Modelling Services for Databases

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Abstract: *Searching services in databases are considered. Service oriented architecture is described. Two layers model of service is proposed. Using SOAP and WSDL technology to implement communication interface of searching services is presented. Semantics of such services is described and abstract model of it is proposed. Three architectures of systems for distributed search are proposed based on two abstract service models.*

Key words: *Databases, Searching, Web Services, WSDL, SOAP*

INTRODUCTION

Like any other large software systems, information systems that offer searching services from distributed sources are typically built in a modular manner. The components of these systems are grouped together and form software architectures. When the components are heterogeneous the crucial point in putting them together is the way of constructing the interconnections between them.

Nowadays Service Oriented Architecture, implemented by the Web Service technologies, is considered to be the best solution of the problem of software complexity and reusability. SOA is architecture consisted of components and interconnections that stress interoperability and location transparency [1]. These are provided by the base features of SOA: 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. SOA can also be considered as a set of interacting services.

Web Services are the best way of implementing SOA [2]. They provide standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks [3]. They are software programs that use XML as an open standard for application-to-application data exchange, SOAP as communication protocol, WSDL for describing services and UDDI for register and locate services.

The Web service framework is being defined, standardized and supported by the industry at a record pace. It receives broad industry acceptance and standard compliance, which makes it widely applicable [4-7].

Building a large information system, based on SOA, involves in step-by-step developing of comprising services. In order to achieve adequate precision and accuracy, the first stage in developing services should be elaborating abstract and formal models. This paper aims to present an abstract model of service and its application in developing services for searching in distributed databases.

TWO LAYERS MODEL OF A SERVICE

The definition of a service given according to [8] is "a service is an active program or software components in a given environment that provides and manages access to a resource that is essential for the function of other entities in the environment". Thus a service must have network-addressable [1] interface. Through its interface a service can be invoked by an authorized client on a network.

Let's look at how a service acts. The application, implementing the service, receives messages (request) from a client application, performs the necessary operations and returns another message (response), see fig 1.

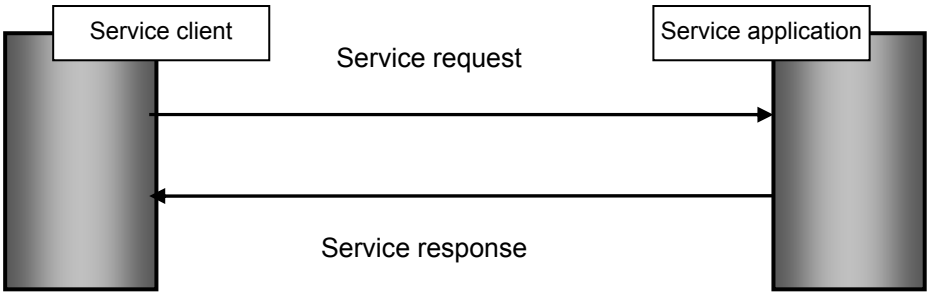

Fig.1. Service Action

Having in mind aforesaid service action, two layers of a service can be outlined: communication layer, receiving and sending back massages, and executive layer, where the core service operation is performed (fig.2).

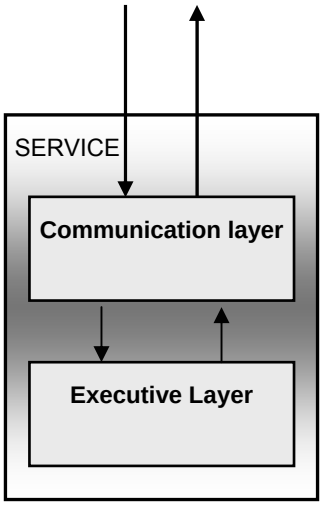

Fig.2. Two layers model of a service

Just the communication layer is the network-addressable interface of the service. Through that interface and in the presence of communication protocol, the service can be invoked and activated by other components. This interface provides not only interoperability of the service, but also reusability. The executive layer presents the semantics of service – its behavior and its functionality.

CONSTRUCTING COMMUNICATION LAYER OF SERVICES

Two ways of implementing communication layer are presented here, considering the proposed layer model of services. The implementations use Web Service technologies WSDL (Web Services Definition Language) and SOAP (Simple Object Access Protocol).

