Web Services Selection Based on Context Ontology and Quality of Services

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Abstract: *By these days, most companies are more aware of than ever in providing quality of services over the web for reasons of economy, reliability, interoperability, flexibility, and universality. Enterprise application integration may rely on B2B scenarios where several candidate services with similar capabilities are provided by different service providers. The question is, how upon a request over a B2B integration scenario, the system chooses a service among several candidate services offering a capability satisfying its requests? This paper proposes a model 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 particularly show how this approach can be made to support an e-business framework and how it can add dynamics to B2B interactions by automating selection among heterogeneous services. We emphasize here on one dimensional quality of services. The approach is illustrated through a purchasing scenario to demonstrate consistency and effectiveness of the proposed method.*

Keyword: *Selection of services, semantic Web service, quality of service, QoS Ontology, context Ontology, matching.*

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1. Introduction

The Semantic Web plays an important role in making the Web more relevant [4]. The data and rules are systematically described so that they can be shared and used by distributed agents. The main components implementing this Web vision include techniques such as XML for adding arbitrary structures to documents; RDF, to express meaning by simple statements about things having properties with values; and ontology, to formally describe concepts and their relationships. A typical ontology is an explicit specification of a conceptualization [10], but the semantic Web still faces major problems in a context. The semantic Web services are located at the cross roads of two major research areas of the net technology: the Semantic Web and Web services. The aim of semantic Web services is to create a semantic Web service whose properties, capabilities, interfaces and effects are unambiguously described and used by machines [13]. Semantics used will allow the automation features needed for effective collaboration between companies, namely; description and publication services, discovery services, selection of services, composition of services, and provision and administration services.

In [24], the author proposes a scheme based on the quality of service. This is a model set that can coexist with UDDI registries. Registers resolved based on this model can be used for applications that require quality of service. The model illustrated in figure 1 consists of four roles, namely; web services provider, web services client, the certifier of quality of service, and the new register.

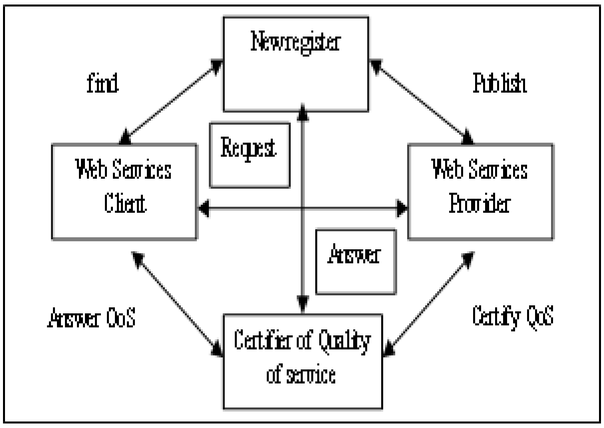

Figure 1 . A model registry and discovery of web services.

The problem is to find the best provider of e-service that responds to a request for service. To solve this, the following steps required:

- Submit the query with terms and values of quality within theirs context.
- Compare the qualities of providers services.
- Select the best provider service.

In the last step, to choose the best provider, we compute the matching degree of published qualities and issued requests for each service without using the context of quality, and then, use the context after we make a comparison. Hence, one may ask about whether or not the context may influence the selection process? In this paper we present only the solution with QoS as in one-dimension. The remainder of this paper is organized as follows: Section 2 presents a web service selection, Section 3 presents context ontology, Section 4 presents the proposed approach, Section 5 is devoted to experiments and Section 6 concludes this article.

2. Web Service Selection

From a semiotic point of view, there are two ways to deal for Web services: first, an approach based on Web Socio semantic [16], and second an approach based on the pragmatic web [1, 2].

In the first approach, the problem is the engineering of ontology semiotics. They have different criteria for the establishment of agreements defining the construction of ontology from logical approaches, contextual and situational.

In the second approach, the pragmatic Web consists of a set of pragmatic contexts of semantic resources.

