WSDL Interface of Services for Distributed Search in Databases

Elena Ivanova

Abstract: *Service oriented architecture and two layers model of a service are described. WSDL technology is applied to implement a network interface of a service for distributed search in databases. Two Web Service architectures are proposed. An application with such a functionality is described.*

Key words: *Distributed Databases, Service Oriented Architecture, Web Services, WSDL.*

INTRODUCTION

Communications and information exchange are between the most important features of contemporary world. These features are connected with the need to make the information selective visible, easy accessible and always actual. The wide area network (Internet) is getting the main way for proposing services for selective information search.

This paper deals with web services in Internet. The main goal is to present design and performance of a complex, reusable, interoperable service for distributed search in databases.

SERVICES AND SERVICE ORIENTED ARCHITECTURE

In general the term "service" is defined as a logical presentation of some physical resources like databases, programs, devices, or humans, grouped as a process that an organization exposes to the network [9]. A service must have a network oriented interface, which means that an authorized client must be able to invoke a service through the network. Thus a service can be presented by two layers model: external (communication) layer and internal (executive) layer (fig. 1).

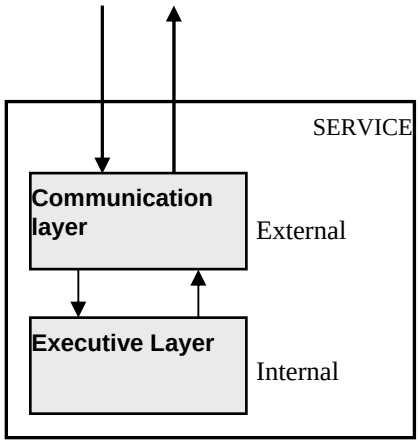


Fig.1. Two layers model of s service

Service oriented architecture (SOA) is a set of services. It is architecture consisted of components and interconnections that stress interoperability and location transparency [7]. The base components of SOA are [7]:

- a standard way for communication;
- a uniform data representation and exchange mechanism;
- a standard meta language to describe the services offered;
- a mechanism to register and locate services-based applications.

Distributed search in databases is a part of distributed and decentralized information systems, hence the most appropriate architecture for such systems is SOA.

WSDL AS A PART OF WEB SERVICE TECHNOLOGIES

Web Service technologies are appeared to be the today's base for distributed and decentralized systems. They are the best way of implementing SOA. They provide a standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks [11]. They are software programs that use XML as an open standard for application-to-application data exchange via common Internet protocols. A Web Service communicates over a network to supply a specific set of operations that other applications can invoke [7], [10], using open standards as WSDL, UDDI, SOAP, Z39.50.

XML (eXtensible Markup Language) is used as the format for transferring information/data between different programming modules and incompatible systems.

WSDL (Web Services Definition Language) is used to describe Web Services.

UDDI (Universal Description, Discovery, and Integration) is an XML-based lookup service for locating Web Services in an Internet scenario.

SOAP (Simple Object Access Protocol) is a lightweight, XML-based messaging protocol that contains an envelope, header, and body, designed to exchange information in a decentralized, distributed environment [11]. It is the channel used for communication between a Web Services provider application and a client application.

Another standard Z39.5 can be used instead or along with UDDI and SOAP in order to communicate, discover and locate Web Services [5].

Because of their interoperability and standardized data exchange, Web Service technologies can be very useful when it has to operate with distributed heterogeneous databases.

WSDL, a XML-based technology, can be successfully used for designing the communication (external) layer of any service to fig.1. Actually, it is the main goal of this technology. This applies especially to the services for selective search in databases.

A WSDL document describes the functionality of proposed Web Service, how it communicates and where it is accessible. It consists of the following pieces of data [1]:

- Interface information describing all publicly available functions;
- Data type information for all message requests and message responses;
- Binding information about the transport protocol to be used;
- Address information for locating the specified service .

WSDL is platform- and language-independent as the rest Web Service technologies [1]. It is used primarily (but not exclusively) to describe SOAP services, because WSDL is much more desirable to create dynamic SOAP calls, where the interface between the service and client is defined at runtime [6].

