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Client level QoS/SLA Management using UML and Ontology

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UML과 온톨로지를 이용한 고객 등급 QoS/SLA 관리

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Abstract

According to increasing of accessing multimedia stream contents, Web services have become popular. However, these Web services are not supported with the same quality to Web clients who frequently access multimedia services. This paper proposes ontological technique to apply client level Quality of Service(QoS) that provides two different levels to serve Web service with proper quality by contribution value. And, it describes with UML(Unified Modeling Language) how to relate QoS and SLA(Service Level Agreement). Main contribution of this paper is to support client level QoS and SLA and to use Ontology for it. Therefore, this work uses an ontology-based approach to organize QoS and SLA, enabling semantic classification of all Web services based on domains and QoS and SLA attributes.

▸ Keyword : QoS, Semantic Web Service, Ontology, SLA

요 약

멀티미디어 스트림 콘텐츠의 접근이 늘어남에 따라 웹 서비스가 매우 많이 사용되고 있다. 그러나, 웹 서비스는 자주 방문하는 사용자에게 매번 동일한 품질의 서비스를 제공하고 있지 않다. 따라서, 이 논문은 고객 등급 QoS에 접근하는 온톨로지를 설계한다. 이를 위해 사용자의 기여도에 따른 웹 서비스의 2가지 등급을 제공한다. 그리고, 본 논문은 이러한 QoS 프로파일과 SLA의 관계에 대해 UML 언어를 통해 기술한다. 본 논문의 가장 큰 의의는 고객 등급 QoS와 SLA, 그들 간의 관계를 지원하고, 이를 위한 온톨로지를 사용하는 것이다. 이것은 QoS와 SLA를 구성하는 온톨로지 기반 접근으로 웹 서비스의 의미적 분류를 가능하게 할 것이다.

▸ Keyword : QoS, 시맨틱 웹 서비스, 온톨로지, SLA

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※ 이 논문은 2010년 한국컴퓨터정보학회 제42차 하계학술대회에서 발표한 논문("UML 기반 SLA과 QoS 프로파일 통합")을 확장한 것임

Ⅰ. Introduction

According to increasing of accessing multimedia stream contents, Web services have become popular. Whenever clients access to Web, who get to serve high quality of service. However, it is not allowed to serve all clients. because many clients try to access to them at same time, Stream service which provides multimedia data service for audio and video have 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.[1]

Generally, relative works with QoS are researched about service usability and utility. On the other hands, there are major factors for considering QoS in Web service: availability, accessibility, integrity, performance, reliability, regulatory, security, etc. For that, QoS specification within SLA has been specified in various ways. 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. An SLA is the documented result of a negotiation between a customer and a service provider, or between service providers themselves, that specifies the levels of availability, serviceability, performance, operation, or other attributes of the service. SLAs can help encourage customers to use new technologies and services as they provide a commitment from the service provider to guarantee specifies performance levels[2]. Also, UMLat the beginning was used as the integrated methodology for software development, but now it is used more frequently as the modeling language of various objects. Currently, UML supports various diagrams for object-oriented analysis and design like class diagram and is widely used as a tool of creating various database schema and object-oriented codes from them.

This paper proposes ontological technique to apply client level QoS that provides two different levels to serve Web service with proper quality by contribution value. And, it describes how to relate QoS and SLA by UML. Main contribution of this paper is to support user level QoS and SLA and to use ontology for it. Therefore, this work uses an ontology-based approach to organize QoS and SLA, enabling semantic classification of all Web services based on domains and QoS and SLA attributes.

Ⅱ. Related Works

2.1 QoS

Reference [1] 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. Reference [4] introduced an XML based QoS Enabling language for the Web. It allows different multimedia application including all the legacy applications on the Web, to utilize various QoS technology suchas middleware, OS and network. Reference [5] designed and implemented a Web-based Internet/Intranet service management system, which can support QoS contracted by users and service provider, using SLA concept. Reference [6] evaluates the QoS ontology research work currently available, and presents an initiative to create a unified ontology.

2.2 SLA

Reference [7,8] apply apolicy to the differentiated control model for the field of HTTP protocol connection management. The history based policy is applied to categorize subscribers into the super class and the base class, and the Latest recently-frequently request algorithm is applied. Reference [9] designed and implemented a Web-based Internet/Intranet

service management system, which can support QoS contracted by users and service provider, using Service Level Agreement concept. This reference has defined the suitable QoS parameters for the management using Java and CORBA technologies.

