Context of QoS in Web Service Selection: The Generalization of Web Services Selection Process

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Abstract: *In this paper, the authors continue the study of Web service selection based on both the context and the QoS ontology and they use the same architecture proposed in the last paper that makes an automatic selection of best service provider that is based on mixed context and QoS ontology for a given set of parameters of QoS. The question is, how upon a request; the system chooses a service among several candidate services offering a capability satisfying its requests? The Quality of service presents the key factor to solve this problem. The idea is to extend on multi dimensional QoS and we emphasize on the effect of increasing the number of services (higher than seven) on the process of selection of web services. Finally, some experiments are run so to demonstrate consistency and effectiveness of the proposed method.*

Keywords: *QoS Ontology, Selection of services, multi dimensional QoS, semantic Web service, quality of service.*

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1. Introduction

Recently, the Web Service provides several advantages in usually fields of WEB .One serious consequence is to delivering relevant service to the user. The web semantic solves these problems, it adds the logic, it expresses the sense by the ontology however, there is a certain difficulty concerning semantic heterogeneity and conflicts semantics. Clearly it is not sufficient for the semantic Web to resolve all problems related to the use of ontology. The Pragmatic Web plays an important role to solve these problems especially it describes the semantic of information in their context. The pragmatic Web services are located at the cross roads of two major research areas of the net technology: the pragmatic Web and Web services. The aim of pragmatic Web services is to create a pragmatic Web service whose properties, capabilities, interfaces and effects are unambiguously described and used by machines with introduce pragmatic technologies. Our goal is to find the best provider of e-service that responds to a request for service. To achieve that, the same steps in the last paper are used:

- Submit the query with terms and values of quality without and within their context.
- Compare the qualities of provider services with the qualities of request.
- Select the best provider service.

In the last step, the selecting the best provider is based on the compute the matching degree of published qualities and required qualities for each service without using the context of quality. Second, we make use of the context of quality and compare the two cases [8, 9].In the last work, we are showed the importance of context in interpreting the concepts of qualities in selecting processes. In this paper, the authors emphasize the effect of increasing the number of services on the process of selection of web services. The rest of this paper is organized as follows: Section 2 related works in the current literature, Section 3 presents some concepts on the context and QoS, Section 4 presents the proposed solution, Section 5 is devoted to experiments and Section 6 concludes this article.

2. Related Works

From a semiotic point of view, there are two ways to deal for Web services: first, an approach based on Web Socio semantic [22], and second an approach based on the pragmatic web [14].our work focus in the second way. We can group the approaches of selection into several categories:

2.1. Selection Based on the Matchmaking

Classification of services deals with ranking. This is by determining the degree of similarity between the requested and the provided services. [13, 17]

2.2. Selection Based on Quality of Service (QoS)

The classification of services is done by evaluating criteria such as response time, cost, and reputation for delivering such service. Major techniques in the current literature are based on the quality of service, some approach based on one dimension [21, 15, 2 and12] and the others on multi dimensional.

2.3. Selection Based on Context

Most relevant concepts found in the current literature are summarized as follows:

- [Gandon F and al 2004]: Stress the need to consider knowledge about user preferences and contextual characteristics to seek information. Their approach is based first on a server context that contains information about preferences, and second, the access rights of a user [6].
- [Behr G and al 2004]: propose a framework that operates on four profiles that describe the characteristics of the content or media (type, format, size, location where the media is stored) of the user (preferences), the device (hardware and software capabilities), network and service (media format supported, network connection, bandwidth, latency and performance [1].
- [Pashtan and al 2004]: propose to adjust the content delivered by the web service through processing of Extensible Stylesheet Language Transformations (XSLT) [16].
- [Keidl M and al 2004]: proposed an integration of the definition of Simple Object Access Protocol (SOAP) in order to find a web service that is able to meet user needs [7].

2.4. Selection Based on Configurable Web Services

The selection algorithm ranks the offered services and their configurations according to the requester's preferences and thus facilitates personalized selection strategies. In addition, the approach leverages existing Web standards to provide a maximal degree of interoperability between services. Providers and their customers leading to significant efficiency gains. The approach is implemented prototypically and the performance is evaluated by means of a simulation [10].

