WEB SERVICE BASED WEB FEATURE SERVICE

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ABSTRACT:

The spatial information interoperability method based on web (xml) standards is the best method to implement spatial information sharing and interoperability through the Internet at present time. Web Feature Service (WFS) is a geographic information service implementation specification based on XML provided by OGC and ISO/TC211. This paper give out the implementation method and key techniques of WFS using Web Service technique, and give out an application sample in the end.

1. INTRODUCTION

With the development of spatial information application and the network technique, the spatial data between different districts and different departments need to be shared and to be interoperated. ISO/TC211 and OGC have done lots of work to define Interface specifications and standards to ensure sharing and interoperable capability of the spatial data. Compare with the CORBA, DCOM and SQL interface specifications defined by OGC, the implementation specifications defined on web (XML) are more successful for they using open standards and protocols, and having the capability of cross-platform and cross-firewall. The emergence of Web Service technique overcomes the shortcoming of traditional Distributed Object technique and provides the interoperable capability of cross-platform and cross-language in distributed net environment .Web Feature Service is one of the GIS web service interoperable specifications defined by OGC. It's the most powerful data service of OGC web service. It can get data and even can update, delete and create data. OGC has defined the Interface of WFS using XML, and appointed HTTP as the distributed computing platform. This paper give out the implementation method and key techniques of WFS using Web Service technique, and give out an application sample at the end. Chapter two briefly introduces Web Feature Service Implementation Specification and Web Service technique, chapter three gives out the architecture design of WFS based on web service technique, chapter four gives out a implementation method of WFS, chapter five discusses GML application schema definition used for WFS, chapter six introduce the WFS client and chapter seven gives out a WFS application example. The last chapter is conclusion.

2. WEB FEATURE SERVICE AND WEB SERVICE TECHNIQUE

Web Feature Service is a geospatial data manipulate interface based on HTTP protocol provided by OGC. It belongs to Data Service according to OGC web service architecture and it is the development of OGC Web Map Service. Web Feature Service allows a client to retrieve geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Service. And it supports INSERT, UPDATE, DELETE, QUERY and DISCOVERY operations on geographic features using HTTP as the distributed computing platform. WFS defined 5 operations: GetCapabilities operation describes capabilities of the web feature service using XML, it indicate which feature types it can service and what operations are supported on each feature type. DescribeFeatureType operation describes the structure of any feature type it can service. GetFeature operation services a request to retrieve feature instances. In addition, the client

should be able to specify which feature properties to fetch and should be able to constrain the query spatially and non-spatially. Transaction operation services transaction request, it can create, update, and delete operations on geographic features. LockFeature operation processes a lock request on one or more instances of a feature type for the duration of a transaction

The working process of a web feature service is as following: first user request GetCapabilities, this operation return a capabilities XML document including geospatial data information which can be provided by the service. Then user send DescribeFeatureType request for the interesting data according the response of GetCapabilities operation. The response of DescribeFeatureType returns the GML schema of selected geospatial feature type, using this information, user can understand well with the returned GML data. Next user can send GetFeature or Transaction or LockFeature operation to query or manipulate geospatial data.

Web Feature service has two functions. First, it can implement geospatial data web service, data provider can establish a web feature service upon on spatial database to provide online data service. Second, it can implement interoperate between heterogeneous system. Two different GIS software can realize heterogeneous data interoperability, including query, browse, update etc.