First implementation uses SOAP technology. It consists of two parts – SOAP Client (on the service client side) and SOAP Server (on the service side), see fig.3. The client application (it can be web site for example) contains software module SOAP Client which calls the remote procedure, performing the real service function, by exchanging messages with SOAP Server module. The modules SOAP Client and SOAP Server forms communication layer of the service. The executive layer is the core application, performing the real searching action. SOAP is used as a communication channel.

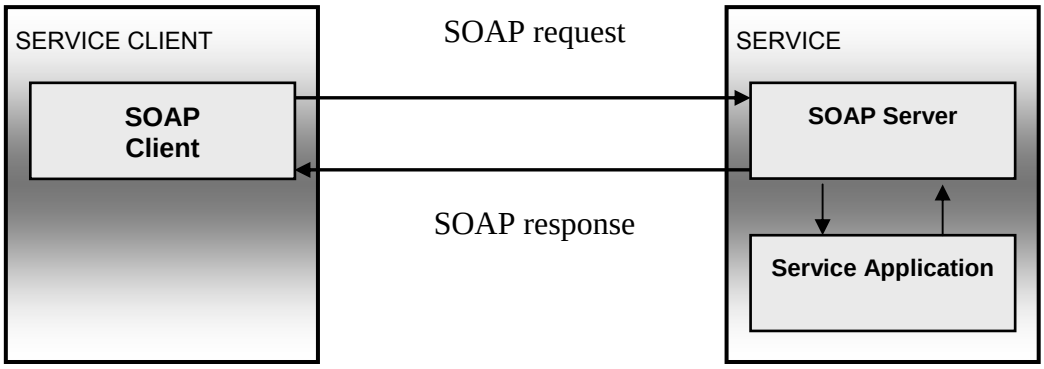

Fig.3. Communication Layer: SOAP Client/Server

The second implementation is similar, but uses WSDL technology to provide suitable interface of the service and to enable it to be invoked through the network (see fig.4). In this case both protocols SOAP and HTTP can be used as a communication channel – it depends on configuration in WSDL document. Using both technologies WSDL and SOAP is very powerful for integrating heterogeneous resources.

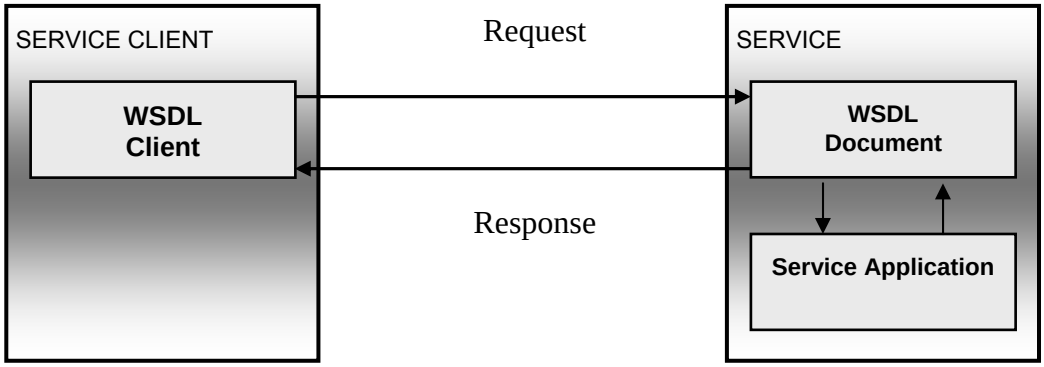

Fig.4. Communication Layer: WSDL Client/Server

SEARSHING SERVICES IN DATABASES

Abstract model of executive layer of searching function is described here. As it was mentioned above the executive layer presents the semantics of service – its behavior and its functionality. It is well-known that the Finite State Machines (FSM) represent a powerful way of describing behavior of a system or a complex object.

Let's take a look at the action of a service for search and retrieval of information from database. When it is called, the function waits for user-entered keyword, and if there is not mistakes in the user input the function performs real searching in the database. At the end the result is produced. Then the service can be run again by another keyword or a set of keywords. Thus three main states of the searching function can be outlined:

- s0 /open/ – the initial state: the searching service is opened and is waiting for keywords; in the case of correct user's input the machines moves to the next state;
- s1 /search/ – performing a search; if it is successful the next state occurs;
- s2 /result./ - it is a final state.

Another state can be included in order to account the case when some operation fails:

- s3 /violation/ – in the case of errors; after error handling the machine moves to the initial state.

All things considered the core searching function can be represented by finite state machine depicted on State Transition UML diagram on fig.5.

