospital conditions, helicopters, fire engines, ambulances and other location information should be shown in real-time, so do meteorological information, remote sensing image and geographical Base Map data (Figure 1).

We know from Figure 1 that information is in server of the different units. According to previous GIS applications, first of all, we used the relevant data to establish a local database. In the component geographic information system period, these subsystems are often on the same machine or the same LAN, to

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be prepared and compiled in the same language. Now the network environment in the application of the system, GIS can be deployed regardless either all other subsystems prepared by any language, or where in the Internet, as long as the Web Service interface provided, as like Web Services, GIS system sent to the various subsystems http request based on the user's business needs, and rapidly get response results, then the information can be dynamically assembled on the map, that be presented to all users.

Figure 1. Emergency treatment sketch

A concrete definition for a web service is informed by the desire for maximum interoperability, so that the main goal of a Web service is to apply the traditional Web programming model, which is simple and interoperable, to problems other than delivering thin-client user interface, and to provide data that can be consumed by an application as opposed to/as well as a human. A web service is an endpoint for communication that satisfies the following conditions (The Develop Mentor Web services team, 2002):

(1)A Web service use standard high-level internet communication protocols like HTTP or SMTP, so that it is interoperable that every platform supports it.

(2) A Web service transfers data using XML messages which follow a ubiquitous, industry-wide standard data presentation with rich tool support. Furthermore, the SOAP specification defines a very widely endorsed format for framing the XML as messages and a convention for representing RPC calls as XML messages.

(3) A Web services provides a way to access metadata written in XML-based WSDL and describing the messages it accepts in terms of the type system mandated by the previous requirement. The metadata contains information about how to connect to the service, what communication protocol to use, what message exchange pattern to use, and what encoding scheme to use to derive the correct serialized form of the messages. This allows consumers to write client code to access services.

Because of these aforementioned reasons, Web services can also be used for business-to-business integration, connecting applications run by various organizations. Web services can also solve the broader problem of enterprise application integration (EAI), connecting multiple applications from a single organization to multiple other applications both inside and outside the firewall (Newcomer, 2002; Jorgensen, 2002).

A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. Web Service communicates with Simple Object Access Protocol (SOAP) messages, which describes the packaging, encoding, and exchange of structured information in a decentralized, distributed environment. In addition, it uses XML and HTTP technologies to define a messaging framework. When a service is published, it is automatically enabled for Web access and given an associated URL. Furthermore, it permit to set security parameters that limit someone who can access the service through the LAN or WAN. A Web service is described using XML-standards like the WSDL (Web Service Description Language). The Universal Description, Discovery and Integration (UDDI) and the ebXML registry provide mechanisms for service developers of their Web services and for service consumers to locate them. All things considered, we can say Web services published by different organizations can be combined to fulfil users' requests. The users can consume the service with a Web browser, and do not have to have any specialized GIS software in order to work with a service.

3. THE FUNCTIONS OF THE GIS WEB SERVICE

Web services provide a group of the functional operations that can be used for other applications. The benefits of using Web services is that the user does not need to know how to build these services, only need to know how to access these services. Because the Web services interface is strictly abide by industry standards. Web Services, are different from Web applications, don't require people to use; but software applications to call. Thus, the Web service does not have any user interface, but the Web Service applications provide user interface. Usually, for the users, applications using Web Service is completely hidden, but ArcGIS Server web services is different, they provide GIS functions to applications, these applications will provide the necessary user experience to demonstrate functions.

Through various protocols, Web services provide the ability of applications to connect available information. Because Web services provide a means of communication between applications that compiled by the same programming language, or different languages, then, we need a neutral language of communication tools. XML is a kind of format for supporting information transmission in the software commonly, XML messages using simple object access protocol (SOAP) transmission, SOAP define message header and effective means for information transmission. Messages transfer usually on HTTP, but in fact it can also occur in areas such as SMTP, FTP or DCOM, SOAP pack xml message and sent to the receiver packaged applications and appropriate process(Figure 2).