A pragmatic context consists of a common context and a set of individual contexts. A common context is defined by the common concepts and conceptual definitions of interest to a community, the communicative interactions in which these concepts are defined and used, and a set of common context parameters (relevant properties of concepts, joint goals, communicative situation, and so on). There are two types of processes on the syntactic and semantic web are assignment and alignment. Meaning assignment takes place when syntactic resources are semantically enriched, such as by XML-tags being added to HTML-pages. Meaning alignment has to do with interoperability between ontology: what extent do their semantic models agree? How can (parts of) ontology be meaningfully linked? How to deal with definitions that partially overlap in meaning, three meaning evolution processes associated with the Pragmatic Web and its interaction with the Semantic Web is meaning selection, meaning representation, and meaning negotiation. Mostly focus on modelling representational and evolutionary aspects of ontology. In this approach Aldo de Moor, proposes a scenario, the aim is not to solve existing problems, but open a new territory for exploration practice.

2.1. The 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. There are two approaches: The description matching DL, and the description matching DAML-S.

In the DL approach, matching the specification of Web service uses the description logic, T is a terminology of e-service S and a query Q expressed in a description logic L, we must find a set of e-services E "that best meets Q" Q and E should share as much information as possible, The part of Q is not covered by E must be as small as possible. Additional information provided by E over Q must be as small as possible. The semantic difference between E and Q must be unique. In some languages like FL_0 this is possible, but for much expressive language rather this difference is not unique? [6]. In the description Matching DAML-S, two scenarios are used**.** In the first scenario, the matching algorithm is controlled by a central authority, service providers register their services with the descriptions. corresponding DAML-S. A customer who is looking for a Web Service connects to the server through an interface and sends its requirements. The server then matches the information with the Web Services available in its database. When a matching (more) is found, the server returns the address of the Web services. In the second scenario, the algorithm is executed locally. The mechanism to find the semantic description of a Web Service is similar to the WSDL documents. In the Web Service WSDL document can be produced automatically by the server, while document DAML-S is manually produced and deployed by the provider [25].

2.2. Selection based on Quality of Service (QoS)

The classification is done by the evaluation criteria such as response time, cost, and reputation for delivering. Most of the current works are based on the quality of service. This includes

QoScomputing: use of measures, technical standards and numerical calculations to determine the maximum or minimum of an objective function that is used to find the better service [15, 19, 5].

- Multi Agent System: is used with an assessment of reputation. We use the calculation on the moments of vectors to adjust the matching based on the concepts of desired quality, provided quality and promise quality [17].
- QoS ontology: In this case, ontology is a consensual semantic specification of the quality for a given field. In combination with the multi agent system, it provides a common vocabulary for quality and facilitates communication and reasoning among agents specifically brokers agent[15]

2.3. Selection based on adaptation of context

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

- Ganden *et al* [8] Stress the need to consider knowledge about user preferences and contextual characteristics to seek information. Their approach is based firstly on a server context contains information about preferences, and secondly, the access rights a user.
- Berhe *et al* [3] these authors propose a framework operates 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).
- Pashtan *et al* [21] propose to adjust the content delivered by the SW to through processing of XSLT
- Keidl *et al* [12] proposed an integration of the definition of SOAP in order to find a SW able to meet user needs.

3. Context Ontology

3.1. Definition of context in Web services

In web services vocabulary, we always associate context with quality, because we interested only the context of quality exchanged between web services. This condition invokes a definition of context. The context of a given element includes even completely outside, which is necessary for a correct interpretation. During an exchange between two high-quality Web services, two contexts come into play: The qualities, which is tied to the requesting client service and the qualities published at their interpretation, which is related to the service provider of qualities. These contexts have their roots in different service providers and consumers. Therefore, the selection process is to transform the quality of the transmitted context in which it was modelled to the context in which it must be interpreted, while retaining the meaning sought by the consumer. To do this, we introduce the concept of object semantics for web services, which aims to describe explicit semantics qualities between the services using the context. We propose to model the context as a hierarchy of meta attributes, which explicitly describes the various semantic properties necessary to a correct interpretation of the qualities contextual ontology a contextual ontology is to write the context of a concept of ontology QoS.

