Automatic Pricing of Web Services Based on QoS

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Abstract

In this modernized business world, the expansion of Web services has grown widely through Business to Business (B2B) integration and its importance for the development of enterprise applications steadily increases over time. However, the increasing number of available web services with the same functionality agitates the clients during selection of such a one that fits best of their requirements. They need to know the quality of the offered web services as well as the price that they should pay for that quality. There are many cases that a service cannot meet the consumer's service requirements in respect to service quality and content. The provision of quality of service is seen as a compromise between the customer requirements and the ability of the service provider and the underlying network. However many of the quality of service requirements of the customers are being ignored. Always the clients think that they are paying for the service that is undelivered. In this paper, we are proposing an Automated Billing System which calculates the price of usage for a Web Service dynamically based on QoS offering. The Architecture is proposed to record the quality delivered by the provider and the billing system will automatically calculate the cost based on the offering quality as per the terms mentioned in the SLA. On the basis of satisfying the provider in cost and the quality for the client, we present an experimental validation, results & analysis of the proposed work.

General Terms: Normalization, Measurement, Performance, Ontology, Parametric.

Keywords: SOA, SLA, WSDL, UDDI, UDDI Business Registries, Quality of Services, QoS, Web Services.

1. Introduction

Current trends show that the vast majority of companies are moving to services-oriented architectures (SOAs) and deploying Web services within and across their IT infrastructure. Web service selection brings a challenge to the clients due to the fact that web services with the same functionality have different QoS property [1]. The current web service architecture is based on Web Service Description Language (WSDL) and Universal Description Discovery and Integration (UDDI) standards that support only functional web service description, publication and discovery. That is why many efforts point to developing of QoS models and ontologies as well as QoS enhanced repositories and selection algorithms. The clients need to know not only the quality of the offered web services, but also what will be the price that they should pay for that quality. The expression "you get what you pay for" is widespread, but it's not always true [2]. In order to provide a solution that can solve these problems, we have defined an architecture for the web services technology to develop a billing system which automatically evaluate the cost based on QoS delivered at runtime, that will help clients to pay the web service with an optimal correlation between quality and price over a period of time or the number of requests for a particular service.

An implementation of the proposed QoS based pricing architecture is discussed in section 2. Section 3 calculates the actual QoS and cost of the web service and Section 4 shows the experimental results.

2. Architecture for QoS based Automated Web Service Billing System (AWSB)

The architecture consists of the basic web service model components web service provider, web service consumer and the UDDI registry. As we can see in Figure 1, the three basic operations of the Web service architecture denoted by publish, bind and find still exist

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[3]. In addition it has a broker based Automated Web Service Billing System (AWSB) which stores QoS information for every customer request into a QoS database by active monitoring

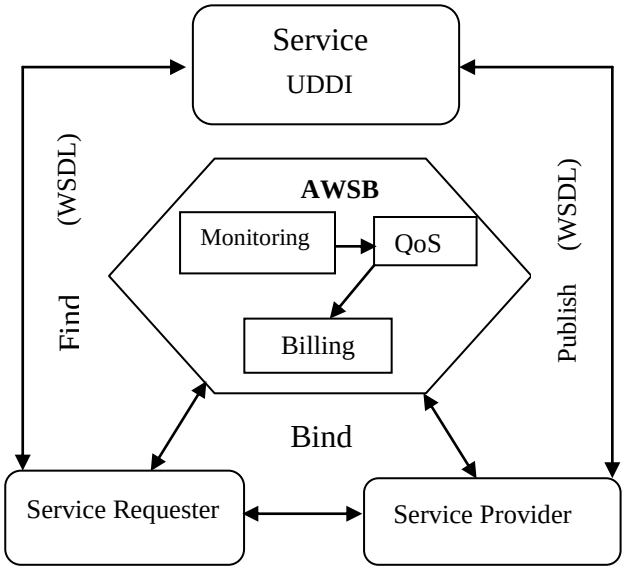

Figure 1: Architecture of Automated Web Service Billing System (AWSB)

The Billing module which calculate the actual QoS for the billing term after n requests and prepare the actual cost dynamically and send the report to both the customer and the provider.

3. Evaluation of Cost based on actual QoS

Let S be the web service selected from the set of web services that are available with same functional properties.

We define a set of QoS parameters of the selected web services as follows:
PS = {P1, P2, P3……..Pm} Where m ($1 \le i \le m$)

Let CS is the cost fixed for the web service S with assured quality QS during its selection.

Our goal is to calculate the actual cost based on the actual QoS of the selected web service S during its usage.

To calculate the actual QoS, the quality parameters are collected through active monitoring and stored in a QoS database for each request.

Let us consider our billing system prepare the cost of usage for the period of every N requests.

Let $R_1, R_2, \ldots\ldots R_N$ are the requests to the web service S for the billing term, TERM -I.