On the other hand, WSDL giving a description of what web services, what methods included, and what types and parameters can be used, as well as the port number used for connections. WSDL define the content of XML messages from SOAP messages. WSDL likes IDL, as a norm, to describe Web services interfaces and parameters. The available method of collection has often been a "port" can be seen as Web Services to demonstrate the different operation views. A WSDL can contain one or more ports. There is a package called arcgisws in ADF, the SOAP Request releases and SOAP Response Analysis of the web service package inside.
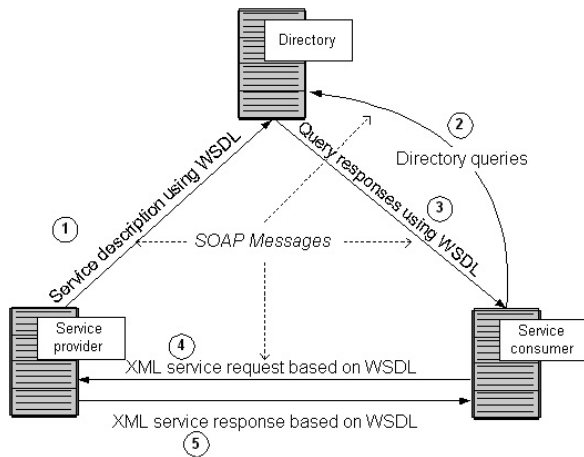
Figure 2. Web services principle

GIS Server provides the platform for sharing the use of GIS resources across clients, such as maps, with your user community. It can create map, geocode, globe, geodata, geoprocessing, mobile data, network analysis, OGC Web Mapping Services (WMS), and Keyhole Markup Language (KML) Web services. GIS Web Service can also support customizable spatial analysis functions. The newly developed GIS server software offers powerful GIS analysis tools at the server side. It is clear that desktop GIS tools are migrating to the web platform. It is totally applicable to develop comprehensive GIS analysis online tools by either using commercial Application Development Framework or adopting lower level of programming models, such as Java-based applications.

3.1 ArcGIS Server Services

ArcGIS Server services can be used to develop two types of Web services: ArcGIS Server data web services and application function Web services. ArcGIS Server web service allows web application developers call, they can also make use ArcGIS desktop applications and ArcGIS Engine applications directly use through HTTP. Via the local Web server Web Service framework, to achieve Web services of applications, but this type of Web service client is not ArcObjects application.

ArcGIS Server ADF takes full advantage of Web services can be used to connect ArcGIS Server services. It is very important to understand the relationship between SOAP and WSDL documents provided by ArcGIS for the developers of using ADF or direct using ArcGIS Server.

In the Web Service layer, using the popular WSDL (Web Service Definition Language), UDDI (Universal Description Discovery and Integration), SOAP (Simple Object Access Protocol), to descript, register and release the GIS service provided by the application service layer. This layer is transparent to clients, and isolate the client layer and the application service layer, the user's request to the server is packaged into SOAP packets by the network (shown in Figure 3), and is sent to the Web Service layer.

After Web Service layer received, it open SOAP packets, extracting requested information, and via the appropriative communication of the application service layer, the requested information will be routed to the corresponding application services. Once the application service layer return to customer

demand data, then Web Service packaged data into SOAP packet (shown in Figure 4), back to the user, or told clients request failed if the application server response to overtime.

Figure 3. SOAP service request

Figure 4. SOAP service response

In this way, the identity of customers is also able to effectively control, leaders and experts can be distinguished from common users. In an emergency, leaders and experts will have the priority to query and analysis needs, in peacetime user rights can also be strictly separate, ordinary users can only simply browse and query, but leaders and experts can carry out a more detailed analysis of data operations. At the same time, a Web Service can manage load balancing, when many users simultaneously access the application server, it can be efficiently distributed requests to a number of different servers, which will also help WebGIS spread of the wider application in the country or more wider scope in the future. Web Service layer achieve the separation of code and services, using the popular XML language to describe the GIS service, which provides great convenience to increase and update GIS services for the future.

