QoS based Client information for semantic Web service

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Abstract

Web services have become popular in order to access multimedia stream contents. However, these Web services are not supported with the same quality to Web clients who frequently access multimedia services. Also, ontologies provide meaning to concepts and their relationships for supporting semantic Web Service. This paper proposes ontological technique to apply user level Quality of Service(QoS) that provides two different levels to serve Web service with proper quality by contribution value. Main contribution of this paper is to support user level QoS and to use Ontology for it. Therefore, this work uses an ontology-based approach to organize QoS, enabling semantic classification of all Web services based on domains and QoS attributes.

1. Introduction

Stream service provides multimedia data service for audio and video through it. There are three main characteristics of streaming service. Firstly, a real-time service provides network traffic for continuous content transmission. Secondly, control admission for clients to access contents while maintaining constant service quality. Thirdly, a system requires large disk and other resources.

Before implementing this kind of system, various views are considered. First of all, much research related to QoS is studied about service usability and utility. Also, there are major factors in regards to QoS in Web service: availability, accessibility, integrity, performance, reliability, regulatory, security, etc. To fulfill these requirements, QoS specification within Service Level Agreement(SLA) has been developed. It is a critical part of a contract between client and its Web server, which describes the quality attributes that the service is required to possess.

Many studies related to QoS specification are focused at different levels such as user level, application level and resource level. Most of them belong to the application level. A few QoS studies to support user level are found in [1][2].

In the INDEX project[1], the user-level QoS specification is composed of different user preferences and price models. Reference [2] introduced an XML based QoS Enabling language for the Web. It allows different multimedia application including all the legacy applications on the WWW, to utilize various QoS technology such as middleware, OS and network. In user level, it specified qualitative QoS criteria, user focus of attention, prices for the required services and the price model. Reference [3] designed and implemented a Web-based Internet/Intranet service management system, which can support QoS contracted by users and service provider, using SLA concept. This reference has defined the suitable QoS parameters for the management of Internet/Intranet management using Java and CORBA technologies, so that various benefits of these technologies such as platform independence and scalability can be obtained. Additionally, the QoSOn[4] aims to promote consensus on QoS concepts, by providing a model which is generic enough for reuse across domains.
This paper introduces how to combine QoS specification and ontology language to serve guaranteed semantic Web service to clients. It specifies domain ontology to support semantic Web service and QoS ontology to be applied user level QoS.

2. Web service QoS

Web service technology is becoming increasingly popular because of its potential in many areas. At the present time, Universal Description, Discovery and Integration (UDDI) based lookups for Web services are based on the functional aspects of the desired Web services. The goal of this initiative is to build an open, global, and platform-independent framework to let business entities find each other, define how they interact with the Internet, and share a global business registry.

And, the use of ontologies in computing has gained popularity in recent years for two main reasons: interoperability, and machine reasoning. The ontology is a set of concepts, their properties, and the relationships between them. The ontology typically consists of a hierarchical description of important concepts in a domain, along with descriptions of the properties of each concept. Web Ontology Language (OWL) is an XML-based language for describing ontologies and OWL-S is an ontology for services created by the DAML group.

In order to implement QoS dimensions, quality information is added to general Web services. The following figure explains how the quality information combines UDDI core content. The Meta model for extended UDDI Core Content Model including the quality information is shown in Fig 1.

![Figure 1. Meta model for extended UDDI Core Contents](image)

3. System

3.1. System Architecture

This is the architecture of the whole system to access a stream server from the Web client through its Web browser.
In this system, QoS Proxies and OWL Processor play important roles. The QoS Proxies has three functions: monitoring, negotiating, and resource managing. The OWL Processor processes ontology that consists of QOS profile and domain with OWL API and Reasoner. A typical implementation would employ an OWL parsing library such as Jena for that purpose. Jena provides a dynamic object model in which OWL classes, properties and individuals are stored using generic JAVA classes like OntClass and Indiviudal. The reasoner is a service that takes the statements encoded in an ontology as input and derives new statements from them. In particular, OWL reasoners can be used to reveal subclass/superclass relationships among classes and determine the most specific types of individuals and detect inconsistent class definitions.

3.2. Principles of QoS application

The subscriber information managed in a Web server generally consists of human statistic data (such as age, gender, address, etc.) and service related specific data (such as service fee, service duration, number of server connections, total service hours, number of service requests for each content, etc.). A contribution value represents how much client contributes to this server. For this process, the following factors are considered and points for each factor are given: payment, service time, service request frequency[5].

The following have been assumed for the calculation of the contribution value of client. First, Wf, Wd, Wt are weighted values for each factor and equation Wf + Wd+ Wt = 1 (where, Wf = Wd+ Wt ).