The root element of a WSDL document is < definitions>. Its main parts are listed below [11] (see fig.2):

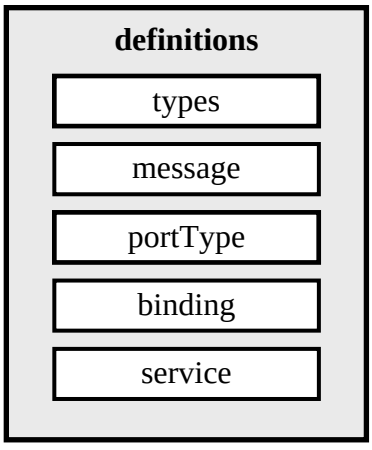
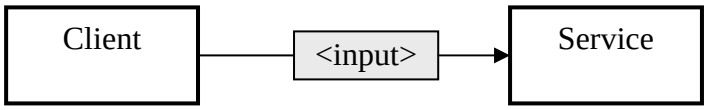


Fig.2. Structure of a WSDL document

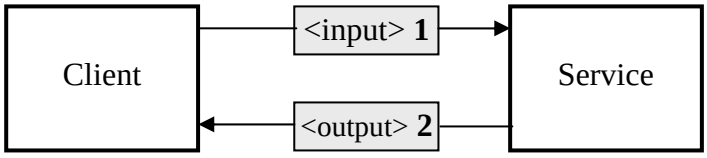
- <portType> - The operations performed by the web service;
- <message> - The messages used by the web service;
- <types> - The data types used by the web service;
- <binding> - The communication protocols used by the web service.

WSDL supports four basic operation types [1], [11]:

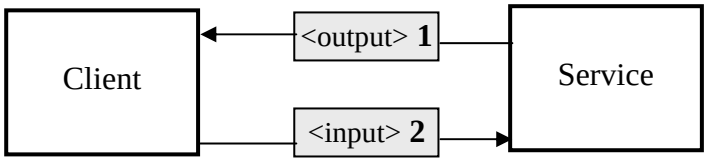
1. One-way: The service receives a message. The operation therefore has a single input element.



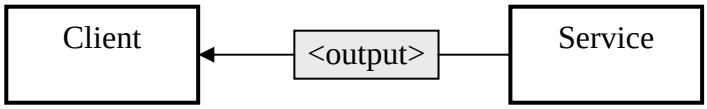
2. Request-response: The service receives a message and sends a response. The operation therefore has one input element, followed by one output element. To encapsulate errors, an optional fault element can also be specified.



3. Solicit-response: The service sends a message and receives a response. The operation therefore has one output element, followed by one input element. To encapsulate errors, an optional fault element can also be specified.



4. Notification: The service sends a message. The operation therefore has a single output element.



The request-response pattern is most commonly used in SOAP services.

Obviously the searching services belong to the second type "Request-response", supported by WSDL, because the obtaining results depend on user input keywords.

IMPLEMENTATION OF WEB SERVICE FOR DISTRIBUTED SEARCH

Relational distributed databases are considered.

The following SQL statement performs selective search from a database, comprising of some tables:

SELECT *Item1, Item2, …*
FROM *Table1, Table2, …*
WHERE <*Condition*>

Actually the core services for distributed search are implemented by middleware functions, containing reference to relevant SQL server with similar queries. The queries, of course, can be more complex. Such functions are parts of Web Service application, providing services for databases. This application can be included in a web site for example or it can be an independent program.

When the database is distributed SOAP protocol can be used as an approach for communicating between the machines on which the database's tables are stored. The queries to the database can be designed as web services. The database can be heterogeneous because of the interoperability of Web Service application.

Let's take a look at a database which tables are stored on two machines.

There are two ways for constructing the searching services. The first is using several WSDL documents, according to every machine (fig.3). Actually there are several web services in this case.