III. Client level QoS and SLA

This study is defining two ontologies simultaneously: a QoS ontology and a SLA ontology. The QoS includes those terms strictly related to quality of service, such as Metric, Characteristic or Value. The SLA ontology is supported by the QoS ontology and represents all the terms that are necessary to define a SLA, define off offers and requirements and perform dynamic selection between different service offers.

3.1 QoS

The main concepts and requirements belonging QoS field have been selected from the definition made in previous works and extended by the result of internal discussion.

① Characteristic or Attribute(e.g.:Delay)

It represents any attribute of a service related to its quality.

② Value or Measurement

It is the result of measuring a characteristic using a metric.

③ Metric

It is a method to measure a characteristic.

④ Function

It is related Metrics. Also, it can be represented as concepts, rules in a rule language or both.

⑤ QoS profile

It is a set of metric values for a service and defines a set of SLO(Service Level Objective).

3.2 SLA

① Quality

It is only a part of a service.

② SLO

It is called Assertion or Constraint. It drives capability and requirementby a value(e.g.: threshold, range) for a Characteristic of a service using a metric..

③ Assessment(Match/Mismatch)

It specifies a relationship between two profiles/service levels.

④ Match

It relates between profiles(e.g. an advertisement and a request). It specifies the grade of matching for comparing with other Matchs.

3.3 Generation of Ontology

This process is composed of seven steps that allow the generation of the ontology.

[Step 1] It determines the domain and scope of the ontology

[Step 2] It considers reusing existing ontologies.

[Step 3] It enumerates important terms in the ontology.

[Step 4] It defines the classes and the class hierarchy.

[Step 5] It defines the properties of classes and the class hierarchy.

[Step 6] It defines the facets of the slots.

[Step 7] It creates instances.

IV. System

4.1 System Architecture

This is the architecture of the whole system to access a stream server from the Web client through its Web browser.

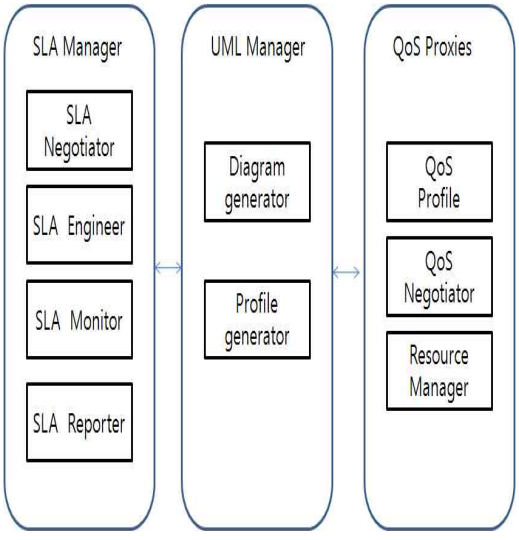

Figure 1. System Architecture

In this system, QoS Proxies, SLA Manager 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. The SLA manager has four functions: negotiating, engineering, monitoring, reporting

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. 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[10].

4.2 Client Request Filtering Policy

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. By this policy, there are two levels for Web service: super level and base level.

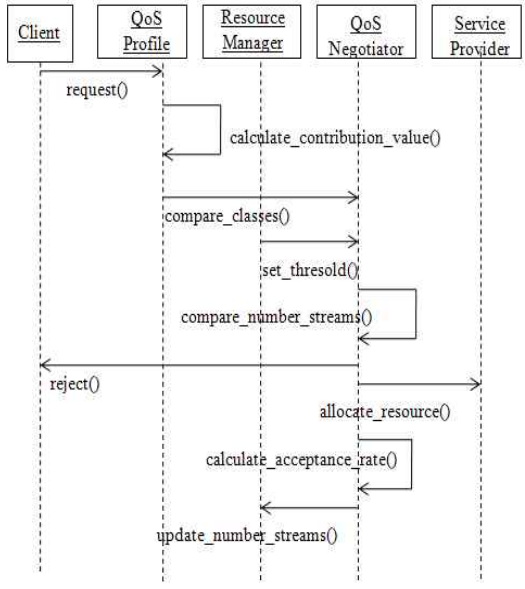

Figure 2. UML Sequence Diagram by Client Request

4.3 QoS and SLA Management

In this section, it describes client level QoS/SLA Management. There are three functions(Client level QoS Performance Assessment, QoS/SLA Violation Management, Reporting management).

