A Technology for Integration of Spatial Information Services using Web Registry Services

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Abstract: Recently, there has been rising concerns to integrate and connect a developed spatial information services without consideration of location in the heterogeneous distributed environment. The Open GIS Consortium provides system architecture model related to open web service for spatial information.

This paper discusses the issues related to the web service framework for spatial information services using standards of Open GIS Consortium. In particular, we concentrate upon the WRS that support the runtime discovery and evaluation of resources. The technology for integration of spatial information services is expected to get synergy effect and overcomes limit of individual development of each spatial information technology. Also this system provides the interoperability and the reusability and prevents the duplication development of system.
Keywords: Web Services, WRS, WFS, GML.

1. Introduction

Recently, The web services are pointing loosely coupled internet application development technologies in new directions. Web application architectures are evolving to better meet the needs of companies investing in the internet.

The web services are applicable to spatial information service to integrate and connect a various spatial information application services and spatial data such as digital maps, satellite images, traffic data etc.

In this paper, we introduce a technology for integrated spatial information services based on Web Registry Services(WRS) of OpenGIS Consortium(OGC) standards. This system supports a distributed sharing for resources of different organizations using OGC standards and W3C standards. So user can retrieve and manage a diverse spatial data in heterogeneous distributed environment and prevent the duplication development investment. Therefore this system has a flexible and powerful architecture of spatial information system.

We will briefly explain the web service architecture of OGC and WRS in the following chapter. The third chapter presents architecture of the system in detail. The fourth chapter concludes the paper and discusses about further study.

2. Background

1) Web Services Architecture of OGC

Web services provide a set of protocols that allow applications to expose their functionality and data to other applications over the Internet. Also web services provide a language and platform-independent syntax for exchanging complex data using messages. The internals of web services are implemented using XML to exchange data between clients and application servers over HTTP or sockets, making it easy for any platform to support this technology[7].

The web services architecture of OGC has three essential roles: service provider, service broker, and service requestor.

The service providers publish the availability of their resources to repository(service broker) using WSDL and delivers services to requestors. The service provider means group, enterprise, and individual offering the spatial data and spatial information services.

The service broker is acting as a registry or clearinghouse of services using UDDI technology. The service broker is defined as a process to find requested spatial data list by comparing the users request from the published metadata by providers. It supports the dynamic binding between service provider and service requestor.

The service requestor retrieves data with human interaction. The service requestor performs service discovery operations on the broker to find the providers. After search of metadata, the service requestor obtains spatial data from service provider using SOAP.

The Web Services Architecture can be depicted in an equivalent manner as the “Publish-Find-Bind”. The “Publish” used to advertise data and services to a broker. The “Find” used by service requestor to locate specific service types or instances. The “Bind” used when a service requestor and a service provider negotiate.

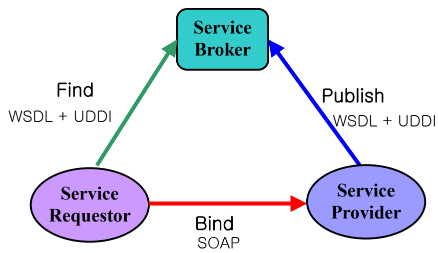

Fig. 1. Web services pattern

The Web Services Description Language (WSDL) is a specification to describe networked XML-based services.

It provides a simple way for providers to describe the basic format of requests to their systems regardless of the underlying or encoding. The WSDL is a key part of the effort of the UDDI(Universal Description, Discovery and Integration) initiative to provide directories and descriptions of such on-line services[5]. The SOAP(Simple Object Access Protocol) provides the definition of the XML-based information which can be used for exchanging structured and typed information between peers in a decentralized, distributed environment.

2) Web Registry Services (WRS)

The OGC has developed open standard for a diverse spatial data service through the web - GML(Geography Markup Language), WRS(Web Registry Services), WMS(Web Map Services), WFS(Web Feature Services), WCS(Web Coverage Services), CPS(Coverage Portrayal Services). It provides standard interface and interoperability.

In particular, a WRS are a software component that supports the runtime discovery and evaluation of resources such as services, datasets, and application schemas[5]. In effect, a registry plays the role of 'matchmaker' in a service-oriented architecture.

A registry that can accommodate all of these forms of metadata can be used to support a wide variety of discovery scenarios that involve multiple communities of practice. The discovery of resources pertaining to geospatial services and data requires ready access to several forms of metadata - services, data sets, images, schemas, presentation rules, spatial reference systems, and other shared resources[5].

Adopting a broader perspective, a registry service can be viewed as a type management system that fulfils a basic repository function in open, distributed systems. It can be linked to—or federated with—other registries[5].

3. System Architecture

1) Overall architecture of system

The web service framework for spatial information services is consist of Extended WRS for service broker, Spatial Data Server for service provider and web client for service requestor.

The Spatial Data Server advertises the availability of their spatial data and spatial information service to extended WRS, and Web Client can then query a Extended WRS to discover resources of interest and determine how to access them. The Extended WRS provides interfaces for querying and managing a metadata repository.

