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A Study on Quality Management for Web Service

Dong-Woo Lee[1*]

Dept. Of Computer Information, Woosong University, 226-2, Jayang-dong, Dong-gu, Daejon, Korea
dwlee@wsu.ac.kr

Abstract

Web service is a software system designed to support interoperable machine-to-machine interaction over a network. Currently, it has been EMPHASIZED quality of web services. Many companies and colleges thus are introducing web service-based business processes, being aware of the advantages. For a successful use of a web service-based business process, a way to evaluate the quality of web service and manage the web service application. *Therefore, we described web service models such as SOAP, WSDL, UDDI in this paper. And we analyzed the characteristics of service oriented architecture. Eventually, we presented a management aspect of web service quality.*

Keywords: *Web service, WSDL, SOAP, UDDI, Service-oriented*

1. Introduction

Currently, various information systems of organizations are being linked and integrated in software infrastructure building to be applied in web service technology providing high mutual operation. A web service is a software system designed to support interoperable machine-to-machine interaction over a network 2]. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards [2, 3, 8].

Web services provide a standard means of interoperating between different software applications, running on a variety of platforms and/or frameworks. A WSA(Web service architecture) provides a conceptual model and a context for understanding web services and the relationships between the components of this model. Architecture of the web service is composed of three components such as XML web service broker(UDDI), XML web service consumer, XML web service producer.

A service provider makes a service specification, and it publishes the service specification to service registry. The service provider receives web service call message from service consumer, and it returns the result after the corresponding service was done.

A service consumer finds a service specification published in service registry. And service consumer calls or binds the corresponding service after it searches a service specification provided by service provider.

A service broker manages such as directory to use and to search easily service consumer the provided service

The WSA describes both the minimal characteristics that are common to all web services, and a number of characteristics that are needed by many, but not all, web services. The web service architecture is interoperability architecture: it identifies those global elements of the global web services network that are required in order to ensure interoperability between web services.

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To implement the above described web service architecture, it needs three technology elements such as UDDI, WSDL, SOAP. Figure 1 shows the three technology elements and basic web service architecture.

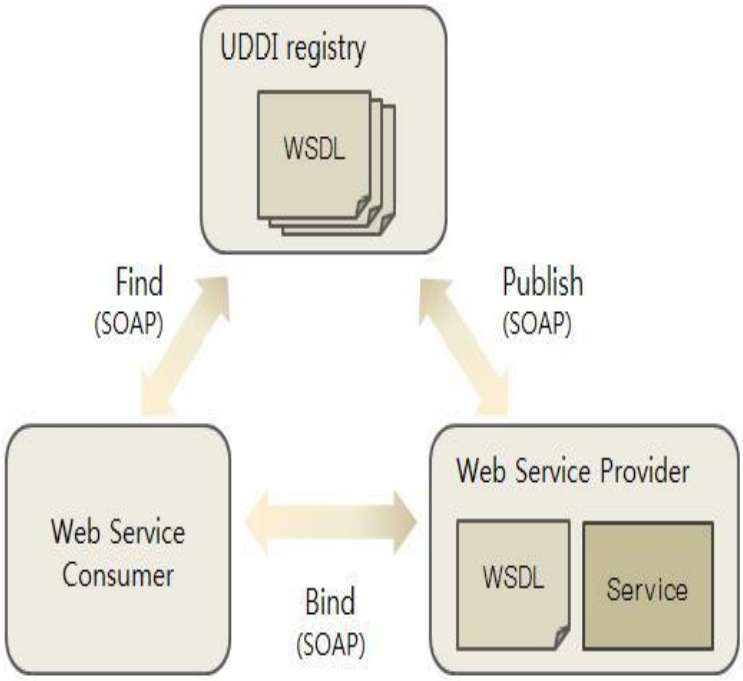

Figure 1. Three Standard Technology Elements and Basic Web Service Architecture

Domestically, convergence of IT839 is planned to be chosen and used. Application can be developed by appropriately combining individual elements of business logic opened to the public through web pages and various operations with same functions can be composed by combining and realizing many web services with small functions.

