QUALITY OF SERVICE BASED WEB SERVICE SELECTION: AN EVALUATION OF TECHNIQUES

Rigga Widar Atmagi, Munjiah Nur Saadah
Department of Informatics, Faculty of Information Technology, Institut Teknologi Sepuluh Nopember ,
Surabaya, 60222, Indonesia
Email: godofodin@gmail.com, mociymociy@gmail.com

ABSTRACT

In service oriented computing, web services are the basic construct that aims to facilitate building of business application in a more flexible and interoperable manner for enterprise collaboration. One of the most promising advantages of web service technology is the possibility of creating added-value services by combining existing ones. A key step for composing and executing services lies in the selection of the individual services to use. Much attention has been devoted to appropriate selection of service functionalities, but also the non-functional properties of the services play a key role. A web service selection technique must take as much as possible the important influencing aspects into account to the selection processes in order to minimize the selection efforts. This paper evaluates several web service selection techniques published in literature with the focus on their contributions to web service selection. The evaluation results may be used as a basis for improving web service selection techniques that may simplify the selection tasks.

Keywords— *Web services, QoS, Service Lifecycle Management, Web Service Broker, UDDI, Web Service Selection Architecture, Web Service Selection Technique, Dynamic Selection of Web Services*

I. INTRODUCTION

Web Service is a software component invoked over the Web via an XML message that follows the SOAP. It is powerful for organization and enterprise-scales applications because it can pass through organizational boundaries [1] [2]. Selection of appropriate web services is an important step in development of composite applications. Quality of Service (QoS) data characterizing nonfunctional properties of candidate web services are usually used in web service selection[3][4].

There are various architectures and techniques that have been proposed from a very simple way until the latest ones that apply some formal or complex techniques.

This paper aims at evaluating several recent web selection techniques that have been published in literature. The evaluation focus is primarily on the capability of the techniques in supporting web selection. The initial results obtained by this evaluation can be used to indicate to what extends each approach has a capability to support web service selection. Consequently, the results can be used as a basis for improving the current techniques related to their support for web service selection. In addition, the evaluation results may also outline the desired criteria for a more holistic approach in web service selection technique.

This paper is organized as follows: Section 2 provide a brief description on the state-of-the-art architecture and web service selection techniques. Section 3 presents the evaluation framework that is utilized to evaluate the techniques. Section 4 discusses the evaluation results as well as the rationale behind them. Section 5 presents the discussion from overall results, while Section 6 explains threat of validity relating the evaluation results. Finally, Section 7 presents the conclusion.

II. OVERVIEW OF ARCHITECTURE AND TECHNIQUE

There is a process known as service discovery that was conducted by a service provider or broker. In this paper, this is included in architecture domain. The development of architecture is accordance to the development of service selection techniques.

We reviewed about of recent papers relating architecture and web service selection topics. We resume here the architecture and web service selection techniques, which will be further evaluated.

A. Web Service Selection Architectures

According to Liavarasan[5] and Maximilian[6] [7] research, architecture of web service selection that have been identified, namely customer as selector architecture, the QoS based Web Service Broker as selector, and the QoS enhanced UDDI as selector.

1. Customer Broker as Selector

The first architecture allows customers to choose a web service. The customer is the actual customer or web services using other web services. Selection mechanism handed over to customer.

2. Qos Based Web Service Broker as Selector

The second architecture is the QoS based Web Service Broker as selector. The consumer will send a request that contains the desired functionality, selection preferences, and QoS requirements to the Web Service Broker. The Web Service Broker will provide the address of the appropriate web services so that consumers can directly access the address.

3. Qos Enhanced UDDI as Selector

The third architecture is the QoS enhanced UDDI as selector. This method is similar to QoS based Web Service Broker as selector, but the Web Service Broker is replaced with a QoS enhanced UDDI registry.

The generic form of web service selection architecture is presented in the following section.

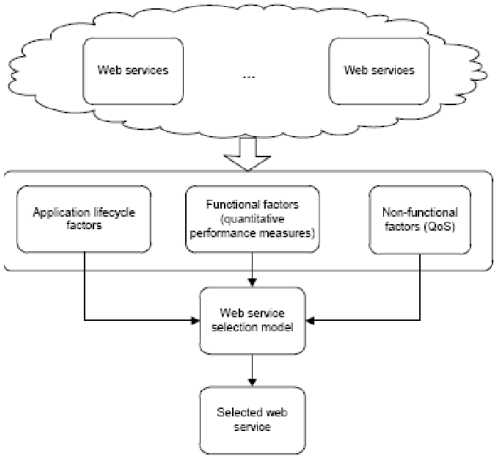

Figure 1 Generic Form of Web Service Selection Architecture

A. Web Service Selection Techniques

We reviewed about of recent papers relating web service selection topics. Based on them, we interested in two techniques that include specific subject, i.e. they put dynamic selection mechanism to perform web service selection. We resume here the web service selection techniques, which will be further evaluated.