3.2 Multi-Source Map Data Services

For sharing geographic information resources in different places, ArcGIS Server provide some modes to find these resources, such as ArcGIS local services, ArcGIS Network Services, ArcIMS services, ArcWeb services, WMS services.

```
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        com.esri.adf.web.ags.data.AGSLocalMapResource
    </managed-bean-class>
</managed-bean>
<managed-bean>
    <managed-bean-name>agsweb</managed-bean-name>
    <managed-bean-class>
        com.esri.adf.web.ags.data.AGSMapResource
    </managed-bean-class>
</managed-bean>
```

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    <managed-bean-class>
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    </managed-bean-class>
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<managed-bean>
    <managed-bean-name>wms</managed-bean-name>
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    </managed-bean-class>
</managed-bean>
<managed-bean>
    <managed-bean-name>arcweb</managed-bean-name>
    <managed-bean-class>
        com.esri.adf.web.aws.data.AWSMapResource
    </managed-bean-class>
</managed-bean>
```

4. DESIGN AND DEVELOPMENT OF THE ERGIP

4.1 Design the Platform

The architecture of the platform server we designed will consist of three parts: GIS server, web server, data server(Figure 5). The GIS server hosts your GIS resources, such as maps, globes and addresses locators and exposes them as services to client applications; the web server hosts Web applications and Web services that use the resources running on the GIS server; the data server contains the GIS resources that have been published as services on the GIS server. These resources can be map documents, address locators, globe documents, geodatabases, and toolboxes. The GIS server can provides access to the GIS functionality that the resource contains. Based on that, consumer can interact with the map to find the closest hospital, fire department, or refuge and then get directions to it from their location. Thus, the GIS server not only allows user to share resources, like maps, but also allows user to access the embedded GIS functionality in them.
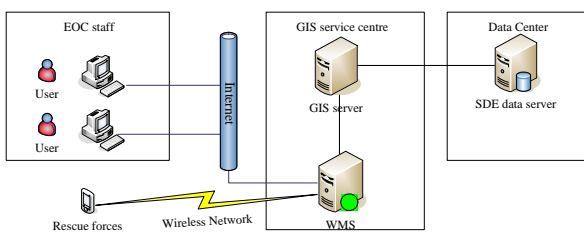

Figure 5. The architecture of the platform server

To build a practical WebGIS by multi-source spatial data integrations based on web service, can resolve the key technology of multi-source spatial data integration in the Internet environment. A web-based spatial decision support system can combine dynamic geospatial information and web mapping services from multiple web servers located in state, province and local authority. The dynamic integration of web mapping services and information can provide more accurate and effective information for decision making processes. The ERGIP approach is to integrate geographic and attribute data from the EOC with disaster occurrence data to analyze, support, record and track the different phases of emergency response management. This project seeks to establish and implement an integrated web mapping services that will allow rapid integration of geospatial data among participating agencies by utilizing a standardized web mapping interface (OGC WMS) and popular vendor-based frameworks.

4.2 Framework of Building ERGIP

Based on Web Services architecture design principles, using layered, loosely coupled, unified standards and norms, middleware, and other technical means, to support emergency services, in-house applications, and external information, such as interactive business integration services to ensure the scalability of the platform, practical and reliability(Figure 6).

4.2.1 Multi-source integration services. This feature providing data integration services and integration services to support heterogeneous system will be the private service into the overall operational standards of public services, focused on achieving the existing application system in the application, data and process level integration, merge duplicate functions, eliminate Information Isolated Island, upgrading of existing business process automation and information sharing standards.