3.2. Semantic property

The role of ontology is to write a field of knowledge, by explaining the concepts used and the relationship between these concepts. To obtain a homogeneous from users, the elements of context to interpret correctly the concepts of ontology are fixed. These elements commonly named semantic properties, describe the various aspects and features of a semantic concept.

3.3. Semantic value

The use of context for the description of semantic aspects has its origin in 1994 with the work of Score [23].To model the semantics of data and facilitate exchanges between heterogeneous information systems, the authors introduce the concept of semantic value as the unit of' exchange. A semantic value is represented by the association of a single value and a context. The context is abstractly defined as the data on the semantic meaning, properties and organization of the semantic value.

The context of the data is modelled by a finite and recursive meta attributes that may contain different values. It is part of the environmental data (data environment), and consists of a schema and a specification. The diagram describes the meta-attributes, properties, and in general the structure of the context, while the specification specifies the values taken by some or all of the metadata attributes in a specific context. It is possible that some metadata attributes do not have values in some contexts, leaving aspects of a semantic value unspecified. For example, the value 5 and the (currency = EUR) is a semantic value, which allows us to interpret the value as 5 is a quantity commencing in Euro.

3.4. Semantic Object

In 1999, Bornh and Goh proposed two extensions of the original model which are very similar. They are both integration of semi-structured data. Such extensions are increasingly used on the Internet, and introduce the concept of object semantics in [11] [9]. The idea in this work is to resume the model functions using a logical objet oriented formalism to represent the information and its context the COIN architecture proposed by Goh [9] and is based on three main components; a domain model, the elevation axioms, and the context. The domain model is to write knowledge in the field at the semantic level. It contains primitive objects and semantic objects that are instances of primitive types and semantic types. The primitive types are of type string, integer, real etc. And the semantic types are complex types that support the description of context.

The elevation axioms establish the correspondences between the attributes of data sources and concepts written in the domain model. They keep simple objects at the semantic level by identifying the corresponding semantic type has the object concerned a supporting the instantiation of the object semantics. The axioms describe the context associated with the transmitters and receivers data, and define the context of interpretation. Two groups of axioms are distinguished: the first group defines the semantics of data by associating values to elements of context and the second group of axioms specifies the methods of conversion associated with elements of the context. [18]

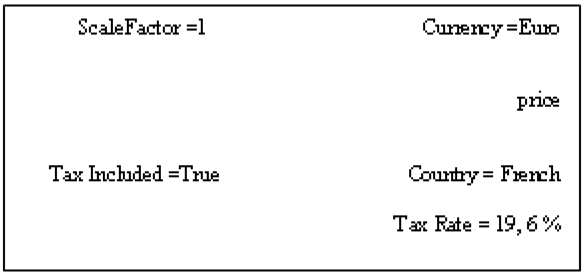

Figure 2. Example Price and its Context

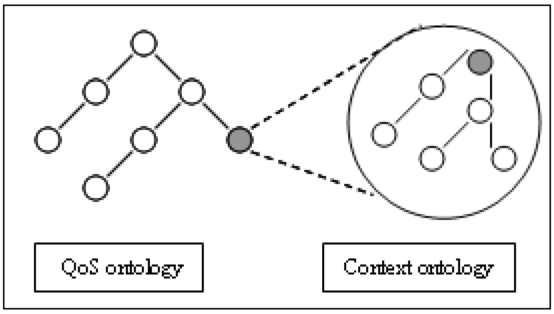

Figure 3. Relationship between QoS ontology and Context ontology

4. The proposed solution

Currently, in the field of Web services, ontology is used to represent the semantics of data and forms a consensus on a common vocabulary. Our contribution is based on the use of the notion of context to facilitate the process of selection between services. We propose to enhance the semantic description of input / output services with the context. To promote interoperability among semantic Web services, we propose an architecture that matches different qualities of services, and allows the correct interpretation. To do this, we first go through some relevant related basic concepts.