According to OGC Web Feature Service implementation specification, a web feature service uses HTTP protocol to send request and get response. It not appoint to a specific implement technique, so people can use different technique to implement a web feature service such as CGI, ASP, JSP, PHP etc. Using CGI technique, when a web feature server receives a request, it must generate a new process to service user request, when lots of user requests come at nearly the same time, it will cost lots of server resource so the service performance becomming poor. ASP, JSP and PHP are server page technique, they can make separation of page logic and process logic, the server generates Thread not Process to service user request, so it can promote performance effectively. These techniques mainly for user-machine interface, they can provide friendly user interface using web pages, but web pages not fit for services integration and interoperability. The emergency of Web Service technique provides a new and effective means to integrate and to interoperate. Web Service is a kind of self-contain, self-describe software Component can be discovered and to be invoked by other software Component. Web feature service provider can use any programming language at any platform to implement web feature application, and then publish it as a web service. The implementation detail is black box for users, so service providers do no need to worry

about information leak, such as data structure etc. Web Service's interface information is described using WSDL, which is an open standard defined by XML and it's machine-understandable. Web services can be register to UDDI, so the users or applications that want to invoke the service can search the UDDI to find the service, get the information of service included in WSDL, then understand it and invoke it. So using web service technique not only provides the interoperability of cross-platform and cross-language, but also provides the capability of integration of difference application. Publishing GIS applications to Web Services can also help to build GIS Service workflow. Now there are many standards about Web Service workflow, such as WSFL, XLANG, BPEL4WS. Using these web service workflow techniques, people can compose GIS web service to more powerful workflow to satisfy user specific request.

3. DESIGN ARCHITECTURE OF WEB FEATURE SERVICE BASED ON WEB SERVICE

A web feature service based on Web Service is a web service that implement the Interface defined in OGC Web Feature Service Implementation Specification. A web feature service can receive SOAP request from client and send back the response using SOAP. A web feature service also needs to support HTTP GET/POST request according to WFS specification. Some of the SOAP servers support HTTP GET/POST besides SOAP such as .net platform, but some of the SOAP servers do not support HTTP GET/POST such as APACHI Axis. So if a web feature service is deployed in Axis server, it's need to build a translator to translate the HTTP GET/POST request to SOAP request and translate the response of SOAP message to HTML page to support HTTP GET/POST. The translator is just between Client and SOAP server. The design architecture of the web feature service is show in figure1. The web feature service first publish itself to UDDI, then the WFS client can search UDDI to find a desired web feature service and then send HTTP GET/POST or SOAP request to the service. If the service can't service the HTTP GET/POST request, the request should send to the translator to translate to SOAP message and then send to web feature service. The web feature service process the request and generate GML data sending back to the client. Other applications or web services or service workflow can also find the feature service through UDDI and invoke the service using SOAP. It's very convenient to integrate Web Feature Service into other GIS applications or non-GIS applications using this design architecture.
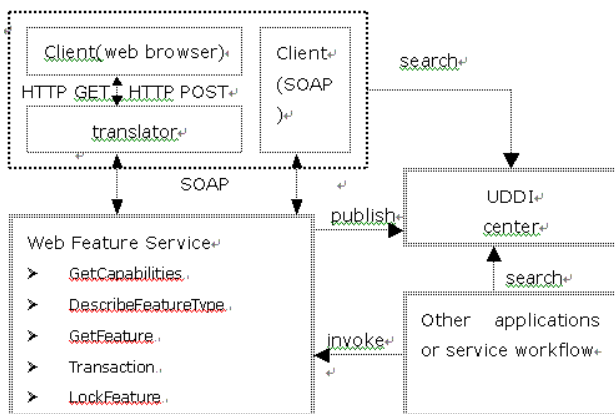

Fig.1 Design Architecture of Web Feature Service Based on Web Feature Service

4. IMPLEMENTATION METHOD OF WEB FEATURE SERVICE

Using Web Service technique to implement Web Feature Service include following 3 steps:

1) Create web feature service application
A web feature service application is an application that implement the interface defined in OGC Web Feature Service Implementation Specification. The implementation detail of the application is opaque to user and the application can be created using any language at any platform. Service providers can create WFS application all by themselves or create the application using available GIS software platform or GIS software components. Using GIS components can cut down the developing workload and increase the reusability of GIS components. We have implemented Web Feature Service using GeoStar and GeoSurf components upon .net platform and Java platform respectively.