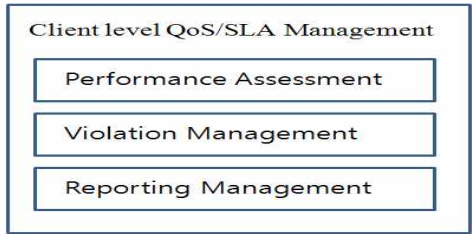

Figure 3. Client level QoS/SLA management

There are two kinds of QoS profile. One is for provider of web service. The other is for requester.

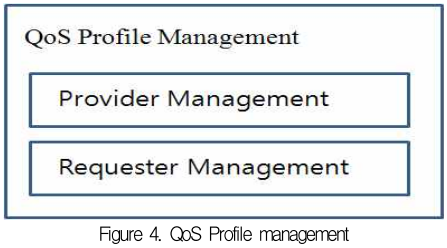

Figure 4. QoS Profile management

In this section, it describes client level QoS/SLA attributes that is applied in this system, which are visualized in UML class diagram.

4.4 UML and Ontology for QoS/SLA

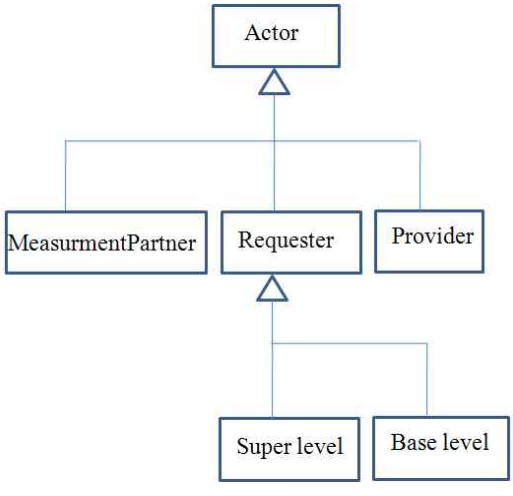

Figure 5. UML for Actor in QoS/SLA

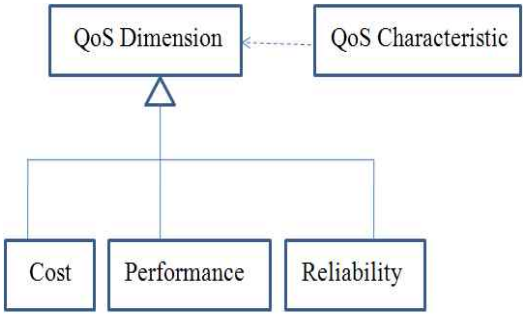

Figure 6. UML for QoS Dimension

This is the part of OWL structure to gather client information. which was proposed in this paper.

```
:
<owl:DatatypeProperty rdf:ID="payment">
<rdfs:domain rdf:resource="#client_level">
<rdfs:range rdf:resource="&xsd:string"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="service_time>
<rdfs:domain rdf:resource="#client_level">
<rdfs:range rdf:resource="&xsd:string"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty
rdf:ID="service_request_frequency">
<rdfs:domain rdf:resource="client_class">
<rdfs:range rdf:resource="&xsd:string"/>
</owl:DatatypeProperty>
<rdf:Rdf>
:
```

4.5 Comparison

This is a table to compare this study with other projects in the field of QoS.

Table 1. Comparison among projects

Project	Characteristic
INDEX project	Different user preferences, price models
METERO-S project	QoS dimensions (time,cost,reliability)
This study	QoS Dimensions (time,cost,performance) Different user levels

V. Conclusion

The proposed model combines QoS and SLA ontologies based on client information by using UML diagrams. The main functions in this system are to design ontology to guarantee QoS and SLA with client information to access Web server. The QoS Proxies in this system processes monitoring, negotiating and resource managing. The SLA manager supports negotiating, engineering, monitoring,

and reporting.

This study contributes to implement semantic Web service framework in regards to QoS attributes extracted from client information. Also, it supports SLA managing functions.

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.

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