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# Web Service Ranking Using non Functional Qos Properties

KEYWORDS: Web Service, Web Service Discovery, Composition, Semantics, SOA, Non-Functional QoS, Web Service Ranking

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**ABSTRACT** *One of the issues in web service discovery process is the tendency to locate appropriate web services which matches the user requirements. Due to the increase in popularity of Service Oriented Architecture, plenty of web services are available in internet. Traditional web service discovery architectures use functional QoS as the only deciding criteria to select a web service. But non-functional QoS is also having major impact in selecting a web service. Hence, this paper presents a suitable web service selection method which uses non-functional QoS properties to rank the web services. The experimental results indicate that the proposed method is better in terms of performance and accuracy.*

## 1. INTRODUCTION

Service Oriented Architecture (SOA) is a collection of services that can communicate with each other for data passing. Sometimes, two or more services are combined to perform a particular activity. Some way of communication mechanism is needed to make services communicate with each other. SOA are used to solve B2B problems as they are capable of providing flexible software support to the dynamic nature of business organization[1]. The services are deployed in internet by a service provider.

Standards of SOA are represented by three components viz. Web Service Definition Language (WSDL), Simple Object Access Protocol (SOAP) and Universal Description Discovery and Integration (UDDI)[2]. WSDL is a XML based language that describes web services and the process of accessing such web services. UDDI stores information related to web services and its descriptions in internet. SOAP provides encoding specifications in XML file to be included in HTTP header to perform communication[3].

Since numerous web services are available in internet for a particular requirement, selecting appropriate web service is a tedious job. The complexity in changing nature, managing compositions and understanding requirements of business process makes difficult for the business modeller to select appropriate web service[4]. Currently this is done by human decisions and furthermore, matching is based on functional requirements. Non-functional requirements judge the operation of a system rather than particular behaviour. Non-functional requirements are very important to select appropriate web service[5]. Serious efforts are made by service community to involve non-functional requirements during web service selection process.

In this paper, selection of appropriate web services based on non-functional properties is presented. The paper is organized as follows: paper starts by giving brief introduction about the SOA and web services in section 1. Related work and concise literature survey is presented in section 2. Proposed system, its basic definitions, metrics used to calculate non-functional properties and ranking procedure for web services in the proposed method are discussed elaborately in section 3. A live scenario of user request is taken to test the effectiveness of our proposed method in section 4 and results were tabulated. The paper ends by briefing the findings as conclusion in section 5.

## 2. BACKGROUND WORK

Non functional requirements cover all the aspects that are not covered by functional requirements. Moreover, many business stakeholders have vested interest in knowing non-functional requirements, especially in large systems. Therefore, non-functional requirements play very vital role in web service selection process[5]. Web service selection using functional QoS is a well researched domain whereas using non-functional QoS has not attracted the concentration of many researchers. In this section, we present a concise note on functional QoS based web service selection as literature review.

Papaiannou et al[6] proposed ontology frameworks to describe web service QoS attributes. The work presented did not consider non-functional properties of web service matching. Quality of Service (QoS) is the dominant criteria used in their work for selection and composition of web services. The work proposed fully supports QoS aware web service representation and formulation of QoS framework using ontology.

Shuping Ran[7] proposed a model for web service discovery with QoS. The proposed model considers both functional and non-functional requirements for web service discovery. Certifier, a new framework, verifies the QoS claims from web service suppliers. Certifiers rate the web service and based on this score, web services are selected. The work also presents an extension to UDDI's data structure type that could be used in web service discovery process.

Yutu Liu et al [8] presented extensible QoS based web service discovery model which is fair, open and dynamic. Business related criteria such as compensation, penalty policies and transaction are included while calculating QoS. QoS registry is also provided for the extensible QoS model. Variation of formula to compute QoS values for different domains using various sensitive factors is also presented. The proposed method also gets feedback from end users.

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Hong Qing Yu and Stephan Reiff-Marganiec [9] presented an automated method for web service selection process. The method uses LSP metrics and OWA operators for calculating aggregate scores for each service. From this, capturing criteria based scores are calculated using type-based evaluation mapping system. The method captures high level satisfaction semantics in terms of fuzzy relations with minimal human interaction.

Xia Wang et al [10] proposed QoS-aware selection model for semantic web services. QoS ontology along with its vocabulary is represented in Web Services Modelling Ontology (WSMO) during initial stage itself. WSMO provides annotating service descriptions with QoS data. Multiple quality metrics of a web service is used for service discovery. For this, normalization algorithm oriented optimal value range is used.

All the above works discussed uses QoS as the only deciding criteria during web service discovery process. These methods fail to express the source of criteria. Moreover, these works fail to include logic relations between different criteria and uses only average individual values as final score. In our proposed method, evaluation and selection attributed are combined which solves web service selection issues.

## 3. PROPOSED METHOD

### 3.1 Obtaining Relevant Non-functional properties

The process of obtaining non-functional properties of a web service is done by assigning each operation of a web service with more than one service category. This stores extra information in the service repository. The non-functional properties, said to be criteria, are defined while generating the categories. The four dominant criterion used in our approach are name, type, weight and value. Name is used to identify the criteria. Type defines the data type of each criterion and it can be string, Boolean, integer, etc. The weight criterion represents initial value. This criterion plays an important role of selecting a web service. If the weight of a web service is equal to 1, it is hard requirement and should be discarded. If the weight value of a web service is less than 1, it is soft requirement and it is having some impact in ranking the web services. The value attribute specifies parameter constraints for the criterion.