2) Deploy web feature service application
After creating the web feature service application, we need deploy it to a SOAP server and make it provide service to outside. SOAP, WSDL and UDDI are all open standards, so different vendors can provide different products of these standards, such as .net platform provided by Microsoft and Axis provide by APACHE and other web service tools packages provided by SUN, IBM and Borland based on Java platform. Web Feature Service Provider can choice any of the SOAP servers to deploy the service in. Nearly all the SOAP services support automatic WSDL generation, so a web feature service provider does not need to write the WSDL for the service. It can greatly reduce the workload of the service provider. To wrap an application to a web service is very easy using these SOAP tools.

3) Publish web feature service to UDDI
After the web feature service is deployed to the SOAP server, WFS client and other applications or services can invoke the it. But they must know the service address and service information, so web feature services need to be published to UDDI. UDDI provide a mechanism to help service provider publishing services and to help service user dynamic finding and binding the service it needs. Among the data model of the UDDI, tModel is a special data item. It provides the description capability of specific specifications or concept or some kind of sharing design. So we can define a tModel for OGC Web Feature Service Implement Specification, the web feature service can reference this tModel to indicate that it compliant to OGC WFS specification. TModel is fingerprint of a web service, using tModel we can easily search find all web feature services compliant to OGC WFS.

5. GML SCHEMA DEFINITION

Web Feature return spatial data using GML. GML is provided by OGC and it is a kind of extensible markup language for transportation and storage spatial data. OGC Web Feature Service appoints to use GML2. Now GML3.0 has published and it has more content than GML2.0, such as Topology, Temporal, 3D, Dictionary, Coordinate etc. GML3.0 is more powerful than GML2.0. With the development of WFS, it will adopt GML3.0 soon. Next will discuss how to define application schemas using GML3.0 for a web feature service.

GML 3.0 specification defines 28 schemas, but for a specific application, it's no need to using all the schemas, it can choose a subset of the schemas according to specific application needs.

GML also give user the flexible ability to define new feature types for application purpose. So to build an application schema is thus a two-part process: The profile acts as a restriction of GML to produce types and elements consistent with the complete GML 3 but potentially lacking in some optional particles. The application schema then uses these types as a common base, and uses them in new types and elements by extensions or inclusion.

$$\text{GML 3} \xrightarrow{\text{selection \& restriction}} \text{GML profile} \xrightarrow[\text{inclusion}]{\text{extension \&}} \text{application schema}$$

GML schema determines content and structure of GML document, so different GML schema definition manner affect the content, size, data presentation manner and the convenience of GML parsing. But WFS specification did not give out a uniform GML application schema define manner, a web feature service provider can define their own application schema, DescribeFeatureType operation return the schema, the only requirement of the WFS specification is that the returned GML document must conform to the schema return by DescribeFeatureType operation. WFS specification let service providers define schema, so it gives service provider lots of freedom and lets the feature services more flexible. But this flexibility also brings complexity for parsing and overlaying GML data from different services providers. Different service providers have different GML application schema, so the GML data structures from different provider are not same. Now there is no effective method can map one schema to another automatically. We hope OGC can provide a uniform GML application schema define manner in the next version of WFS specification.