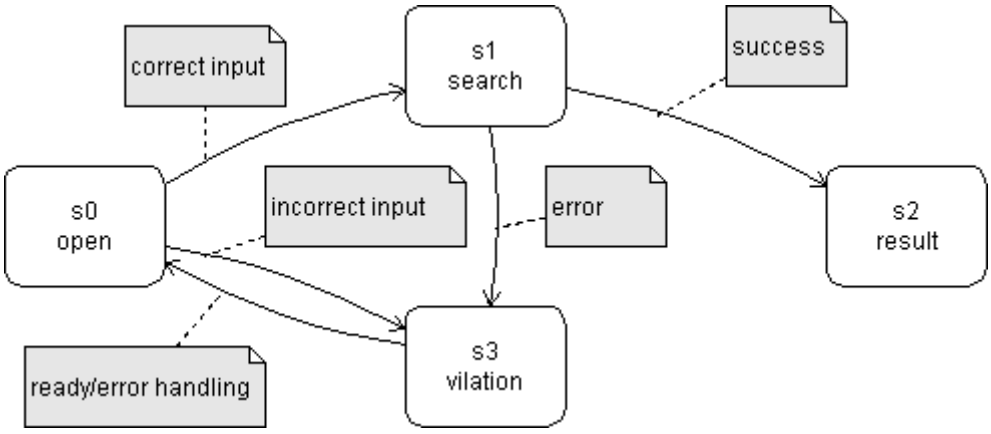

Fig. 5 – Searching function presented by FSM

ARCHITECTURES OF SYSTEMS FOR DISTRIBUTED SEARCH

Three architectures of systems for distributed search are proposed here, having in mind two abstract models of communication layer of service presented above.

Let's consider a database which tables are stored on two machines. When the database is distributed there have to be an approach for communicating between the machines on which the database's tables are stored. According to the idea of Web Services, two methods can be used for communication - SOAP protocol and HTTP/GET. However, SOAP is a typical communication channel, used in Web Service applications. The queries to the database are designed as Web Services. Due to the interoperability of Web Services, the database can be heterogeneous.

First case concerns using SOAP Client/Server model. Program module SOAP Server is loaded on the remote machines, where the tables of the database are stored. That program communicates with SQL server (for example MySQL, MS SQL, ODBC, etc) and thus it operates with data. A Client application may be web site, or independent program, or even it might be wap site (site with WML content accessible through Wireless Application Protocol [9]). This functionality is provided again by interoperability of Web Services. The Client application invokes a remote service or function by communicating with SOAP Server. SOAP is used as communication channel. This architecture is shown on fig. 6.

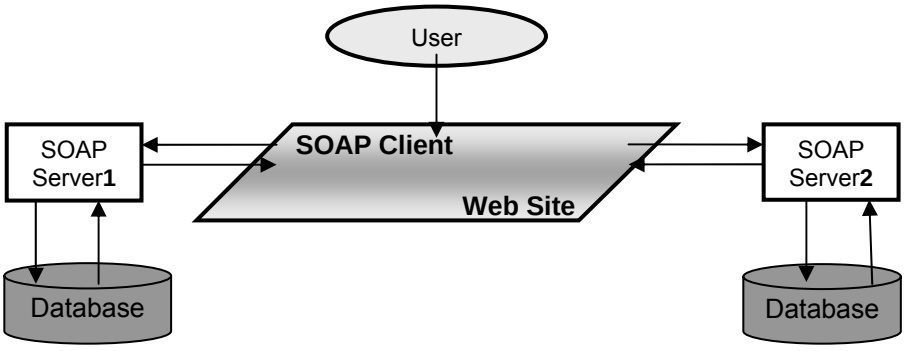

Fig.6. Distributed search using SOAP Client/Server

This architecture can be used successfully in applications serving a single organization, where the databases are for internal usage and it is no necessary to develop WSDL interface of services.

Second and third cases concern using WSDL Client/Server model. The functionality, described in the previous paragraph, can be extended and improved by using WSDL technology. There are two ways for constructing the searching services. The first is using several WSDL documents, according to every machine (fig.7). Actually there are several web services in this case.