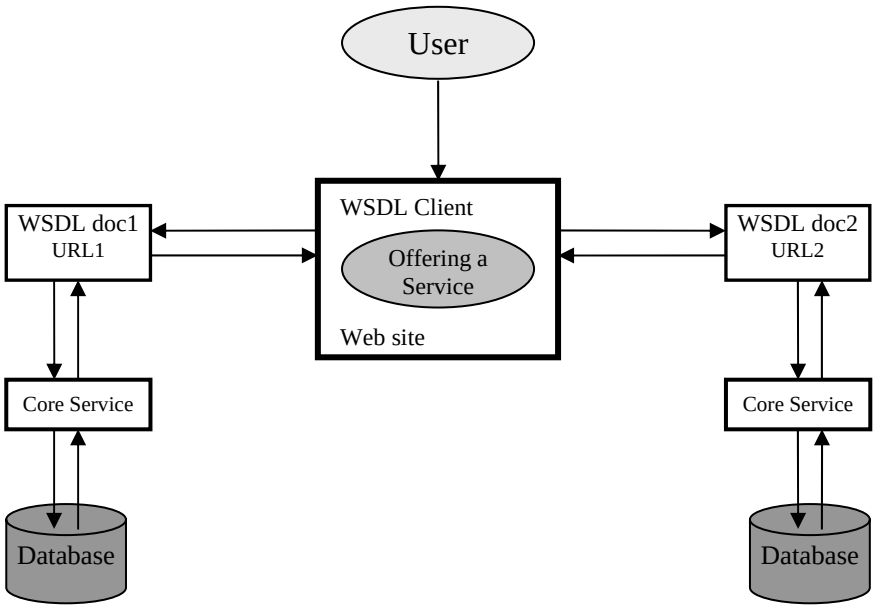


Fig.3. Searching in distributed database using several WSDL documents

The second way is using only one WSDL file, pointing to the core service, which connects to the machines housing database (fig.4). Apparently in this case adding new services and including new locations of the database is more flexible than previous case. Thus can be developed so called network of e-services [4].

SOFTWARE IMPLEMENTATION

An application with the architecture on fig. 4 was developed. It provides services for searching in distributed database, containing textual documents. The tables of the database are stored on two machines. This application uses the following open source software resources:

- Apache web server (http://www.apache.org) - an open-source HTTP server, developed by Apache Software Foundation, for various operating system, such as UNIX and WINDOWS.
- MySQL Server (http://www.mysql.org) - an open-source database server, developed, distributed and supported by MySQL AB [2].
- PHP (http://www.php.net)- widely used Open Source server-side scripting language, especially suited for Web development [3].
- NuSOAP – an open source SOAP implementation, object oriented, deployed with PHP scripting language by Nusphere corp. [8].

