USING THE XML WEB SERVICES AND SOAP AS A REGISTRY SERVICE FOR INTEROPERATING THE OGC CATALOGUE SERVICES

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Abstract

Geoportals are important tools of Spatial Data Infrastructures (SDI). Functional geoportals are consisted of client services such as WMS, WFS, WCS, CS-W and z39.50 that enable users to discover, access and use/represent geospatial data and metadata. Nowadays, especially usage of ISO 19100 and OGC standards has leveraged developing distributed infrastructures. However, distributed systems require, especially, a mechanism to store and serve service metadata.

This paper presents an Extensible Markup Language (XML) Web Service approach for Web Registry Services (WRS) with preliminary results of an ongoing geoportal research project. Current version of WRS supports CS-W and Z39.50 OGC catalogue services and provides service metadata with different capabilities.

Key words: Catalogue, Metadata, Web Service, Geospatial data, XML

1. INTRODUCTION

A Web service is a software system designed to support interoperable machine-to-machine interaction over a network (W3C, 2004). It has an interface described in a machine-processable format (Web Services Definition Language- WDSL). A more technical definition of a web service is a "URL-addressable software resource that performs functions and provides answers" (Seybold, 2002).

The great advantage over existing integration technologies is that Web Services are designed to interoperate in a loosely coupled manner; they can request a particular type of services across the Internet and wait for responses (Parsons, 2003). A Web Service can be discovered and used by other Web Services, applications, clients, or agents

(Jacobsen, 2002). Web Services provide a modular, well-defined and encapsulated service, based on standards such as XML, XSLT, SOAP, WSDL, RDF, DTD, UDDI (W3C, 2004) and WSRP (OASIS, 2003), which are used for implementing loosely coupled integration between the systems or applications. Other systems interact with the Web service in a manner prescribed by its description using Simple Object Access Protocol (SOAP) messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards (W3C, 2004).

A web service is "published" to the network by providing a document describing it functionality and mode of operation. This document is created using the core building block of web services, XML. The web service is described using the WSDL, it describes how the service is evoked and what is returned; while SOAP specifies the communication between a requester and a provider (Figure 1.), WSDL describes the services offered by the provider (an "endpoint") and might be used as a recipe to generate the proper SOAP messages to access the services (Gunzer, 2007).

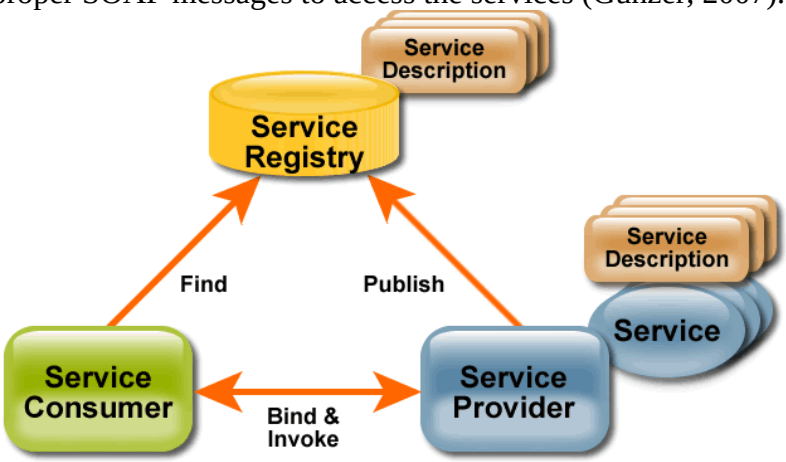

Figure 1. A simple web service model

Nowadays, there are many web services over Internet. An important question is how to find out if someone provides a web service that might be of use to an application developer or user. It is possible to answer this question with usage of Universal Description, Discovery and Integration (UDDI). It was proposed by IBM, Microsoft and Ariba, who jointly developed UDDI (Gonzalez, 2005). UDDI represents the service broker that enables service requesters to find a suitable service provider. Nowadays, combination of WSDL and UDDI standards are supported by major industry companies and are already implemented in many tools. UDDI registries are hosted by many organizations, including SAP, Microsoft, and IBM. A UDDI registry's functional purpose is the representation of data and metadata about Web services (OASIS, 2004).

In Figure 1, a simple scenario is depicted for web services. Service providers publish their service(s) with the registry repository of a service registry. Then, a service consumer initiates a search for a service by contacting the service registry and searching

the registry repository for services that meet specific search criteria. The service registry returns a list of services along with details of the associated provider for each service. Finally, the service consumer finds and binds with a selected service provider based on the provided details of registry repository and uses them.