4.1. Similarity measures

4.1.1. Measure of Wu and Palmer [26]

The length of a path between two concepts in a hierarchy is an intuitive measure to calculate similarity. This is a useful and easy to implement. The measure that depends on the length of a certain path is defined as follows:

$$sim(C_1, C_2) = \frac{2 * depth(C)}{depth_c(C_1) + depth_c(C_2)} \quad (1)$$

Where C is the most common subsumed specific depth (C) is the length of path between C and the root of the hierarchy, $depth_c$ (C_i) is the number of arcs between C_i and root through C. This measure is easy to implement but it does not include descriptions of concepts.

4.1.2. Measure of Resnik

The notion of information content (IC) was used by [22], which defines relevance of a concept in a corpus. The frequency of a concept is calculated to determine the IC (the frequencies of concepts in a hierarchy) and is estimated using the frequency of terms

$$CI(c) = -\log(P(c))$$
$$P(c) = \frac{frequency(c)}{N} \quad (2)$$

Where P (c) is the probability of a concept c, and N is the total number of concepts. We define a measure of similarity between two concepts by the amount of information they share. This similarity is expressed by :

$$sim(c_1, c_2) = CI(lcs(c_1, c_2)) \quad (3)$$

Where lcs (C1, C2) is the most common subsumed specific C1 and C2 in hierarchy.

4.1.3. Measure of Lin

In [14], the author proposes a theoretical definition of a similarity measure applied from the moment we have a probability model. This similarity is defined as the ratio of information shared by A and B on the information necessary to describe a complete A and B. This measure is expressed by:

$$sim(A, B) = \frac{\log p(common(A, B))}{\log p(description(A, B))} \quad (4)$$

where common (A, B) is the set of common characteristics of A and B, and description (A, B) is the union of all the features of A and B. This measure is applicable in several areas and has shown good correlation with human judgments

4.1.4. Measure based on the interpretation of concepts

The authors in [7] have proposed a similarity measure for the concepts described in logic defined as follows:

$$s(C, D) = \frac{|(C \cap D)^I|}{|C^I| + |D^I| - |(C \cap D)^I|} * \max\left(\frac{|(C \cap D)^I|}{|C^I|}, \frac{|(C \cap D)^I|}{|D^I|}\right) \quad (4)$$

Where **(.)** $^{\mathbf{I}}$ 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 concepts equivalent (C ≡ D) is equal to 1, the similarity between two concepts is not null.

4.2. Proposed Model

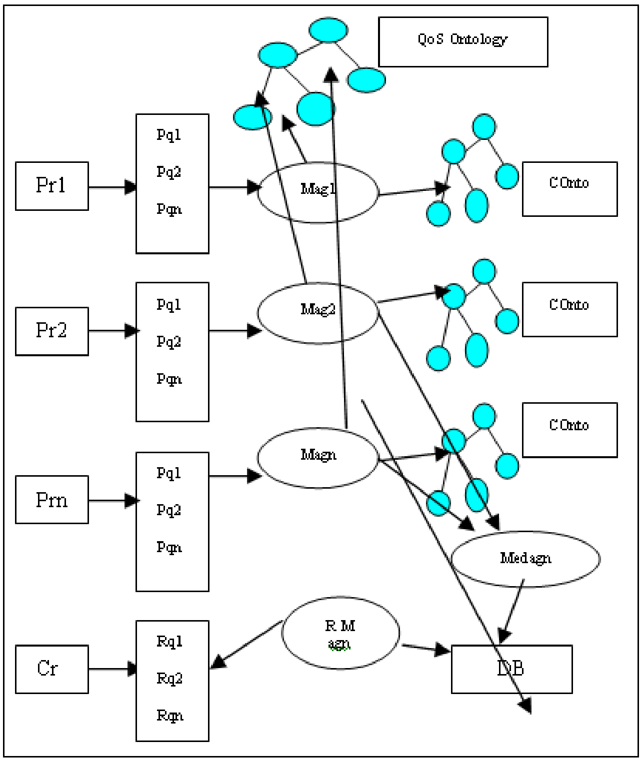

Figure 4. The proposed architecture

Pq: published Quality, Rq: required Quality, Pr: provider, Cr:customer, COnto: Context Ontology, Mag: MatchMaker Agent, Medagn: Mediator Agent, RMagn : Rank Maker Agent