Computer systems of public institutes and companies must be controlled, but control on the 3rd supplier supplying service is difficult when building application based on web service that assessment on web service quality is essential to provide predictable possibility based on QoS[1][6][8]. Also, integration of dual service modules composed by several forms and research on policies, methods to provide consistent security interface is needed. To increase electronic commerce reliability in web service security, providing authentication, authorization, and digital signature functions is very important. Resources such as web service environment is distributed and remote operation, forwarding environment have high risk in various frauds with exposure of personal information. To build trustworthy system access, service request, identity check for service requests or commerce, it is essential to link technology of user awareness including body information.

Following propagation of web pages, service quality is becoming an important standard of selection to users when assessment on quality on web service is demanded[1, 2, 3]. Standardization models for assessment on web service quality based on OASIS is in progress and WSQM TC being operated as a result. WSDL is providing only functional information of web service to service users [4] and studies on information on QoS of timeout, response time of service specification through expansion of WSDL is in progress as elements on web service performance and stability has become significant.

2. Models of Web Service

2.1. SOAP Model

SOAP(Simple Object Access Protocol) is used as a mechanism to logically deliver messages between described services by WSDL interface. It is a simple architecture in concept to deliver SOAP messages through transport protocol that is set between web services.

SOAP is the oldest, most mature, and most important protocol in web services [3, 5]. SOAP messages are XML documents with route element of envelope. There are two knowledge elements of header and body in the envelope in which there is an application payload in the body and the heather block generally has data from several web service protocols expanding basic SOAP based structure.

SOAP messages provide conceptual basic based on all SOAP models. Application payloads are mostly saved and moved to the body part of messages as additional protocol messages(random matter or unnecessary to be marked when delivering only application data) are saved and moved to heather blocks. This is saved in application level messages and SOAP heather space in SOAP processing level that makes web service protocols of higher level(Ex, transaction process or security) separated.

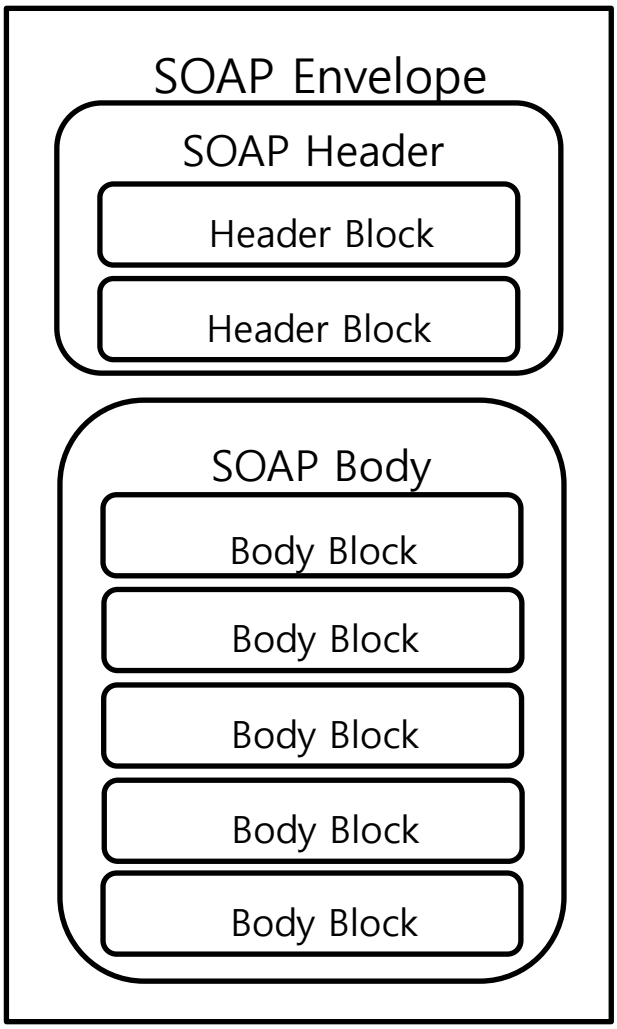

Figure 2. SOAP Message

SOAP is a standard protocol defining certain method of delivering encoded data to XML as a binding protocol. Function to call web service method using XML format is provided. SOAP uses XML as a protocol that is text based of lightweight using information exchange in distribution environment to have the advantage not to be dependent on hardware platform, OS, programming language, and network hardware platform. SOAP messages provide delivering function of one-way messages. All basic SOAP coding is composed of XML schema specifications and provides two grammars for data express type.