2.5. Selection Based on Communities

There are two ways for this category: first, an approach a reputation-based Web services community architecture and define some of the performance metrics that are needed to assess the reputation of a Web service community as perceived by the users and providers [20] and second an approach based on the model of communities whose main objective is to allow client applications to select the services which better meet a set of non-functional properties such as quality of service. The model of communities is formalized by a set of abstract data types. Types provide operations which enable service providers to register services to a community and client applications to select services, either at design time or at run time, and those that meet their needs [11].

2.6. Selection Based on Negotiation Between Requester and Provider

In this approach, authors propose an agent negotiation framework towards Pragmatics Web Service. First, they abstract the rule and policy for access control to private information about context, preference towards the Pragmatics Web Service. Second, they have formalized the access control rules, context information and preference policy, and stored them in the service ontology base possessed by service agent [18].

3. QoS and Context

Selection of service still is an important challenge, especially, when a set of services fulfilling user's capabilities requirements have been discovered, among these services which one will be eventually invoked by user is very critical, generally depending on a combined evaluation of qualities of services (QoS) [19].Due to the increasing number of Web Services, which provide similar functionality, the non-functional properties are becoming more important during the selection of the best available service. Non-functional properties describe Quality of Service (QoS) as well as context of service execution. Although there are many approaches considering only QoS or context during service discovery and selection, there is a lack of systems taking both non-functional categories into account [3]. In our work, we always associate context to quality. Moreover, this condition justifies the adoption of a use of context; we can define "the context of Quality includes all internal or external elements which is relative to the quality that is necessary to the correct interpretation of the Concept of quality". For raison of simplicity, we choose an approach for modeling of context proposed by [5] .this approach consists to store the context using a set of couples (attribute, value), mainly because of the diversity of the contexts in a multi dimensional QoS.

Furthermore, we may say that a formal and practical model of the context is not available, big efforts are provided to define how to capture the context to the system. Our goal is to give an answer of how to combine the QoS with the context. This is where this paper is supposed to give contribution.

4. The Proposed Solution

Our work is based on the use of the notion of context to facilitate the process of selection between services. We already have proposed an architecture which uses different qualities of services, and gives the appropriate interpretation for these qualities in their respective context. But remember we introduce some relevant related basic concepts.

4.1. Similarity Measures, Measure Based on the Interpretation of Concepts

In [4] the authors proposed a similarity measure of the concepts described in logic, and defined as follows:

$$s(C,D) = \frac{|C \cap D|^I}{|C|^I + |D|^I - |C \cap D|^I} \times \max\left(\frac{|C\cap D|^I}{|C|^I}, \frac{|C\cap D|^I}{|D|^I}\right) \quad (1)$$

Where $(\,.\,)^I$ is a function of interpretation and $|\,.\,|$ is the cardinal of a set. This measure is interesting because it verifies the semantic properties such as the similarity between two equivalent concepts ($C \equiv D$) is equal to 1.