### 3.2 Metrics for Non-functional Properties

Since the output received from context information is not always numeric data, it is important to define the values of non-functional properties that are not in numeric data type[11]. Most of the value of criterion is expressed in numeric data and numerical data type includes integer, double, time and currency. If the value of the criterion is expressed in Boolean data type, that Boolean value is converted into numerical value. The output of any Boolean expression is true or false, and there two values are replaced with 0 and 1.

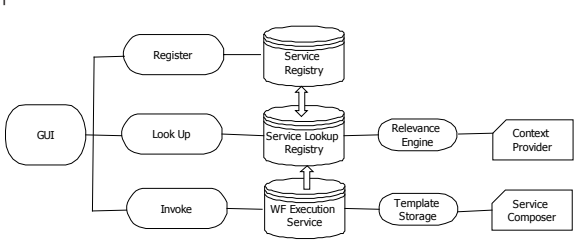


**Figure 1 Service Management System**

But there are certain instances where the criterion takes more than two values and that cannot be expressed as simply as true or false. The respective formula to compute values of the criterion which contains larger subsets are as follows:

Let $V_{min}$ and $V_{max}$ be the threshold value of all the services, 'v' is the value for the current service, and 'w' is the weight aggregation into account then

$$E = \begin{cases} 1 - \left(\dfrac{v_{max} - v}{v_{max} - v_{min}}\right) & if\ W \geq 0 \\ \square \\ \left(\dfrac{v_{max} - v}{v_{max} - v_{min}}\right) & otherwise \end{cases}$$

$$E = \begin{cases} 1 & if\ criteria\ is\ met \\ \square \\ 0 & otherwise \end{cases}$$

The advantage of defining metric is that, the proposed method evaluates rules based on attribute types. Moreover, one metric rule can be used for different aspects.

### 3.3 Ranking the Services

Minimum two or more non-functional QoS criterion is used to rank a web service. Hence Global Preference Calculation Function (GPCF) is required to calculate all aspects of criteria. This global preference function must represent specific requirements and logic conditions like simultaneity, replaceability, etc. The global preference for a web service is calculated as follows:

$$L = (|\omega 1|\, E_1^r + |\omega 2|\, E_1^r + \ldots\ldots) \text{ with } 0 \leq E \leq 1$$

Where 'w' represents weight criteria, 'r' is the logic power adopted from LSP. All the mandatory requirements are grouped as hard criteria group and soft criteria group represents remaining requirements. The above equation is used twice using two different logic powers adopted from LSP. The result calculated during first iteration is called as DAC and second one as CA. CA values are used to remove services that do not satisfy hard requirements.

## 4. EXPERIMENTAL RESULTS AND DISCUSSION

To test the effectiveness of our proposed method, consider a scenario where a user needs a payment service for online transaction. As discussed, to select a web service, several non-functional criterion such as market aspect, customers location and address, devices used by customers like laptop, PDA, landline, desktop, mobile phone, etc. The QoS properties are security, performance and privacy. The soft and hard requirements of the given criterion and their corresponding data types, weight, etc are given in the below table.

| **Soft Requirements** | | |
|---|---|---|
| Performance | Integer | 0 – 1 |
| Privacy | Boolean | 0 – 1 |
| Cost | Numeric | 0.5 |
| Payment type | String | 0.2 |
| **Hard Requirements** | | |
| Security | Boolean | 1 |
| Location | String | 1 |

**Table 1 Soft and Hard requirements of user**

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As per the above soft and hard requirements, five web services have been selected from the repository which satisfies the requirements. By using the global preference calculation function, these web services are ranking using our proposed method as follows:

| | *Devices* | | *Cost* | | *Payment* | | *Privacy* | | *Security* | | *GPCF Result* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***w*** | ***E*** | ***w*** | ***v*** | ***w*** | ***E*** | ***w*** | ***E*** | ***w*** | ***E*** | ***Soft*** | ***Hard*** |
| $S_1$ | 0-1 | 0-7 | 0-5 | 1 | 0-2 | 0-68 | 0-1 | 1-0 | 0-1664 | 1 | 0-8294 | Reject |
| $S_2$ | 0-1 | 0-6 | 0-4 | 2 | 0-2 | 1-00 | 0-1 | 1-0 | 0-1664 | 1 | 0-7563 | Reject |
| $S_3$ | 0-1 | 0-6 | 0-5 | 1 | 0-3 | 0-68 | 0-1 | 1-0 | 0-1664 | 1 | 0-8968 | 0-6325 |
| $S_4$ | 0-1 | 0-7 | 0-6 | 3 | 0-2 | 0-68 | 0-1 | 1-0 | 0-1664 | 0 | 0-6324 | Reject |
| $S_5$ | 0-1 | 0-7 | 0-6 | 4 | 0-2 | 0-68 | 0-1 | 1-0 | 0-1664 | 1 | 0-5948 | 0-5644 |

**Table 2 Calculated results of soft and hard requirements**

Security criterion value of web service S4 is 0, which is directly removed from the final result list. The other web services viz, S1 and S2 are also having lapses with the given criterion and they are also rejected. Service S3 and S5 satisfy all the requirements and S3 is having higher hard requirement value. Hence S3 is selected as the appropriate web service and returned to the user.

## 5. CONCLUSION

A method for selection of web services based on non-functional requirements is presented as the traditional methods concerns more on functional aspects of a web service. The method captures non-functional attributes which are defined as criterion of services with functional behaviour. The proposed method considers both soft and hard requirements criterion, and calculates GPCF value for both. Based on the GCPF values of hard and soft requirements, web services are ranked eliminating the needless ones. It uses relevance engine which is used to enhance any service lookup process. The relevance engine is also used to obtain requirements.

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