2.2. WSDL Model

WSDL(Web Service Description Language) is an XML document explaining summary on the service provided by the web service which is made by integrated SDL specification and standardization is leaded by W3C[3, 4].

The basis of all WSDL interfaces is the gathering of messages that send and receive service behind interfaces. Although WSDL allows using other schema language, it is general for one message to use and define an XML schema type and several logical parts are divided to increase access on context. portType is the place thought to start to make shape of the web service. portType is the gathering of calculation that thinks it will become a web service. However, calculation in this point is still defined in abstract language and several message exchange gatherings are bound in this calculation.

The binding part of WSDL interface describes on how abstractly defined messages and calculations are mapped in physical return protocol. Calculation of portType to be bound to a certain protocol(used in the network again in the end) adds binding related information and is expanded. Thus, WSDL supports SOAP, HTTP GET and POST, MIME, and provides a prototype specialized version on the original portType declaration.

Lastly, port composes service elements with accumulated addressing information and information referring to particular binding, and becomes the final form of web service that can be physically connected by network. The abstract parts of WSDL description are types, message, portType elements, and the actual elements are binding and service. Separation between abstract and actual parts is a useful concept, and this is because interface design can be separated from the final deployment environment and only uses abstract definition in WSDL.

2.3. UDDI Model

There is a growing need for web service providing companies to maintain, manage, and open registry to register server lists and instructions to conveniently search companies and using companies should find partners to provide needed web services as effective tools to search this has become needed.

UDDI is a registry and protocol of web service to publish and search web services[3]. Because web services are standardized tools to independently access and use software functions provided by other companies in platforms, UDDI must also be open and standardized.

Information within UDDI is composed of instance of data structure expressed by XML. Data saved and managed by UDDI node are the instances created by this data structure. These data structures are called entity and the 4 entities are defined in UDDI specification

3. Characteristics on Service-Oriented Architecture based Service Model

SOA(Service-Oriented Architecture) is a software architecture that correlates services, units of application, through the contract between a well-defined interface and services on the basis of the standard interface concepts[7, 11]. SOA is a network-enabled entity

specialized for certain functions, and the service is based on software components binding a set of protocols and behaviors. Since the interface is defined as independent to the hardware platform, operation system, and programming language, any type of services designed for various systems can interact in a general and integrated manner. Service-Oriented Computing makes it possible to develop services of added values by binding the service provider and applicants. Figure 3 shows an SOA-based service model. The roles of major entities are as follows:

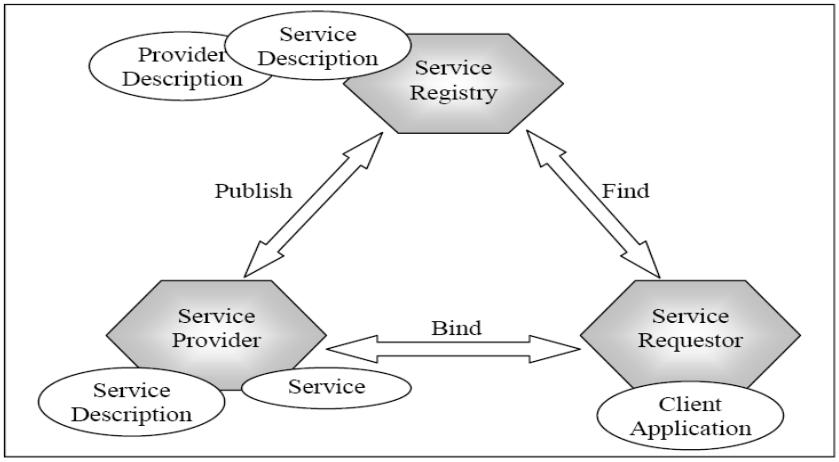

Figure 3. SOA based Service Model

○ Service Provider
- Owner of service in terms of business
- Platform that provides service in terms of architecture

○ Service Requester
- Business that demands certain functions to be processed by a related service
- Client application that finds and calls service in terms of architecture

○ Service Registry
- Owner of service at the registration office in terms of business
- Platform that provides access to registered service information in terms of architecture

Since SOA uses a neutral interface regardless of the embodiment type, services are correlated in a form of loosely coupled service. As to tightly coupled services, various components of the application are closely connected to one another in functions and formations, which make it difficult to modify part or all of the application. In contrast, a system of loosely coupled services is of agility and adaptability to the internal structure of each service and changes in the general embodiment. The following is the major characteristics of SOA:

1) SOA is a way to establish the basis of software designed for a business; thus, it enables applications to exchange data and processes regardless of the operation system or development language.
2) SOA embraces the technical complexity since it embodies the interaction through a standard interface in terms of business process, which is a superior concept to that of development of a unit application.
3) SOA utilizes a standard-based integration technology to connect different types of systems.