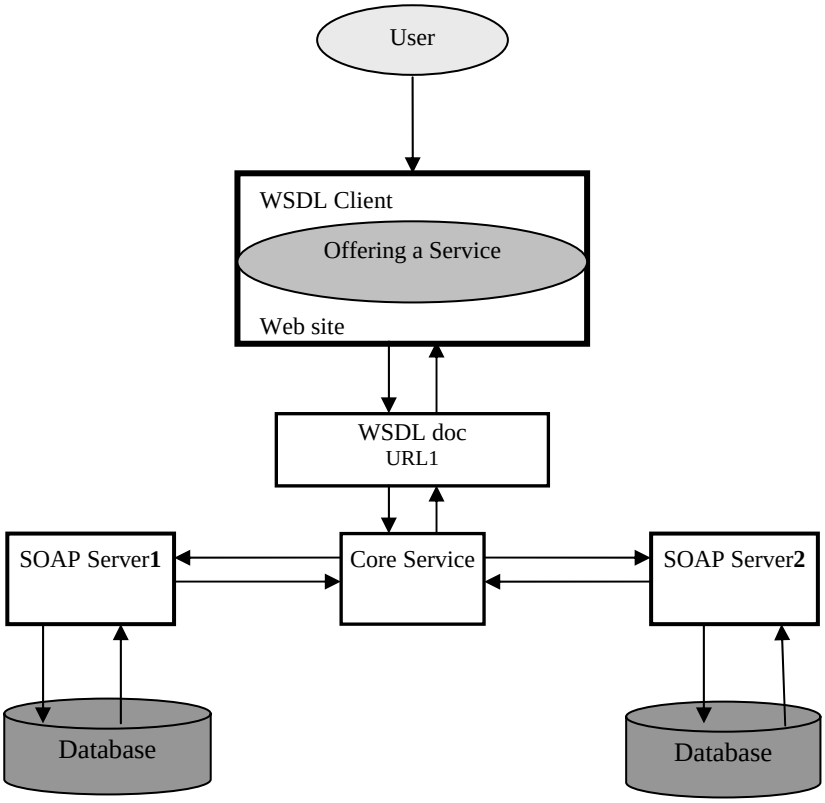


Fig.4. Searching in distributed database using one WSDL document

Basic components of the application are the main php script, used to design the web site, authentication module, and programs, implementing the proposed web services for distributed search – WSDL document and WSDL Client.

The main part of developed WSDL document is listed below.

```
…
<portType name="HsiPort">
  <operation name="searchArticlebyKeyword">
     <input message="tns:searchArticlebyKeywordRequest" />
     <output message="tns:searchArticlebyKeywordResponse" />
  </operation>
  <operation name="searchArticlebyAuthor">
     <input message="tns:searchArticlebyAuthorRequest" />
     <output message="tns:searchArticlebyAuthorResponse" />
  </operation>
</portType>
<message name="searchArticlebyKeywordRequest">
    <part name="inputString" type="xsd:string" />
</message>
<message name="searchArticlebyKeywordResponse">
    <part name="outputString1" type="xsd:string" />
  …
</message>
<message name="searchArticlebyAuthorRequest">
    <part name="inputString" type="xsd:string" />
</message>
```

```
<message name="searchArticlebyAuthorResponse">
   <part name="outputString1" type="xsd:string" />
…
</message>
<binding name="iBinding" type="tns:HsiPort">
   <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http/" />
…
 </binding>
<service name="HsiService">
  <documentation />
   <port name="HsiPort" binding="tns:HsiBinding">
      <soap:address location="http://hs18.iccs.bas.bg/Hs/SOAPServer.php" />
   </port>
      </service>
```

CONCLUSIONS AND FUTURE WORK

Two layers model of a service was described. Service oriented architecture was proposed for the base of information system offering searching services. WSDL usage of designing the communication level of the service was presented. Two kinds of Web Service architectures for distributed search in databases were proposed. The second proposed architecture is proved to be more flexible. An application - software realization of the proposed architecture was described. The problem for optimization the searching services, concerning speeding up and precision, states as a future work.

REFERENCES

[1] Cerami E. Web Services Essentials, O'Reilly, 2002

[2] Dubois P. *MySq*l, New Riders, 2000

[3] Scollo C. at al. *Professional PHP Programming*, Wrox, December 1999

[4] Stoilov T., K.Stoilova. Network of e-services. Proceedings of the International Conference on Computer Systems and Technologies, COMPSYSTECH'2003, Sofia, Bulgaria, 19-20 June, 2003, p.IIIA16.1-IIIA16.6.

[5] Trichkov Kr. Peculiarity of Z39.50 protocol in advanced distributed information systems. Proceedings of the International Conference "Automatics and informatics'03", vol.2, Bulgaria, Sofia, October, 6-8, 2003, p.63-66

[6] Tsenov M. Implementation of SOAP/WSDL web services with open code, International Conference "Automatics and informatics'03", Bulgaria, Sofia, October, 6-8, 2003.

[7] http://www.developer.com/

[8] http://www.nusphere.com/

[9] http://www.sys-con.com/webservices/

[10] http://www.webservices.org/

[11] http://www.w3.org/tr/

ABOUT THE AUTHOR

Assistant. Prof. Elena Ivanova, Department Hierarchical Systems, Institute of Computer and Communication Systems, Bulgarian Academy of Sciences, Phone: (359 2) 979 2774, fax: (359 2) 72 39 05; E-mail: e_ivanova@hsh.iccs.bas.bg.