1. Dynamic Selection Of Web Services With Recommendation System (DSWS)

User describe theirs need into semantic document form. These needs may vary according to the criteria of the service. Furthermore, service provider also register services what they offer. Service's service provider also contains the QoS parameter and saves into semantic document form. Next approach initiated by semantic matcher engine. This machine will match the consumer's request for documents semantics of services. Matching result is a list of web services order by match point. This list will be given to the recommendation system. The recommendation system based on its learning through users' feedback orders the list and presents to the user. Each component of the list, finally provided to the user, may be a single service or a composition of registered services. The user can select a service from this list. After the execution is over, the user may provide a rating to this service using given metric. This rating indicates user's satisfaction level. It is stored in a repository and used as an input to the recommendation. Konstatinos[8], Manikrao[9] and Le-Hung Vu [10] also proposed method where consumer will get a selection of web recommendation service in accordance with the previous consumer satisfaction ratings.

2. Agent-Based Adaptive Dynamic Semantic Web Service Selection (AADS)

In the classical SOA, the caller service will bind to a particular service after selecting the appropriate one. However, the selected service may be changed frequently by its provider. Sometimes it can't even be invoked due to unreachable hosts or failed networks. Therefore, an intelligent agent is required to handle the changing environment. The service agent can help the software application select the optimal services dynamically at real-time and bind the service adaptively without human's intervention. Figure 2 describe how AADS works.

Jing li [14] propose this approach as consumer-agent maintains the list of candidate services and adaptively selects the "right" service according to the real-time subscription information.

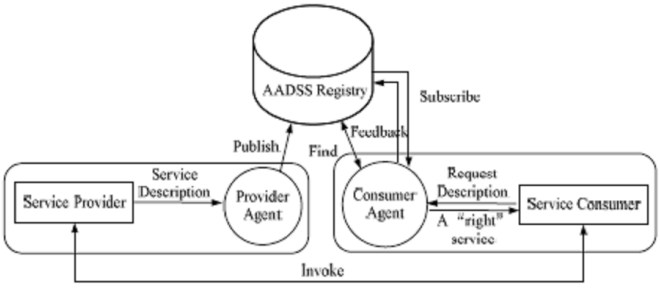

Figure 2 AADS Scheme

B. Relationship between Architecture and Techniques

Architecture and implementation of web service selection techniques have associated relationships. Architectures have different levels of complexity. It is also influence the selection of techniques used. If the web service selection techniques have a high complexity, then required architecture should also be able to support these techniques.

Usually architecture is built using a different platform. Platform differences also affect the election results web service. A platform architecture that is used only occasionally matches a particular technology. So that any kind optimal technique is, may not generate optimal results.

III. EVALUATION FRAMEWORK

Ladan[11] proposed service quality metrics that are more simple than those in the Yao Wang[12]. Yao wang's approach is complex and complicated method but has a very complete metrics. Ladan divides into service quality criteria such as performance, reliability, integrity, accessibility, availability, interoperability, and security. Criteria are referred to as service criteria. Satya[13] on his research has conducted an assessment of the various types of service selection method based on the quality of service. Assessment conducted by Satya generates a significant number of criteria. Table 1 describes these significant criteria.

TABLE 1 SIGNIFICAT CRITERIA

No	Specification	Descriptions
1	QoS Modeling	Specify the modeling language used. Such as WSML and its variants WSML – Core, DAML, WSML – Flight, WSML – Rule, WSML – DL and WSML – Full. Generic type is called by semantic ontology.
2	Consumer Preference	Describe the varying preferences for the non-functional criteria specified by the service consumer
3	Aggregating the evaluation of QoS	This deals with aggregating individual scores to gain a final score for the service.
4	Level Automation	States the level of automation mechanisms. The options are: 1. A – Fully automated, 2. SA – Semi automated, 3. NA – Not applicable.
5	Agent Involvement	State whether agent participation is involved in the process of service selection mechanism.
6	Ranking Algorithm	A service rank is a quantitative metric that shows the "importance" of a service within the process of service selection mechanism to rank the services.

IV. EVALUATION OF TECHNIQUE

This section describes a comparative evaluation of various QoS-based web service selection techniques. The evaluation focus is primarily on their capability to support QoS criteria. The initial results obtained from this evaluation can be used to indicate to which extent an approach satisfies some features in term of its support for web service selection.

1. Qos Modeling

This approach using a model based on semantic QoS ontology. DSWS specifies the user requests a service description through DAML (DARPA Agent Markup Language) documents. DAML input obtained from a service WSDL document. It matches the DAML description of user requirements with the DAML description of a web service to find a matching service.