Recently, its corporate service started adopting a service module through which a user can deliver demanded service online anytime either independently or through a third party

company. The framework and basis of the Internet-based integrated B2B service is one of the major objects of research. The web service-based system is attracting attention as a method to integrate companies and organizations based on an open-type Internet standard. In particular, the web service system solves Internet-based communication problems between corporate information systems that are common in existing distributed object technologies such as CORBA.

The web service system is a self-describing, open-type component provided by the service provider. Service is available as a basic component for application development.

Web service is a distributed component technology that is recently drawing keen attention as a means to interconnect corporate businesses via the Internet. In a web-service standard environment, a business process of a business entity consists of various modules collected from different sections. Web service forms an integrated system that interconnects and binds such various elements rather than relying on a single complicated integrated system.

A service component, which is a type of service interface with business logic, embodies a modularized service-based application of a single concept. A service component may be expanded, specialized and inherited, or used to generate an application. Table 1 compares the corresponding concepts of CORBA and web service.

Table 1. Comparison of CORBA and Web Service

Concept	CORBA	Web Service
Service definition	IDL	WSDL
Remote Object Call Protocol	IIOP	SOAP
Specification & Discovery Mechanism	ORB	UDDI
Message Format	Binary Message	Text based Message
Interoperability Level	Platform Level	Message Level

In terms of SOA, web service utilizes Internet-based transmission protocols such as HTTP and SMTP to integrate systems, which satisfies pervasive requirements, and provides SOAP protocols based on XML formats and expandable message formats, which meets extensibility requirements for interoperability and open-type functions. Besides, the registry mechanisms based on UDDI (Universal Description, Discovery and Integration), WSIL (Web Service Inspection Language), etc. meets deployment requirements.

In terms of pervasive requirements, web service adopts the message delivery mechanism in accord with Internet standard protocols, but when HTTP is used, the status information to be provided upon request from a client may not be available, which leads to problems of transaction processing and reliable message delivery. In terms of extensibility requirements, web service provides information by means of SOAP, but SOAP format as well may involve various problems such as delay due to XML-based SOAP message parsing, lack of desynchronized messaging, etc. Lastly in terms of deployment requirements, as the kinds and number of web services increase, the demand for dynamic service searching mechanisms for service deployment increases accordingly.

Table 2 compares advantages and disadvantages of web service according to requirements in terms of SOA. For web service and involved function management, a middleware and tools are required. Especially for reliable applications, a service platform and service deployment and application also need to be managed.

Table 2. Web Service Characteristics in SOA Aspect

Requirements	Advantage	Disadvantage
Ubiquity	Internet based standard protocol Access easiness	Transaction process mechanism Security mechanism
Extensibility	Message with various data types	SOAP message process Asynchronous message function
Deployment	UDDI based centralized service registration mechanism	Dynamic service discovery mechanism

4. Web Service Quality Management

When it comes to integrated platforms, web service makes possible advancement into an open-type business model. Many companies and colleges thus are introducing web service-based business processes, being aware of the advantages. For a successful use of a web service-based business process, a way to evaluate the quality of web service and manage the web service application.

In a broad sense, web service quality is determined based on the functional requirements and nonfunctional requirements. Functions to be provided through web service are embodied in accord with WSDL standards in general. In this study, however, the quality of web service is defined based on nonfunctional attributes such as response time, service processing rates, availability, reliability, and security rather than functional attributes for mere access to web service. Service quality is a basis for prediction and management of system resources that may affect the execution performance of an application.

Web service for business entities advances from the initial stage of searching and utilizing web services with similar or same functions to the maturity stage of utilizing web services developed by a third party on the basis of the quality items related to performance and stability. Currently web service is in the level that SOAP and WSDL, basic standard technologies, are utilized for interoperability. Performance quality is partially evaluated according to the characteristics of each company's tasks. Especially regarding security in terms of web service quality, such factors as message messages, confidentiality, authentication, and access control need to be considered when data sets are integrated with other companies through SOAP messages.