6.WEB FEATURE SERVICE CLIENT DESIGN

The client of Web Feature Service based on web service can be created in any language at any platform. User can send request to different web feature services, and the WFS client receives the response of the request from different services and overlay them for user. If the return data has same Reference Coordinates System, the client can overlay directly, otherwise the client need to change data to the same Reference Coordinates System first and then overlay. WFS client not only overlay data come from different web feature services, it also can overlay data come from other OGC web services (such as Web Map Service) and data come from local storage. WFS client can provide basic operation functions: zoom in, zoom out, span, query etc. The data come from WFS are written in GML, so WFS client can parse it and storage it to memory data structure in the client side. Using memory data structure, the basic functions such as zoom in, zoom out, span and query can operate memory data, so it can improve the response speed of the client and cut down net workload. If the client overlay two kind of data, one comes from a web feature service, one comes form a web map service, if user wants to zoom in, there is no need to send a new request to web feature service, the client can process memory data directly, but for a web map service, the client needs to send a new request to web map service and overlay the result with the WFS data. The design of WFS client is show in figure2. A WFS client implementation using Java shows in figure3.
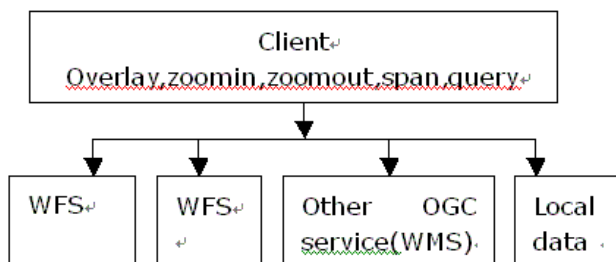
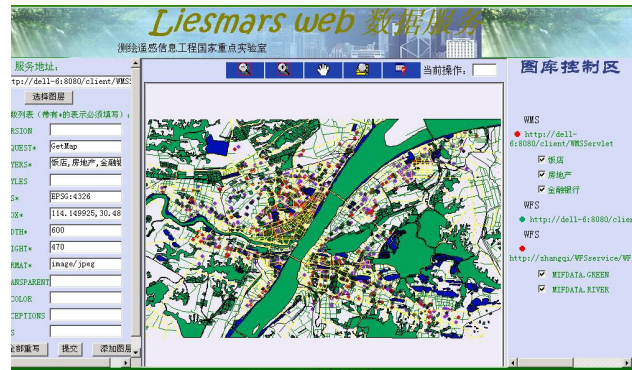Fig. 2 Web Feature Service Client

Fig. 3 A Web Feature Service Client implementation using Java

7.WEB FEATURE SERVICE APPLICATION SAMPLE

Web Feature Service gives out an effective manner for spatial data sharing and interoperability based on Web (XML). It can query data, and it also can provide data manipulate functions such as add, delete, and update. We are using Web Feature Service to build data exchange system in Ministry of Land and Resource, this system can implement the capability of two level (country level and province level) data exchange and can satisfy the update requirement of 1:10000 land use status quo data. Web Feature Service provides a real time online data update manner. When the province land use data changed, Update Management will send out update message to Country Data Management, and Data Management decides when to get the new data using web feature service. The architecture design of the system is show in figure4.
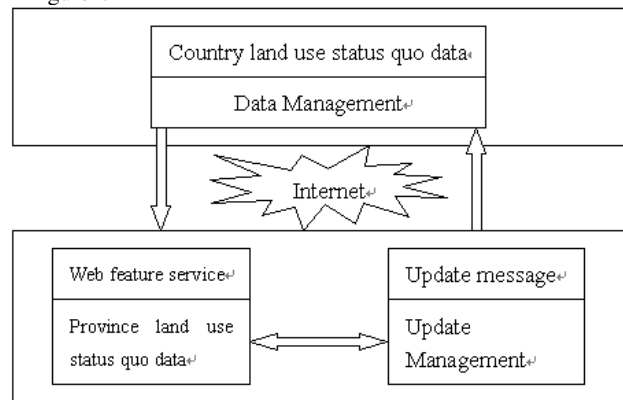
Fig. 4 Data Exchange System Design

8.CONCLUSION

Web Service based Web Feature Service provides an effective spatial data sharing and interoperability manner through web. It provides strong cross-platform operating capability of spatial data. This paper discussed the implementation method of Web Feature Service based on Web service technique, and give out an application example to indicate the power of WFS. With the development of GIS web service, more and more GIS web services will appear in the Internet, and one day, we do not need traditional GIS software any more, what we need is to compose GIS web services to implement our purpose.

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