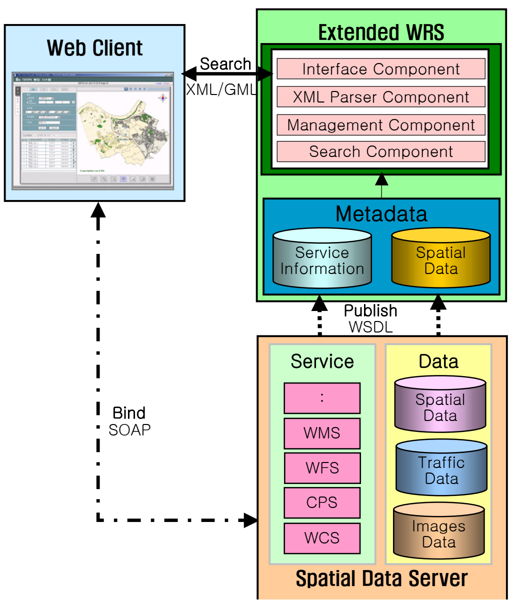

Fig. 2. System architecture

2) Extended Web Registry Server

The WRS observes the Web Registry specification of OGC. It is the server to support runtime retrieving and evaluating of the resource. It manages metadata of spatial data and extended to manage a metadata of spatial information service using a part of UDDI specification. The UML component diagram in Fig. 3. displays the modeling of extended WRS component.

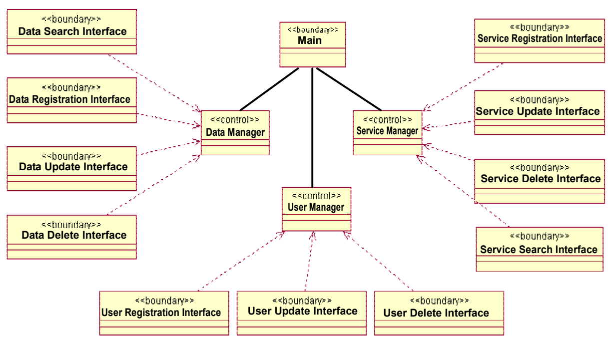

Fig. 3. The modeling of extended WRS component

The Extended WRS is consists of Interface Component, XML Parser Component, Search Component, and Management Component(Fig .4.). The Interface Component has functions of connecting with external interface.

The XML Parser Component imports and exports the XML using XML encoder and XML decoder. When user specify the criteria and request data, it is transformed the XML string by Encoder and it is transmitted the server. And server processes the encoded XML string by Decoder. The Search Component retrieves a metadata of registered spatial data and spatial information service. The Management Component registers and authenticates the spatial data, spatial information service published by provider, and provider information.

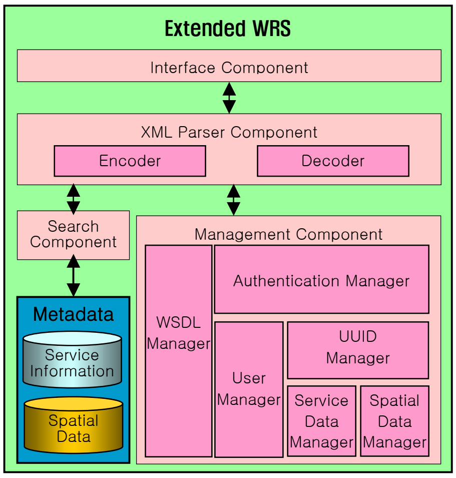

Fig. 4. Architecture of extended WRS component

3) Spatial Data Server

The Spatial Data Server provides the mechanism to offer a rapid geographic data management, client connectivity, and communications, and support the international standards. It consist of Spatial Data Manager(SDM), Web Feature Server(WFS), and Web Service Manager(WSM).

The SDM provides main-memory based spatial data manager. It provide XML based Memory management, GML encoding, geographic data processing, progressive transmission to increase the first response time, compression to reduce data size, and encryption to protect the data. It uses spatial index and main-memory manager for rapid response. Also it supports access spatial data without consideration of data formats because use data provider.

The WFS is adopted for accessing requested spatial data in web environment. The WFS provide a web interface for GML data transmission. The GML is an XML grammar written in XML Schema for the modeling, transport, and storage of geographic information[4]. The WFS is implemented ISAPI extension to reduce server load by multi user access.

The WSM publishes the extended WRS the to metadata describing its capabilities and network address.

4) Web Client

The user easily retrieves a diverse spatial data such as digital map, satellite images, traffic data through web browser. A Web Client is an application used to query the Extended WRS.

The Web client can obtain the spatial data from the web feature server for GML through network using SOAP and converts to the internal data which is suitable for graphic presentation. The Fig. 5. displays example of inquiry of satellite images and digital map in client.

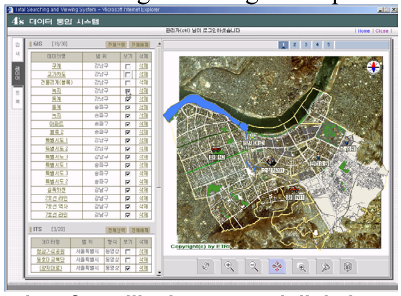

Fig. 5. Inquiry of satellite images and digital map in client

4. Conclusions

To locate, access, and use arbitrary resources is difficult practically in the open, distributed systems. Because client will generally not know in advance where a desired resource is located.

This paper describes the framework of web service for spatial information using WRS. It is advantageous to allow fast binding between service requesters and service providers using WRS in dynamic, heterogeneous environments. It is integrating the business processes of different organizations through the interoperability of spatial information system. It is applicable to the spatial information to share with a general user, business fields, public sector.

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