With a similar approach to other applications of web services, geographical information (GI) communities have also started using web services for exchanging and searching the geospatial data and information over Internet, not more than a decade. The reason behind this idea is to promote sharing of geographic information throughout the maximum number of users. However, to do this, it is necessary to create distributed networks of catalogues that use a standardized mechanism for catalog querying, thus enabling enterprise and technological independence (Nogueras et al, 2005). Especially Opengeospatial Consortium (OGC) has been working on creating standards or specifications for geospatial web services (OGC, 2009). Nowadays, several geospatial web service specifications are published and in use such as Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and OGC Catalogue Services (CS/W, Z39.50). The aim of those geospatial web services is to provide the geospatial data or information according to the user requests and capabilities of the service. However, different geospatial web services specialized in particular types of data or information. For example, WMS deals with producing map images of spatially referenced data dynamically from geographic information, WCS can provide or update coverage data, WFS produces Geographic Markup Language (GML) data online for clients and OGC catalogue services support the storage, retrieval and management of metadata (OGC, 2002)(OGC, 2006)[14.

Similar to the registry procedures such as UDDI for generic web services, there is also necessity for geospatial web service registry. However, since it is geospatial centric, there should be more particular registry services than UDDI.

In this paper, it is aimed to determine the XML web services for registry services for geospatial web services using service metadata. The requirements of the registry service were arisen during the implementation of the catalogue portal project based on geospatial web services for SDI. In this paper, an XML web registry service was developed and presented for integrated OGC catalogue services (Z39.50 and CS/W). Paper outlines the preliminary result of study, which contains OGC catalogues.

2. REGISTRY FOR THE GEOSPATIAL WEB SERVICES

Although it is important to visualize or get the data via geospatial web services (WMS, WFS, WCS) for many users; it is, actually, more important to find the related data in a distributed geodatabase environment than visualization. In fact, the task of finding the right data is different from using the data and requires different supporting tools (Flewelling and Egenhofer, 1999). Catalogue services are required to support the discovery and binding to registered information resources within an information

community. They seem to be a solution to publish geospatial metadata documents and enable searches across multiple servers in order to give the detailed description about the dataset (Kottman, 1999). Users first must have some knowledge of the dataset's contents, either experience with the dataset or through a detailed description. In this manner, metadata documents stored in the catalogue servers provide enough information about the requirements of the users. With the usage of metadata documents with catalogues, users can decide whether that dataset is fulfilling the requirements or it exists.

Nowadays, geoportals are very popular tools for data discovery and retrieval as a part of National SDI (NSDI) and especially INSPIRE. The geoportals consist of different sub-tools to search metadata and retrieve geospatial data. In some cases geoportals also stores metadata documents and make an internal search. However, some cases, geoportals enables performing only search and retrieval processes. In this case, geoportals play client roles for operations and connect to servers such as web services and perform the process. The second case or scenario is quite similar to the generic web services and it is corresponding with the OGC web service approaches. In this case OGC plays important role and prepares specifications in order to solve the interoperability issue between different GI systems.
However, in order to find the desired data from geospatial web services through the metadata documents, it is necessary to know the exact locations of catalogue service providers (servers). This location information is stored in registry services.

3. MOTIVATION

As a part of a SDI geoportal research project and a proof of concept, a common framework was designed. In this design it is aimed to supply a framework for a generic client approach including various clients such as WMS, WFS, WCS, CS/W and Z39.50. The idea is a general portal, which enables users to search the distributed OGC catalogues through metadata documents and retrieve the metadata documents and access the geospatial data via WMS, WFS or WCS, if there is online data. However during the study it was reveled that there is a requirement for a web registry service, which stores International Standardization Organization (ISO) 19119 service metadata.

A service metadata document describes a service instance including a description of the services operations and an "address" to access the specific service instance (ISO, 2001). Service metadata records can be managed and searched using a catalogue service as is done for dataset metadata. It provides information to reach the catalogues publishing 19115 metadata or geospatial web services publishing geospatial data.

In the first phase, OGC catalogues are focused. OGC has published a specification for catalogue services in order to deal with the interoperability problem of catalogue services. Although there are 3 protocol bindings in the specification (CORBA, Z39.50, CS/W) (Nebert, 2005), mostly two of them are, Z39.50 and CS/W, in use in practice.