We define the set of QoS properties for each request for the selected web service as follows

$R_i P_j = \{P_{i1}, P_{i2}, \ldots\ldots\ldots\ldots P_{im}\}$ Where n ($1 \le i \le n$) and m ($1 \le j \le m$)

The set $P_{s\,AVG} = \{P_{1\,AVG}, P_{2\,AVG} \ldots P_{m\,AVG}\}$ is the average value for each quality parameters is as follows

$$P_{s\,AVG} = \left\{ \sum_{i=1}^{N} P_{i\,1}, \sum_{i=1}^{N} P_{i\,2}, \ldots\ldots\ldots\ldots \sum_{i=1}^{N} P_{i\,m} \right\}$$

The parametric values are normalized [4] as

$$P_{S\,NOR} = \{P_{1\,NOR}, P_{2\,NOR}, \ldots\ldots\ldots\ldots P_{m\,NOR}\}$$

$$P_{j\,NOR} = \begin{cases} \dfrac{P_{j\,AVG} - P_{i\,j\,MIN}}{P_{i\,j\,MAX} - P_{i\,j\,MIN}} & \text{if Upper Bound QoS parameter} \\ 1 - \dfrac{P_{j\,AVG} - P_{i\,j\,MIN}}{P_{i\,j\,MAX} - P_{i\,j\,MIN}} & \text{if Lower Bound QoS parameter} \end{cases}$$

Where n ($1 \le i \le n$) and m ($1 \le j \le m$)

After normalization the values of QoS properties will be presented in the range of [0, 1].

The actual QoS for the web service can be calculated as follows

$$\text{Actual } Q_S = \frac{1}{m} \sum_{j=1}^{m} w_j \cdot P_{j\,NOR}$$

The actual cost [4] can be calculated as follows

$$\text{Actual } C_S = \frac{C_S \text{ x Actual } Q_S}{Q_S}$$

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4. Experimental Results

Let us consider billing system prepare the billing cost for every 1000 requests for a particular service.
The parametric values Response Time, Throughput, Availability, Scuccessiblity, Reliability are recorded for each 100 request and stored in the QoS database as follows

Table 1: Recorded parametric values for the Billing Term I.

Quality Parameter /Requests	P1	P2	P3	P4	P5
R1(1-100)	762	5	81	91	81
R2(101-200)	765	4	83	87	86
R3(201-300)	761	4	86	81	79
R4(301-400)	749	8	90	85	83
R5(401-500)	745	9	82	81	89
R6(501-600)	743	6	86	95	89
R7(601-700)	768	5	91	96	90
R8(701-800)	766	3	90	94	84
R9(801-900)	765	5	89	79	82
R10(901-1000)	762	8	88	89	85
Average	758.6	5.7	86.6	87.8	84.8

$P_{1\,MIN}$= 743, $P_{1\,MAX}$=768, $P_{2\,MIN}$ = 3, $P_{2\,MAX}$ = 9

$P_{3\,MIN}$ =81, $P_{3\,MAX}$ =91, $P_{4\,MIN}$ =79, $P_{4\,MAX}$ =96

$P_{5\,MIN}$=79, $P_{5\,MAX}$ =90

The normalized values for each parameter is calculated using

$P_{1\,NOR}$ = 0.38, $P_{2\,NOR}$ = 0.45, $P_{3\,NOR}$ = 0.56, $P_{4\,NOR}$ = 0.52, $P_{5\,NOR}$ = 0.53

Let us consider w1= 0.9, w2=0.95, w3=0.85, w4=0.8, w5=0.9 are the weights to measure the actual QoS of the web service

Actual QoS = w1 x $P_{1\,NOR}$ + w2 x $P_{4\,NOR}$ + w3 x $P_{3\,NOR}$ + w4 x $P_{4\,NOR}$ + w5 x $P_{5\,NOR}$
=(0.34+0.43+0.48+0.41+0.47)/5
=0.426

Assured QoS=0.45+0.48+0.43+0.40+0.45
=0.440

Actual Cost = 0.426 x 1.2/0.440 = 1.16

Table 2: Average parametric values for the continues Billing Terms.

Parameters / Billing Terms	P1	P2	P3	P4	P5
Term I	758.6	5.7	86.6	87.8	84.8
Term II	754.1	6.7	87.7	88.8	85.6
Term III	748.9	7.4	88.3	88.4	86.5
Term IV	748.2	8	89.6	89.3	88.3
Term V	746.3	8	89.5	90.1	89.1

In the same manner the billing is done for every n requests and the corresponding actual QoS and cost for the web service is recorded as follows

Table 3: Actual Cost based on QoS for continues Terms.