In this architecture, the QoS ontology is used to give meaning to the terms of quality. There are three types of QoS Ontology; the QoS upper ontology: this captures the concepts of the highest quality generic and defines the basic concepts that are related to quality; for instance a measure of quality. The QoS middle ontology introduces aspects of quality met in distributed systems. And finally, the lower QoS ontology: this contains the qualities of the domain. In our architecture we use a set of agents: Matchmaker agents, mediator agents, and rank maker agent

4.2.1. Matchmaker agents

The role of each agent is to know the required qualities and publishes them, then applies the matching such that it must consult the ontology of quality service to set the concepts of quality; then the agent evaluates the associated matching degree. The result will be a message sent by agent mediator upon performing the following steps:

- The 1st stage [without use context ontology] [20]

True: if the required quality = published quality
then the degree of match = 1

Plug-in: if the required quality is called a sub concept of published quality
then the degree of match = 0.5

Subsumed: if the required quality is called a super concept of published quality
then the degree of match = 0

Fail: no correlation
then the degree of match = 0

- The 2nd stage [use ontology context]

We use the semantic distance (Equation 5) because this distance may introduce the interpretation that we need in our method.

4.2.2. The mediator agent

The agent receives the message that represents the matching degree ; each of these will be stored in a table in a database. The mediator agent has to connect with a database using the DB connector JDBC: ODBC

4.2.3. Rank maker Agent

The agent consults the table that contains the matching degrees with ranking score, and then the result will be sent back to the consumer.

5. Experimental results

To illustrate this approach, we propose a purchasing scenario to demonstrate consistency and effectiveness of the proposed method. In this example, there are four providers s1 to s4 providing the same services. The evaluation of quality of services is made by one-dimensional QoS for instance attribute price. The second column shows all terms of quality. The third presents the values of quality, the fourth and fifth columns are the current values of the parameters of the ontology of context

Table 1. Experiment data.

		quality	Quality value	currency	Tax
customer	c1	price	30	dollar	false
services	s1	cost	25	dollar	true
	s2	price	40	dollar	true
	s3	cost	29	euro	false
	s4	price	55	dollar	false

Following the proposed method in section 4.2, we first start with identifying the effect of the ontology of context on the selection of services based on QoS. First, no ontology of context is used, the results obtained after calculating the matching degrees between web services and customer requests are shown in the following figure.

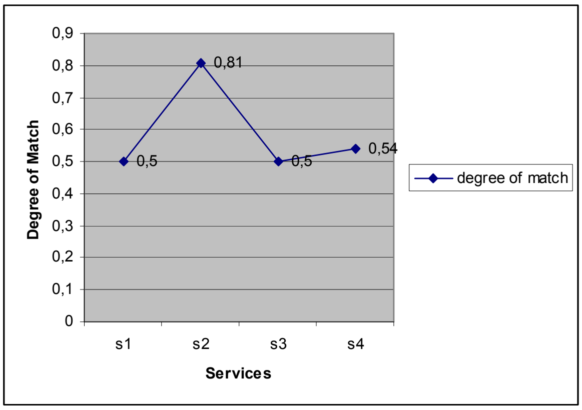

Figure 5. Evaluation of qualities for 4 services without using context ontology

Following this step, we rely on ontology of context to make selection of best service for a particular request.