4.2. The proposed architecture

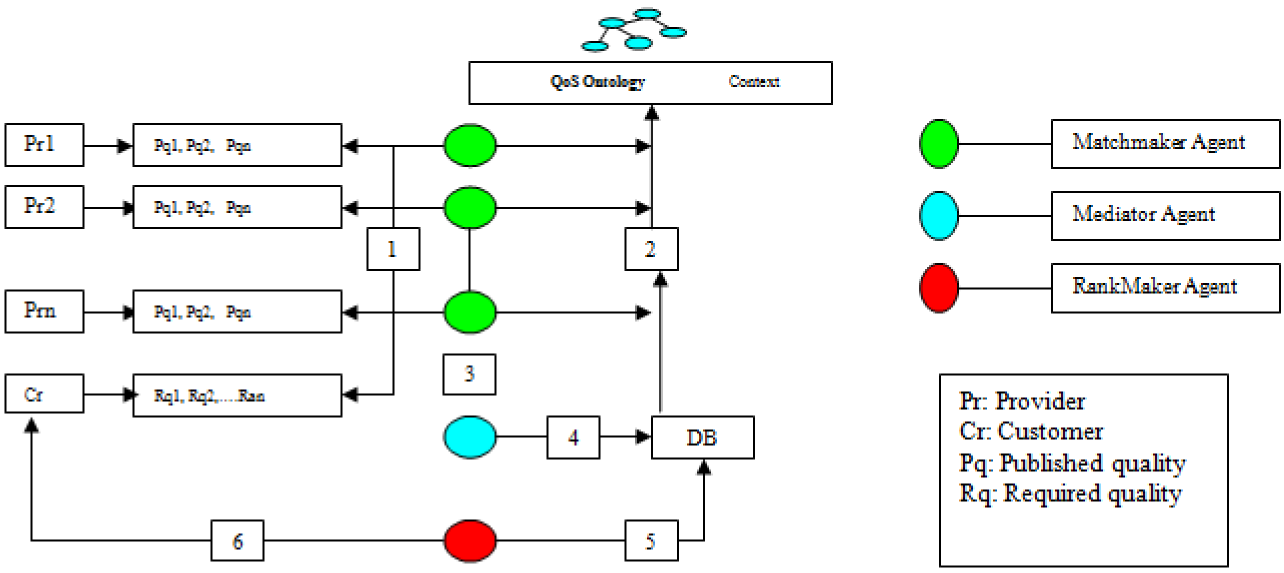

Figure 1. The proposed architecture.

Our architecture consists of a set of agents: Matchmaker Agents, Mediator Agent, and a:

1. Matchmaker Agent consults the required qualities and the published qualities.
2. Matchmaker Agent uses QoS ontology to match the required qualities and the published qualities.
3. This Agent sends the result by a message to the mediator agent.
4. Mediator Agent receives the message that contains the result and stocks it in a Database.
5. Rankmaker Agent consults this Database and makes the ranking by using Algorithm in two stages without using context and using it.
6. Finally, RankMaker sends the result to the consumer.
7. The primary task of this architecture is ranking through using the proposed algorithm in [19] in two stages without using context and with context. This is resumed as below.

4.2.1. The 1st stage [without using context]

We assume that $Q_R = \{r_1, r_2, \ldots\ldots r_k\}$ expresses the profile of a user's quality requirements, which includes k quality metrics. Similarly, the quality profile of m candidate services in set S is denoted as

$$Q_S = \{Q_{A1}, Q_{A2}, \ldots\ldots.\}$$

Where $Q_{Ai} = \{q_{i1}, q_{i2}, \ldots\ldots \; q_{ij}\}\; i,j \in N$. Therefore, the matrix of QoS for service matchmaking $M_Q = \{Q_R, Q_{A1}, \ldots\ldots \; Q_{Am}\}$ with the quality requirements Q_R in the first row, and the quality information of candidates services in the other rows. For uniformity, matrix M_Q has to be normalized [19], i.e., the elements of the matrix are real numbers in the range [0, 1], the result matrix is $M_{Q'}$. Finally, we compute the evaluation result for each quality metrics by summing the values of each row. These abstract values are taken as a relative evaluation of each service's QoS.

$$M_{Q''} = M_{Q'} \times W = \sum_{I=1}^{M} (q_{ij} \times w_j) \quad (2)$$

$W = \{w_1, w_2, \dots\dots\dots\dots.., w_n\}$, Where w represents the weighted value for each quality metrics.

4.2.2. The 2nd stage [use of context]

We use the semantic distance (equation 1) because this distance may introduce the required interpretation in this method.

We assume C_j The Context of Quality r_j for customer

We assume C'_{ij} The Context of Quality q_{ij} for service

The interpretation of required quality in context is: C_j^I

The interpretation of published quality in context is: C'^I_{ij}

We apply equation (1)

$$S = \frac{|C_j \cap C'_{ij}|^I}{|C_j|^I + |C'_{ij}|^I - |C_j \cap C'_{ij}|^I} \times max\left(\frac{|C_j \cap C'_{ij}|^I}{|C_j|^I}, \frac{|C_j \cap C'_{ij}|^I}{|C'_{ij}|^I}\right) \quad (1)$$

The degree of match with context for q_{ij} present by the average between the normalize value of q_{ij} and semantic distance $S(C_j, C'_{ij})$, after we compute the evaluation result for each quality metrics with context by summing the values of each row (equation 2) .These abstract values are taken as a relative evaluation of each service's QoS with context. In our case the context presents additional information, therefore we compute the degree of matching without use QoS ontology, then we take the average match degree that specifies the relation existing between the context and the quality of service.