Actual /Terms	Term I	Term II	Term III	Term IV	Term V
Actual QoS	0.426	0.441	0.448	0.492	0.511
Actual Cost	1.16	1.20	1.22	1.34	1.39

The graph for actual QoS for various terms shown that there is a remarkable improvement in quality over a period of time

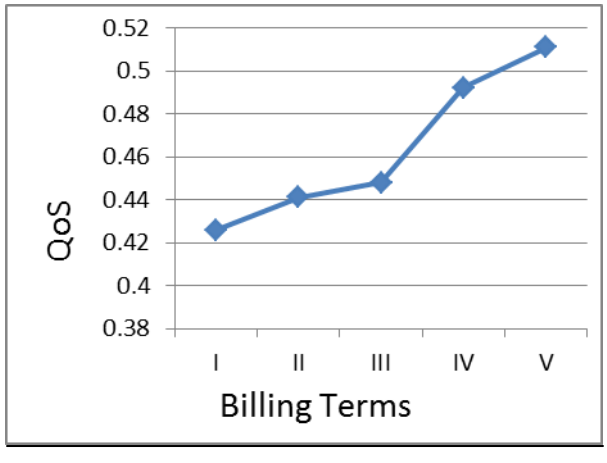

Figure 2: The Actual QoS values for continues Terms.

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The graph for actual cost for continues terms show that there is a benefit for the service provider when the QoS is increasing.

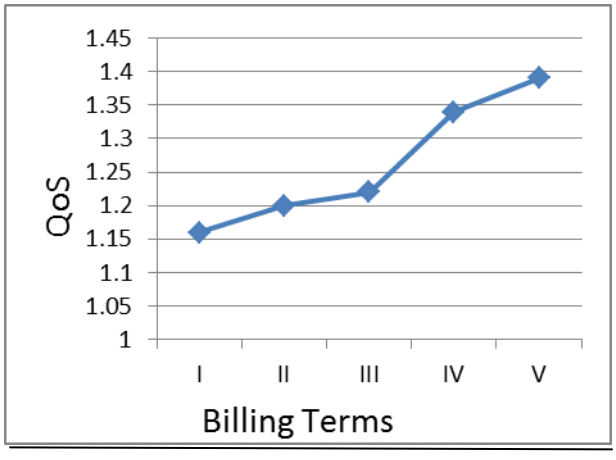

Figure 2: The Actual cost for continues Terms.

5. Conclusion and Future Work

This paper contributes to the calculation of actual cost of a web service over a period of time that allows the service consumer and provider with an optimal correlation between the quality and price. This system motivates the Provider to update the web service in regular interval of time by monitoring the actual performance. Also the customer can take measures to improve the Business performance by monitoring the increase in web service requests and other quality parameters. Here the base cost is fixed based on the assured QoS of the web service during its selection. But the actual cost is calculated based on the actual QoS by considering the non functional variant properties of the web service dynamically at runtime. The performance of the billing system have been studied and the change in QoS and cost are compared for continues terms of requests. The results show that there is a remarkable improvement in the QoS and actual cost of the service which will benefit both the provider and consumer. In future the business performance and invariant properties such as security, interoperability, and reliability are also considered to evaluate the actual cost.

6. References

[1] Al-Masr.E, Mahmoud,*" Discovering the Best Web Service"* In: WWW 2007, Banff, Alberta, Canada, pp. 1257-2589 (2007)

[2] Ruth Lenon, John Murphy, *"You can't always get what you want...-QoS in CWS*", Generative Programming & Component Engineering for QOS Provisioning in Distributor System, UAB Computer & Information Science.

[3] A.Mani, A. Nagarajan, *"Understanding Quality of Service for Web Services*", Developer works. 01 Jan 2002. www.ibm.com/developerworks/library/ws-quality.html.

[4] Dessislava Petrova-Antonova, *"Cost Dependant QoS based Discovery of Web Services*", Demetra EOOD (2010).

[5] Y.Mitsos, FAndritsopoulos, D.Kagklis, *"A Study for Provisioning of QoS Web-based Services to the end-user*", Proceedings of the SAC. ACM. March 14-17 2004. Cyprus.

[6] J.Cardoso, A.Sheth, J.Miller, J. Arnold and K.Kochur, *"Quality of Service for Workflows and Web Service Processes*. Journal of Web Semantics, Elsevier. 2004.

[7] R. Lennon, J. Murphy, *"Web Services Management and Selection"*: Applied Performance Mechanisms in Proceedings of ICCCN (San Diego, 2005), IEEE, 59

[8] C.Courbis, A.Finkelstein, *"Weaving Aspects into Web Service Orchestrations*", the 3rd IEEE International Conference on Web Services (ICWS), Orlando, (Florida 2005).

[9] J.Farrel, H. Lausen, *"Semantic Annotations for WSDL",* W3C Working draft standard. 30 June 2006. www.w3.org/ TR/sawsdl/

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