Catalogue services, described in the OGC specification, work effectively, there is, however, still a necessity for registering the online catalogue services. To make the rest of the network aware of a geospatial web service the WSDL is published to a public clearinghouse or yellow pages site known as a Universal Discovery, Description, and Integration or UDDI registry. A developer of web services or a web service itself can therefore either couple with another known web service or may use UDDI to discover equivalent services.

In general, OGC catalogue clients require metadata of catalogue services (server IP address, port number etc) in order to communicate and send queries. However, OGC Catalogue Specification document doesn't address any operation related to registry. This topic is being tried to be solved by Web Registry Server Specification, which is still a discussion document (Reich, 2001). Another registry solution OASIS/ebXML Registry Information Model developed (ebRIM) by OASIS/ebXML Registry Technical Committee (OASIS, 2003). Currently there is no implementation specification from INSPIRE, however it defines a of 19915-19119 service metadata profile. There is also an implementation specification based on ebRIM which is called ebRIM profile of CSW and a discussion paper OGC Cataloguing of ISO Metadata (CIM) Using the ebRIM profile of CS-W in OGC. Standalone ebRIM is free of any profile or geospatial data standard. However, OGC profiles are presenting geospatial solutions to ebRIM. ebRIM profile of CS-W provides a general and flexible web-based registry service that enables users to locate, access, and make use of resources in an open, distributed system (OGC, 2008). CIM, complements the ebRIM application profile of CS-W for the cataloguing of ISO 19115 and ISO 19119 compliant metadata record. It defines for this purpose a Core ISO Metadata extension package of ebRIM (OGC, 2007).

In this study distributed approach is implemented. In this way, a chance is given to the publishers to select any of CS-W or Z39.50 catalogue services. Web registry service serves 19119 metadata and custom metadata document for both CS-W and Z39.50. Therefore, geoportal supports both of the OGC catalogue services.

3. WEB REGISTRY SERVICE DESIGN

In order to find the required capabilities for web registry service, a sample scenario is created. In this sample scenario:

- Publisher registers the web service to the registry service
- Registry service stores the metadata in database
- User uses the geoportal for search
- Geoportal request the required registries from registry service
- Geoportal creates query
- Geoportal sends the query to web services
- Geoportal collects the responses and present the results

Although it is possible to expand the scenarios, the given sample scenario envisages the general idea of the registry service with the geoportal and it is possible to derive the actors and use cases (Figure 2).