AADS also propose a modeling approach using semantic QoS ontology. Any semantic Web Service description language will be accepted by AADS framework, if it contains the information seems like WSDL such as operation name, parameter, data type, and QoS References like respond time or reputation. As far as know, web service description depends on AADS registry.

2. Consumer Preferences

DSWS and AADS accommodate user preferences to improve the accuracy of search results. Two methods here need input from user what web service is needed. These inputs are such as operation names, service objective, data type parameter, respond time, threshold matching point and output parameter.

Domain consumer preferences for DSWS are functional and the nonfunctional requirements, agreements, contracts and interface of a service.

Domain consumer preferences for AADS are depend on what AADS registry.

3. Aggregating The Evaluation Of Qos

DSWS deals with aggregating individual scores to gain a final score for the service. This approach provides value to each criterion that matches the selection process using semantic matcher engine.

AADS deal with aggregating individual rating based feedback score to gain final score for the service. That score is not final value. That score will be order by maximal reputation.

4. Level Automation

DSWS and AADS are semi-automated because it needs consumer involvement. These approaches provide result based on consumer input. Human intervention may involve selecting QoS parameters used for selection, and changing preferences. But semi – automatic process involves little human intervention.

5. Agent Involvement

DSWS utilize no agent in selection mechanism.

AADS utilize an agent. This agent works real time to select the appropriate web service if selected web service is changed.

6. Ranking Algorithm

DSWS deal with ranking algorithm. DSWS will sum the values of user satisfaction, functional suitability and compatibility the desired quality of service. The accumulation of value will be used to determine the rank a service

AADS deal with rating algorithm. AADS get the rate from user feedback after using the service. Service ranking is determined based on the accumulated rate from all the users.

It can be summarized on Table 2, result evaluation feature web service selection.

TABLE 2 RESULT EVALUATION FEATURE WEB SERVICE SELECTION

	DSWS	AADS
QoS Modeling	semantic QoS ontology	semantic QoS ontology
Consumer Preferences	accommodate	accommodate
Aggregating the evaluation of QoS	aggregating individual scores to gain a final score for the service	aggregating individual rating based feedback score to gain final score for the service
Level Automation	Semi-automated	Semi-automated
Agent Involvement	No agent	Semantic matcher agent
Ranking Algorithm	Accumulate point ranking algorithm	Accumulate rating feedback algorithm

I. DISCUSSION

It can be concluded that most approaches contribute specific aspects to the overall picture of service selection, which requires methods for expressing user requirements, expressing service offerings and also the actual service selection method. Approaches tend to concentrate on specific of these areas and employ a variety of techniques to do that. It is more appropriate to make some suggestions for future developments in the area of selection approaches.

Important aspects that need addressing are powerful mechanisms to capture user requirements that are both user friendly and also expressive enough to capture large numbers of preferences and the logical relations between preferences. One aspect that falls into this area is the measuring of weights. Also, in the process of capturing the needs of users, their preference of data, research has to show interest and capability to automatically capture this, to reduce the burden on the user part, and to react to changes in circumstances automatically.

Modeling conducted by the two selection techniques web service has been very good. Semantic ontology was chosen because it is able to accommodate your searching based on the context. Currently, the search based on context is recognized well than searches based on the syntax. Semantic models also have benefits for recommendation web service case.

In the overall results of modeling web service, it is very difficult to determine which web service will be selected. Furthermore in DAWS, that technique not only uses semantic matching but also utilize by recommendation system. The semantic matching will be generate an appropriate one web service, if this is not, results is compared by each rating to determine ranking. The top rank in results is selectable web service.

Those scenes have impact in positioning web service. Web service with better quality of service will get more rating than other service which offers same functionality but poor service quality.

In DAWS is very difficult to determine a web service from web service pool with high similarity when each web service does not provide rating. This is not applicable and describe clearly yet on paper. Consumer client must provide request in DAML form for this techniques. This conversion is not user friendly yet.

Consumer suitable to use this technique if selected web service did not change often enough. If not, consumer will be bothered to make a request, select the web service and re-register the rating after using it.

The other technique seems like more advanced. AADS describe and divide selection web service into four phases. Each phase has unique objective. Phase one is clustering based service discovery. It clusters all the services according to their name properties, and extracts a tag for every cluster. It minimizes time process because generating the relative service list before concepts matching can decrease the number of the services that should be considered. Unlike DSWS, if result service discovery is large, so it will take time much longer. Phase one is focused on efficiency of service discovery.

Phase two is Ontology based Service Function Matching. Output this phase is matching point. Furthermore is phase three and four, QoS Based Service Filtering and Reputation Based Service Selection.