ISO/IEC 9126 (Information Technology-Software Quality Characteristics and Metrics), a software quality evaluation model, defines software quality elements and characteristics to measure and evaluate software quality. This model categorizes software quality elements into three layers to quantify them objectively in a development process. Table 3 shows software quality characteristics defined in ISO/IEC 9126 are functionality, reliability, availability, efficiency, portability, maintenance.

Web service quality factors may be divided into two based on the software quality model presented by ISO-9126: actual quality of web service and quality of the application software or product; and quality of web service as a user recognizes while using it. Even if software itself may be a model of appropriate quality, a new software paradigm should be applied to convert the existing installation-based use into service-oriented web service system. In other words, a model of web service quality should be established in view of service quality rather than product quality in consideration of service-orientedness of web service. Web service quality management may be viewed in two different perspectives: that of service providers and that of service applicants.

○ Quality management in service providers' perspective: a series of behaviors to secure a certain level of service provided to applicants

○ Quality management in applicants' perspective: behaviors to confirm if the proper level of service is maintained; monitoring of quality-related contracts

The quality of web service is managed through an architecture that monitors the quality based on the related contract at the time that a service is used between a web service provider and applicant. A designed architecture consists of the step for the service contract between the provider and applicant and the step for service the use of web service.

A web service contract includes the definition of quality of the provider's one or more web services, basic information of the contract, and information of the web service provider and applicant. It also defines requirements to secure the specified level of quality as well as specifications of quality elements.

As to the web service quality contract procedures, first of all, a task appropriate for the web service is selected among one's business processes. After checking if it would be proper to adopt web service for the selected task, the user learns the requirements for the selected business process. Based on the understanding, he defines the requirements for the business process to be designed by means of business process models, use-case models, etc. As to the definition of management object quality, specifically, the quality items and levels of each item are to be defined. Service is designed based on the definition of requirements. Thereafter, whether the introduction of an external service through the contract of service use would be appropriate is examined and confirmed.

In the step of web service contract, a broker that acts as a quality manager mediates the contract.

The contract of quality assurance relates functional specifications of web service to be provided to the applicant, quality items at the time of use, level of assurance, measures for violation, etc. A contract of web service quality, which is a type of service level contract(Service-Level Agreement, SLA), is commonly used. In the step of contract, the selected option for web service to be utilized may be varied depending on the applicant's web service operation environment including embedded system and mobile computing. A list of certain recommended services suitable for the user may be additionally provided.

The contract of web service quality assurance specifies the quality of web service at the time of using the web service. This type of contract is used as item and level specifications regarding the web service quality expressed in XML. The web service quality contract includes general terminologies, objectives, conditions, modifications to the service contract, settlement of disputes, etc. on a business level. It also contains the matrix of each service item, QoS, security, etc. on a service level.

The web service quality contract can be mapped in XML. In the actual step of contract, it may be converted into an XML document and used in the management system for quality management. A service level contract model consists of the quality level specifications of the managed object, the section that officially specifies the quality, requirements upon quality violation, and WSDL of web service that relates quality elements. The quality level specifications include the contract parties' information, and object specifications. Quality requirements define the quality level that the web service provider shall maintain and measures for quality violation. The section of quality level specifications reuses pre-defined QoS parameters. QoS service structure is mapped correspondingly with the existing structure of WSDL. When the performance and stability are measured outside the service platform, they are defined through QoS service.

5. Conclusions

Recently, its corporate service started adopting a service module through which a user can deliver demanded service online anytime either independently or through a third party company. The framework and basis of the Internet-based integrated B2B service is one of

the major objects of research. The web service-based system is attracting attention as a method to integrate companies and organizations based on an open-type Internet standard. In particular, the web service system solves Internet-based communication problems between corporate information systems that are common in existing distributed object technologies such as CORBA.

For these aspects, we described characteristics on service-oriented architecture and quality management aspects on web service.

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Author

Dong-Woo Lee, he received his BS in electronic engineering, MS in computer engineering, and PhD in computer science from Korea University, Korea. He joined the department of computer information science, Woosong University, Korea at 1995. He is currently a professor. His research interests include distributed processing and systems, database, and reactive systems. (Corresponding author of this paper)