5. Experimental results

In the last paper [9] , we showed the performance of selecting web services using four quality services is similar to the one using up to seven quality services, and we proved the selection of web services using four qualities (price, ComRat,PenRat,Repu) is well adapted up to seven services. This paper emphasize on the effect of increasing the number of services (higher than seven), to illustrate this approach, we propose a purchasing scenario so to demonstrate consistency and effectiveness of the proposed method. In table 1, there are thirty one providers s1 to s31, all of them providing the same services. The evaluation of quality of services is made by multi-dimensional QoS. The second, third, fourth, Fifth and sixth columns represent respectively price, Compensation Rate, Penalty Rate, Time execution and Reputation. The second table presents the normalization of quality; the third and forth present the sort current values of each QoS without and with context. Following the proposed method in section 4.2, we first start with identifying the effect of the context on the selection of services based on QoS. In the first time, the context is not used; the results obtained after calculating QoS are illustrated in the figure2. Following this step, we rely on the context to select the best service for a particular request. The results obtained are illustrated in the figure3.In Figure 2, the best service is s26 and in Figure 3 it s29. Through this example, we notice that the context affects the process of selection. Furthermore, we repeat this experiment forty times. We try to check the dependencies existing between the two major variables: QoS modality with context and QoS modality without context. In all those experiments, we observed that the ranking procedure

Table1. experiment data with five qualities.

Services	Pri	CompRat	PenRat	Execu	Repu
s1	25	0,6	0,9	155	2
s2	44	0,8	0,1	40	3,3
s3	31	0,2	0,8	200	2,2
s4	37	0,7	0,5	198	3,2
s5	47	0,7	0,2	181	2
s6	33	0,6	0,5	100	2,8
s7	42	0,6	0,4	194	2,5
s8	26	0,2	0,6	45	3,9
s9	40	0,4	0,6	78	3,6
s10	43	0,3	0,3	131	2,4
s11	41	0,6	0,3	191	2,4
s12	45	0,7	0,3	104	2,4
s13	46	0,3	0,1	91	2,5
s14	49	0,5	0,5	128	2,8
s15	49	0,4	0,2	56	3,1
s16	25	0,5	0,3	141	2,5
s17	44	0,8	0,7	107	3,9
s18	38	0,5	0,4	158	3,4
s19	29	0,4	0,6	50	3,6
s20	48	0,4	0,2	120	3,3
s21	42	0,5	0,5	88	2,6
s22	32	0,3	0,1	181	3,1
s23	42	0,8	0,8	47	3,3
s24	49	0,5	0,6	107	3
s25	26	0,6	0,3	155	3,6
s26	27	0,7	0,7	80	3,2
s27	55	0,6	0,3	109	2,6
s28	49	0,2	0,5	68	2,4
s29	31	0,8	0,4	45	3,6
s30	26	0,6	0,5	73	2,6
s31	55	0,7	0,7	113	4

Table2. Normalization.

Pri	CompRat	PenRat	Execu	Repu	QoS
1,000	0,728	1,098	0,278	0,000	6,832
0,377	1,000	0,000	1,000	0,641	5,789
0,789	0,000	1,000	0,000	0,110	4,377
0,589	0,882	0,583	0,011	0,580	5,876
0,270	0,821	0,191	0,121	0,015	3,065
0,741	0,664	0,542	0,624	0,424	6,306
0,438	0,706	0,490	0,040	0,262	4,216
0,960	0,081	0,771	0,970	0,940	7,622
0,514	0,394	0,720	0,762	0,803	5,934
0,413	0,114	0,300	0,428	0,215	3,038
0,460	0,620	0,277	0,058	0,198	3,810
0,340	0,793	0,232	0,603	0,220	4,220
0,289	0,183	0,054	0,684	0,243	2,746
0,201	0,554	0,535	0,451	0,410	3,721
0,197	0,363	0,172	0,899	0,571	3,726
0,993	0,435	0,262	0,367	0,248	5,965
0,365	0,919	0,827	0,578	0,969	6,643
0,571	0,500	0,487	0,265	0,716	5,468
0,864	0,382	0,682	0,940	0,784	7,409
0,232	0,272	0,141	0,497	0,675	3,463
0,431	0,441	0,548	0,701	0,318	4,493
0,761	0,202	0,068	0,116	0,528	4,688
0,446	0,962	0,971	0,958	0,632	6,902
0,192	0,433	0,784	0,582	0,480	3,963
0,980	0,603	0,289	0,281	0,812	7,319
0,919	0,816	0,823	0,751	0,589	8,059
0,008	0,722	0,253	0,572	0,300	2,900
0,205	0,032	0,534	0,827	0,178	2,600
0,806	0,919	0,377	0,971	0,812	8,031
0,972	0,699	0,526	0,795	0,280	7,168
0,000	0,795	0,927	0,542	1,000	5,058