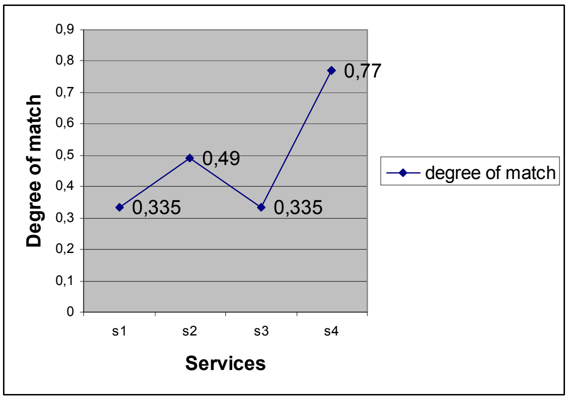

Figure 6. Evaluation of qualities 4 services with use context ontology

In Figure 5 the best service is s2 and in Figure 6 is s4. Through this example, we see that the context affects the process of selection, thus reinforcing our hypothesis.

Furthermore, we run an example using 100 random services. We first try to check the dependencies existing between the two major variables: Matching degree and matching modality (with or without relying on ontology of context). We make use of the χ^2 test. The following figure displays the dependencies.

From table 4, we deduced that the value of χ^2 is 29.1855935. The table has 2 rows and 3 columns; we conclude that the number of degrees of freedom is $(2 - 1) \times (3 - 1) = 2$. Therefore, the probability of observing a value of 29.1855935 with two degrees of freedom is 4.5965e-7.

Furthermore, through this experiment, we may assert that the matching degree strongly depends on the contextual ontology. Hence, we may say that quality of service Ontology provides a meaning of quality but the context of ontology identify and interprets the meaning of quality more precisely.

Future work will emphasize on extending the proposed method to multidimensional QoS in the selection process.

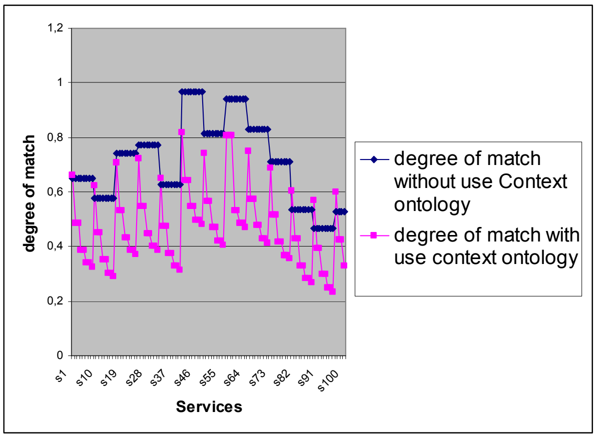

Figure 7. Evaluation of qualities for 100 services

Table2: Distribution of the observed matching degree over different ranges.

	the degree of match			
Range	0,25-0,49	0,491-0,73	0,731-0,97	Total
Without	6	20	23	49
with	35	11	5	51
Total	41	31	29	100

Table3: Theoretical Distribution

	the degree of match			
Range	0,25-0,49	0,491-0,73	0,731-0,97	Total
without	20,09	15,19	13,72	49
with	24,99	15,81	14,29	51
Total	41	31	29	100

Table4: χ^2 partial

Range	0,25-0,49	0,491-0,73	0,731-0,97
without	9,88193630	1,52311389	1,52311389
with	4,00960784	1,46338393	6,03070029

We implemented computer simulation of several scenarios using jade [http://jade.tilab.com] for implementation agents and Jena [http://jena.sourceforge.net] for interaction with ontology.

6. Conclusion

In this work we propose an approach that shows that context of ontology may affect the quality of service selection. We made also a compromise in using contextual ontology, on a single representation imposed by the use of QoS ontology and the multiplicity of local ontology of Web services. The concept of context around which relies the proposed method has several advantages in terms of opportunities that it affords for advances in web service selection. Furthermore, prospects remain open, not only in the field of Web services, but more generally in various fields involving the interoperability of data. Hence, the context of ontology has effects on the degree of match which is the core of the pragmatic selection.

Moreover, this approach may be extended to automatic service selection using multi-dimensional QoS.

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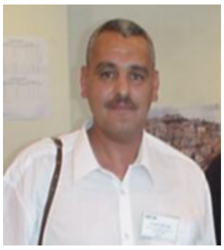

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