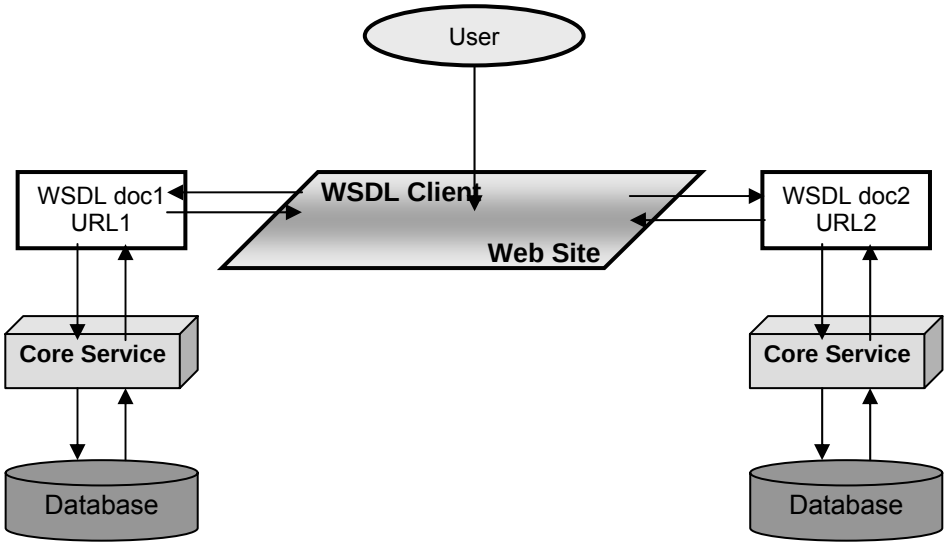

Fig.7. Distributed search using several WSDL documents

That architecture is very suitable for applications, where different organizations support their own databases, but there is a need of distributed search and integration between sources.

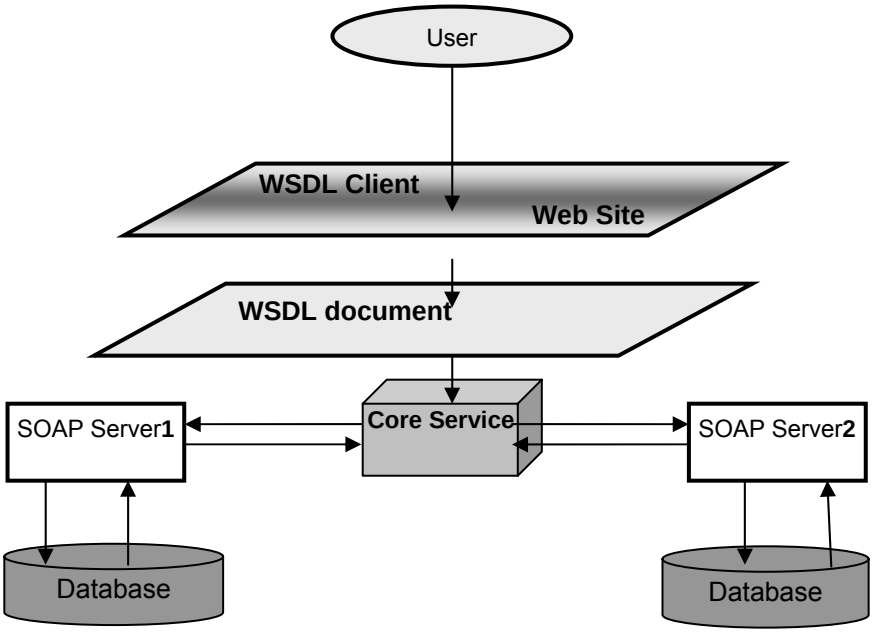

Fig.8. Distributed search using one WSDL document

The third architecture is using only one WSDL file, pointing to the core service, which connects to the machines housing database (fig.8). WSDL file is a communication-layer-description of the searching services and it is performed instead of several SOAP Server programs. WSDL document corresponds to core service application, which in fact operates with data. This is typical distributed Service Oriented Architecture. Between the client application (web site) and WSDL level is the place of UDDI part to discover the services. In this case adding new services and including new locations of the database is more flexible than in the previous two cases.

CONCLUSIONS AND FUTURE WORK

Service was presented by two layers model, consisting of communication and of executive layer. This presentation addresses the need services to be equipped with network-oriented interface in order to achieve interoperability with other components in a complex heterogeneous environment and reusability. Usage of SOAP and WSDL technologies to implement communication interface of searching services was presented. Semantics of such services was described as well as an abstract model for representing it. Three kinds of Web Service architectures for distributed search in databases were proposed.

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