4.2.2 The establishment of GIS analysis services. In the emergency management, the relevant data processing packaged as a series of services for system calls. From the viewpoint of integration, it is to provide a unified system of emergency management services for the emergency services to provide a more effective mechanism to deal with strengthening the information in the communication and interaction, and further to form a core business for the emergency service system.

4.2.3 Information portal. The portal provides internal information release and the cooperative office united network platform for achieving internal emergency management system in the application interface level of integration, was the uniform entrance of the internal application system for an emergency staff, and with a unified security structure to achieve unity Authentication system and the application of the SSO(single sign-on).
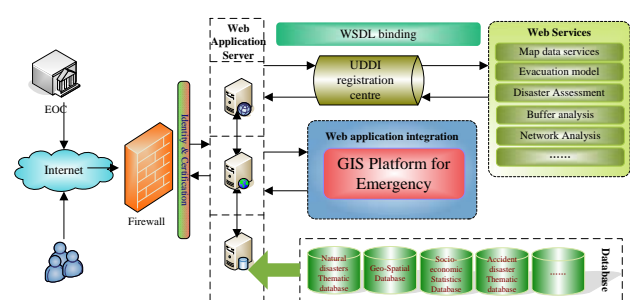

Figure 6. The system structure framework

4.3 Implementation of System Platform

As shown in Figure 5.5, the client of the framework is end-use applications for the user. They can directly get input from the data memory access or the middle services. The client can be a common browser; may also be other GIS services to achieve the integrated services, or GIS applications. GIS applications use JSP to construct client interface, client dynamically generated agency class with a description document of the service, to use agency class generate the sent request news, receive analytical

response information, Remote Access Service Localization, use the Plug-in to realize map showing. Directory services generates in ArcGIS Server Manager, ArcGIS Server Manager take charge for the service requested of receiving, analysis, finding, positioning, and returned service description information to services requester. Programmable GIS service is the core of the whole framework; they provide spatial data, non-spatial data and other input data to the client application. Development of services relies on the ArcGIS Server's ArcObjects components, and ArcGIS Server ADF for Java that can be seamless integrated with development platform eclipse and JSF. JSF (Java Server Faces) is an Internet application used to build the Java framework. It provides a method to develop Java Web user interface with component as the centre, thus simplifying the development. With the design pattern, Model - View - Controller (MVC), JSF ensure that the application has a higher maintainability. In the service course, the size class of service should be cared, first of all divided basic services, and build a higher level service entity via basic services combination, to avoid duplication of functions between the services. The data source of the entire framework through the GIS service package, to facilitate the reuse of data and incremental deployment, the physical structure of data and function in a transparent manner to achieve data users, the sharing of heterogeneous data with data transform into services to achieve data collected, copy and synchronization to ensure that heterogeneous, multi-source data seamless integration. Management and maintenance of data can be achieved with ArcCatalog, data management and application is separate, which is conducive to ensure data security, consistency and stability of the system.
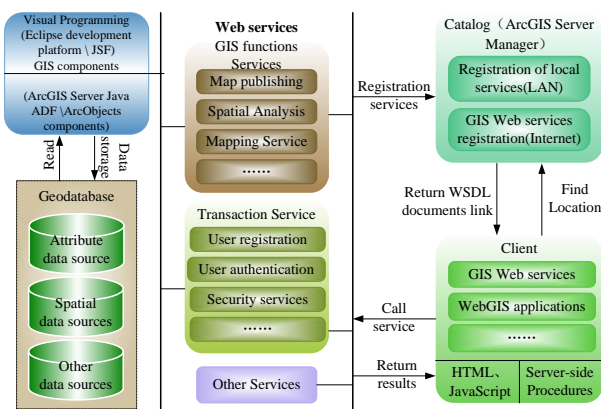

Figure 7. The frame structure of system implementation

5. CONCLUSIONS

By the research of the establishment of emergency response geographic information platform, this paper illustrate an GIS Server mapping service which combine different departments and local GIS data in the research region to demonstrate the potentials of WebGIS spatial decision support systems. Such information exchange is essential to pre-emergency planning, critical first response actions, relief efforts, and community recover. Furthermore, such information can greatly enhance daily operations and cooperation among agencies in meeting emergency response responsibilities.

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