Second, subscribers are grouped into the super class and the base class. Third, CVi is contribution value for client and the range is 0 ≤ CVi ≤ 100.

\[
CV_i = W_f \frac{100}{N} \sum_{p=0}^{N} p \frac{N_p + F_s(x - F_{value_s})}{\kappa} + W_d \frac{100}{N} \sum_{t=0}^{S} t \frac{F_t - S_{value_t}}{\eta} + W_t \text{per_score}(i,t)
\]
There are attributes for calculation of contribution value. The N means total number of subscribers and index i is between 0 and N. The p means fee index and s means service time index per one subscriber. The Fvalue and Svalue are lower limit of internal containing x and number t respectively. Also, the Fx and Ft are numbers of subscribers in the interval containing fee x and number t respectively. The $\kappa$ is size of interval and $\eta$ is size of service time. The $N_p$ is number of paid subscribers and $S_t$ is number of subscribers served for t hours.

3.3. OWL Design

In this section, it describes user level QoS attributes that is applied in this system, which are visualized in UML class diagram and written in OWL. A UML profile is a collection of stereotypes, tagged values and custom data types used to extend the capabilities of the UML. The UML profile is used for modeling QoS ontology.

![UML profile for QoS based on client information](image)

This is the OWL structure to describe user level QoS which was proposed in this study. The “owl:Class”, “rdfs:subClassOf” and “owl:DatatypeProperty” are used to represents classes and relationships between them.

```xml
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xmlns:owl="http://www.w3.org/2002/07/owl#">
    <owl:Ontology rdf:about="xml:base"/>
    <owl:Class rdf:ID="user_class">
        <rdfs:comment>User classes are divided into two classes.</rdfs:comment>
    </owl:Class>
    <owl:Class rdf:ID="super_class">
        <rdfs:subClassOf rdf:resource="#user_class"/>
    </owl:Class>
    <owl:Class rdf:ID="base_class">
        <rdfs:subClassOf rdf:resource="#user_class"/>
    </owl:Class>
    <owl:DatatypeProperty rdf:ID="payment">
        <rdfs:domain rdf:resource="#user_class"/>
        <rdfs:range rdf:resource="&xsd:string;"/>
    </owl:DatatypeProperty>
    <owl:DatatypeProperty rdf:ID="servicetime">
        <rdfs:domain rdf:resource="#user_class"/>
        <rdfs:range rdf:resource="&xsd:string;"/>
    </owl:DatatypeProperty>
    <owl:DatatypeProperty rdf:ID="service_request_frequency">
        <rdfs:domain rdf:resource="#user_class"/>
        <rdfs:range rdf:resource="&xsd:integer;"/>
    </owl:DatatypeProperty>
</rdf:RDF>
```
3.4. Evaluation

There are several dimensions to consider QoS on Web service. This study is focused to increase performance by collecting user information to access Web service. In general, QoS dimensions are broken into three parts as Fig. 5.

![Figure 4: Object Modeling for QoS Dimensions](image)

The following equations are to get each value to consider three aspects from client information. First is to obtain acceptance rate by request number. There are two kinds of classes such as super class and base class. The service request number is divided by total requests number called acceptance-rate. Second is ratio of resource utilization for performance, which is $\frac{\sum NetTraffic(t)}{\sum MaxTraffic}$. Where, the NetTraffic(t) means the maximum network traffic that occurred in time t and the MaxTraffic represents the maximum network traffic in NetTraffic(t). The performance of each model is evaluated by measuring work implementation time of N times. The processing time is expressed as TCSTh which is $N*(2* DReq / RTh + 1/ RWork)$. It explains each attribute to calculate the processing time. The DReq means size of the message that a client requests to the server. And, the RWork means Work throughput at the client. It is assumed that the ratio follows the exponential distribution with fixed values. The RTh means transmission throughput when message moves on the network.

In Table 1, we compare this study with other research in regards to QoS specification by using XML or OWL.
## Table 1. Comparison among QoS research

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### 4. Conclusion and Further Study

The proposed model combines semantic Web service and QoS Service based on client information. The main functions in this system are to design ontology to guarantee QoS with client information to access Web server. The QoS Proxies in this system processes monitoring, negotiating and resource managing.

This study contributes to implement semantic Web service framework in regards to QoS attributes extracted from client information.

Currently, we are in the process of designing the system that supports the approach discussed in this paper. As part of our future research, we intend to implement the proposed system. Furthermore, we intend to support certain QoS dimensions such as security.

### 5. References


Authors

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