without context is different that with context. We make use of the χ2 test. In this experiment, the observed frequency is 40, the theoretical frequency is 1- $\frac{40}{(5040)^{40}}$, and χ2≅ 0 this means that we can accept the hypothesis of dependencies. We may assert that the QoS depends on the context. Future work will emphasize on extending the proposed method. To using different others cases we implemented computer simulation of several scenarios using jade [http://jade.tilab.com] for implementing agents and Jena [http://jena.sourceforge.net] for interaction with ontology, and finally R language for generating random values.

Table 3. Result of selection with 31 qualities and without using context.

s26	8,059
s29	8,031
s8	7,622
s19	7,409
s25	7,319
s30	7,168
s23	6,902
s1	6,832
s17	6,643
s6	6,306
s16	5,965
s9	5,934
s4	5,876
s2	5,789
s18	5,468
s31	5,058
s22	4,688
s21	4,493
s3	4,377
s12	4,220
s7	4,216
s24	3,963
s11	3,810
s15	3,726
s14	3,721
s20	3,463
s5	3,065
s10	3,038
s27	2,900
s13	2,746

Table 4. Result of selection with 31 qualities and with using context.

s29	8,031
s8	7,622
s19	7,409
s25	7,319
s30	7,168
s23	6,902
s1	6,832
s17	6,643
s6	6,306
s16	5,965
s9	5,934
s4	5,876
s2	5,789
s18	5,468
s31	5,058
s22	4,688
s21	4,493
s3	4,377
s12	4,220
s7	4,216
s24	3,963
s11	3,810
s15	3,726
s14	3,721
s20	3,463
s5	3,065
s10	3,038
s27	2,900
s13	2,746
s28	2,600

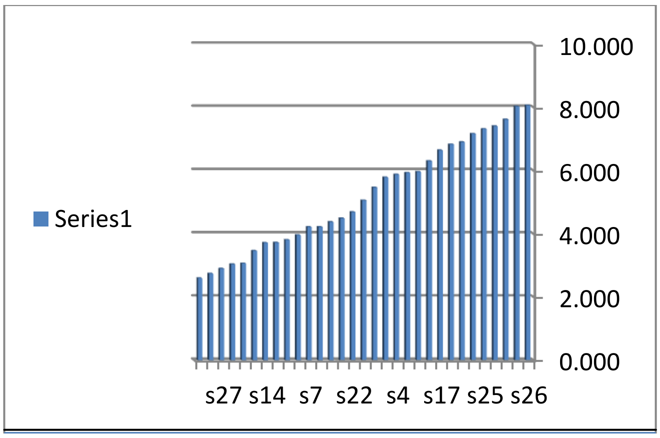

Figure 2. Evaluation of qualities of 31 services without using context.

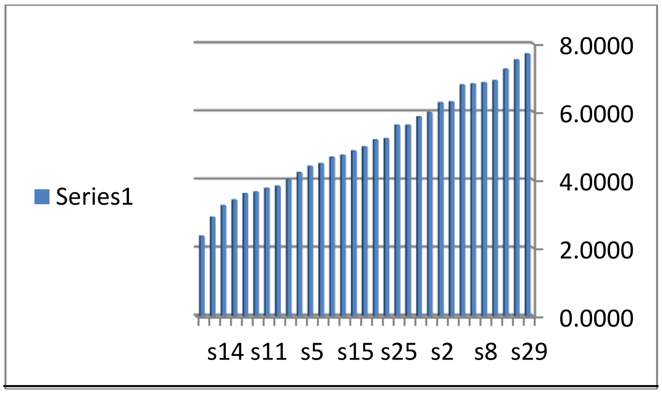

Figure 3. Evaluation of qualities of 31 services with use context.

6. Conclusion

This paper continued our work of selection of web services based on both context and the QoS ontology. This is done by proposing an architecture that makes an automatic selection of best service provider that is based on mixed context and QoS ontology for a given set of parameters of QoS. We first showed the effect of increasing the number of services (higher than seven) on the process of selection. We demonstrated in all these experiments that the QoS is strongly dependent of the context. Furthermore, future work may be extended to using different others cases and emphasize on the effect of context of qualities on the process of selection of web services.

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