On phase three, Consumer-agent filtrate the unsatisfied service. Once consumer invokes the service, if invoking is successful, consumer-agent will update the QoS measures according to the real value; if invoking is failing, consumer-agent will not update the QoS measures, but decrease the reputation value of this service as a punishment. On phase four, Consumer-agent filtrate the poor reputation web service.

As we know four phase in AADS, cover the crucial domain so good. This is good solution, while DSWS didn't cover this yet. Time consuming of DSWS is increases with the number of results service discovery whereas resource consuming for AADS is more than DSWS because, it need resource computing more.

II. THREAT TO VALIDITY

In this section, we discuss the threats to validity on the design and results of our evaluation.

Firstly, we use simulation to evaluate our evaluation paper. Simulations have been used in many engineering disciplines to compare different techniques, in both research and practice. We have tried our best to model the major factors that may affect the comparison results in the evaluation design, such as the failure rates of service providers and the random selection of initial service providers.

Next, we set up the initial scenarios as randomly as possible to avoid bias. The random setting may be good for comparing techniques but may not represent a general setting of the Internet.

We only compare our approach with a baseline (the random) technique in our evaluation, which show that our approach can effectively alleviate the evolving quality problem. Comparison with other techniques will not invalidate this reasoning.

Finally, in the evaluation, we assume that the environment does not affect the failure rates of candidate services. The study of context dependencies of services is a question that we shall investigate in the future.

III. CONCLUSION

In this paper, we have presented the evaluation of state-of-the-art web selection techniques, especially in the context of web selection technique. We have evaluated the techniques using criteria QoS web service framework in brief way, especially in their support for web service selection schemes.

The matching service can be a single service or composition of registered services. The recommendation system is based on user feedback and collaborative filtering techniques. It helps the user in selecting a web service from a set of similar services.

The results showed us that so far, there is no techniques fully satisfied all of the requirements and criteria QoS based web service selection. This means that much work have to be done to achieve the better techniques in the future.

IV. FUTURE WORK

Recommendations for improvement of web service selection technique are performing a combination of several techniques. There are two general phases before selecting a web service, the service discovery and service selection. The hypothesis proposed is, if each phase using the most optimal method then we will get the best web service and satisfy user requirements.

Some of the specific proposal is to add a module generator at AADS techniques so that the conversion web service interface (WSDL) to DAML becomes easier. In the AADS, agent can be utilizing to act more advanced. Agents can establish a composite web service if it cannot find an appropriate web service.

REFERENCES

[1] Xin Dong Alon Halevy Jayant Madhavan Ema Nemes Jun Zhang "Similarity Search for Web Services." Proceedings of the 30th VLDB Conference, Toronto, Canada, 2004

[2] Le-Hung Vu, QoS-based Service Selection and Ranking with Trust and Reputation Management, EPFL, Switzerland

[3] Mārtiņš Bonders, "A Holistic Method for Selecting Web Services in Design of Composite Applications," Institute of Information Technology, Riga Technical University, 1 Kalku Street, Riga, LV – 1658, Latvia, martins@iti.rtu.lv.

[4] Natallia Kokash, "A Service Selection Model to Improve Composition Reliability".

[5] Dr. Iiavarasan Egambaram. "Qos Based Web Service Selection", 2009.

[6] E. Maximilien and M. Singh. "Towards Autonomic Web Services, Trust and Selection." ICSOC'04 pages 212–221, November 2004

[7] Jyoti Jakhar," A Test Based Web Service Selection Approach", In International Journal of Research and Reviews in Computer Science (IJRRCS), 2011.

[8] Konstantinos Tserpes,"A Recommender Mechanism for Service Selection in Service-Oriented Environment", In Future Generation Computer System-Sciencedirect, 2011.

[9] Umardand Shripad Manikrao," Dynamic Selection of Web Services With Recommendation System", 2005.

[10] Le-Hung Vu, QoS-based Service Selection and Ranking with Trust and Reputation Management, EPFL, Switzerland.

[11] Mohamad Ibrahim Ladan, Ph.D.," Web Services Metrics: A Survey and A Classification", International Conference on Network and Electronics Engineering, Singapore, 2011.

[12] Yao Wang, Julita Vassileva," Toward Trust and Reputation Based Web Service Selection: A Survey", 2006.

[13] M. Sathya, M. Swarnamugi, P. Dhavachelvan & G. Sureshkumar," Evaluation Of Qos Based Web- Service Selection Techniques For Service Composition", In International Journal Of Software Engineering (IJSE), Volume (1): Issue (5) , 2011.

[14] Jing Li, Dianfu Ma, Lusong Li, Hong Zu,"AADS: Agent-Based Adaptive Dynamic Semantic Web Service Selection", In 4th International Conference On Next Generation Web Services Practices, 2008.