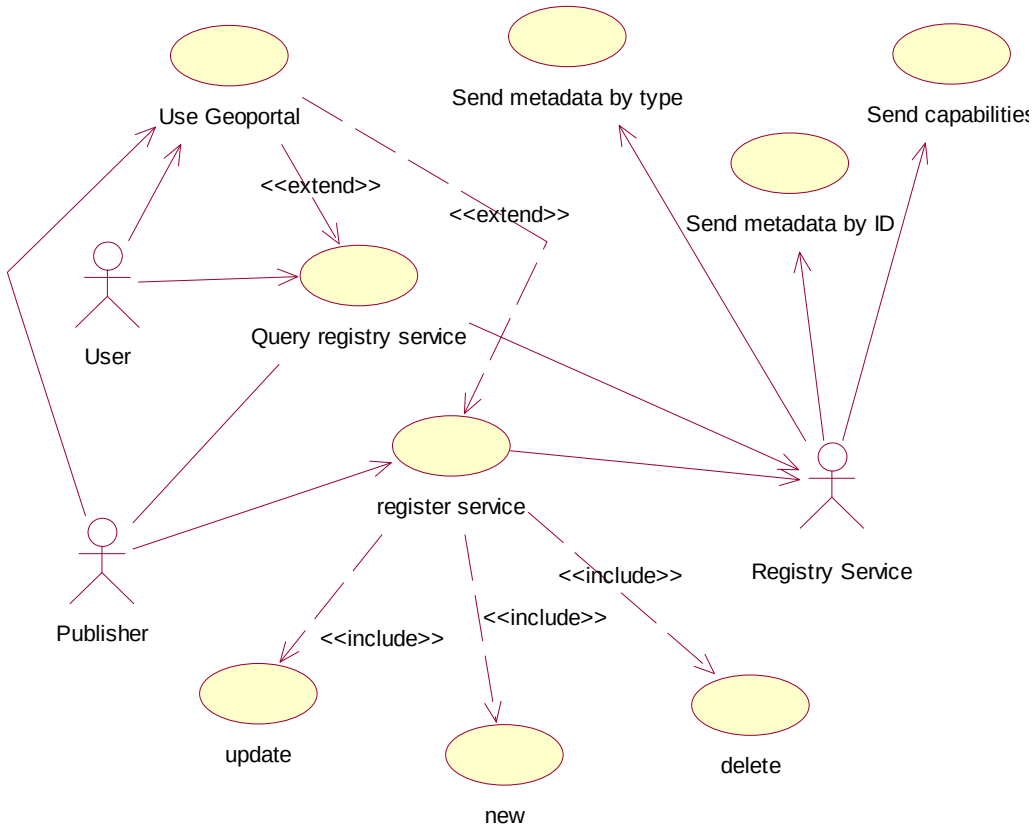

Figure 2. Use case diagram of sample scenario

According to the Figure 2, WRS should support different operations. In this study, it is designed to consist of different capabilities to store, delete, update and query catalogue registries according to the service metadata. These operations are as follows (Figure 3):

- GetCapabilities,
- RegisterService,
- DeleteService,
- UpdateService.
- GetServiceByID,
- GetServiceByType,

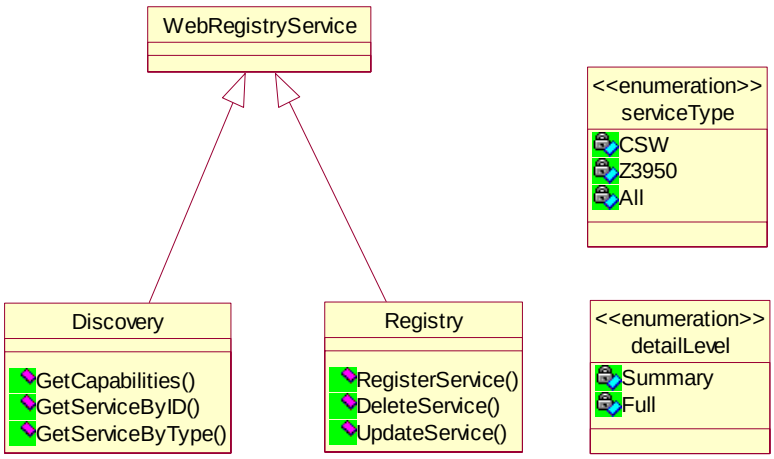

Figure 3. Capabilities of WRS in class diagram

GetCapabilities operation aims to get the general information about the service, that summarize the supported operations and required parameters for inquires.

RegisterService, UpdateService and DeleteService operations are part of Registry class, and RegisterService registers a new service with a new ID and stores that 19119 metadata in database; UpdateService, updates the 19119 metadata of a registered service in the database; and DeleteService deletes a registered service from the database.
GetServiceByID and GetServiceByType operations are part of discovery class. GetServiceByID requests a single or multiple registered services and returns them in full or summary service metadata; and GetServiceByType classifies the catalogue services and returns catalogue services full or summary service metadata. It can also be used for requesting all registered services.

4. Implementation of WRS

Implementation of WRS is done using ASP.NET 3.0 framework as a XML web service application by C#. By using XML web services it is aimed to enable to access WRS from any XML web service supported client. On the back-end, service metadata information is stored in Oracle 10g. In DBMS, relational tables are created in order to store service metadata, and read when a request occurs.

Since it is implemented web services, it supports SOAP implementations; and clients are encouraged to use SOAP messages for the requests (Figure 4).

Figure 4. Sample request and response SOAP messages

By using this WRS, clients are enabled to query and retrieve registered services or group them according to service types in order to access and query published metadata. Afterwards, implemented WRS is integrated with the geoportal and tested for Z39.50 and CS-W queries (Figure 5).

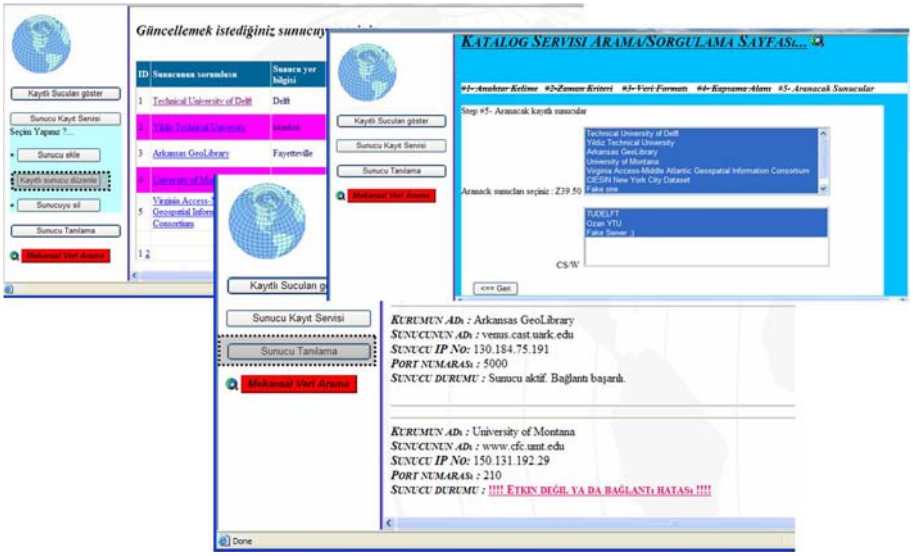

Figure 5. Sample views from integration of WRS and Geoportal

5. CONCLUSIONS

Developments in software implementations and Internet technologies leveraged using web services in geospatial applications. Especially usage of OGC specifications and ISO 19100 standards seems to be solutions for interoperability problem of different systems and constitutes a base and proof of concept for INSPIRE.

In these paper, preliminary results of XML web registry service is presented. This approach to WRS enables clients to store, query and retrieve the service metadata, and use that information and parameters to communicate the geospatial web services.

XML web services provide mechanism for accessing from any client to service with XML, SOAP, HTTP and UDDI support. Designed and implemented WRS approach is aimed to meet the requirements of clients in order to obtain the service metadata. WRS is designed to be an alternative to UDDI services for geospatial data. And, ability to be published by other UDDIs is a plus for registry services.

REFERENCES

Flewelling, D. M., Egenhofer, M.J.:Using digital spatial archives effectively, int. j. geographical information science, 1999, vol. 13, no. 1, 1-8 (1999)

Gonzalez, B.: SOAP/WSDL/UDDI, Distributed Systems (CS439) / 2005, http://webpages.cs.luc.edu/~mt/student/benjamin/soap.pdf (2005)

Gunzer, H.:Introduction to Web Services, White paper, http://www.daimi.au.dk/

ISO: 19119 Geographic information – Services, International Standard Document, Version 2, ISO/TC 211, International Organization for Standardization (ISO) (2001)

Jacobsen, C.: Web Services: Stitching together the Intuitional Fabric, Educause Review Magazine, March/April 2002, (2002)

Kottman, C.: The OpenGIS abstract specification. Topic13: Catalog Services (version 4). OpenGIS Project Document 99-113, OpenGIS Consortium Inc (1999)

Nebert, D.: OpenGIS catalog services specification, Versiyon 2, Implementation Document 04-021r3, Open Geospatial Consortium Inc. (2005)

Nogueras, J., Zarazaga, F.J., Bejar, R., Alvarez, P.J., Muro-Medrano, P.R.: OGC Catalog Services: a key element for the development Spatial Data Infrastructures, Computers & Geosciences 31:199–209 (2005)

OASIS: Introduction to UDDI: Important Features and Functional Concepts., White paper (2004)

OASIS: Web Services Remote Portal TC, April 2003, Web Services for Remote Portlets Specification 1.0 - Committee Specification 0.95 (2003)

OGC, OpenGeospatial Consortium, www.opengeospatial.org, 2009

OGC: Cataloguing of ISO Metadata (CIM) Using the ebRIM profile of CS-W, Discussion paper, Document OGC 07-038, Version 0.1.7 (2007)

OGC: CSW-ebRIM Registry Service-Part 1: ebRIM profile of CSW, Standart Document, Document OGC 07-110r2, Version 1.0 (2008)
OGC: Web Feature Service Implementation Specification. Versiyon 1. OGC Implementation Specification (2002)
OGC: Web Map Service Implementation Specification, Versiyon 1.3.0, OGC Implementation Specification (2006)
Parsons, E.: The Role of Web Services for Spatial Data Delivery, GITA's Annual Conference 26 in March 2003 (2003)
Reich, L.: Web Registry Server Specification, OpenGIS Project Document 01-024r1, Discussion paper (2001)
Seybold P.A.: Web Services Guide for Customer-Centric Executives, Patricia Seybold Group, Inc. Boston (2002)
W3C, http://www.w3.org/2002/ws/arch/, http://www.w3.org/TR/2004/NOTE-ws-arch-20040211/ (2004)