ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 1, pp: (358-363), Month: January - March 2015, Available at: www.researchpublish.com

# QoS Probing Of Real-World Web Services

SathishKumar [1], Anantharaj [2] , Chendhavarayan. R [3]

Student [1], HOD [2], Assistant Professor[3]
Computer Science Engineering, Thiruvalluvar College of Engineering and Technology, TamilNadu, India

***Abstract:*** **Quality of service (QoS) is extensively utilized for describing nonfunctional characteristics of web services. Although QoS of web services has been inspected rigorously in the field of service computing, there is a requirement of real-world web service QoS data sets for authenticating diverse QoS-based methods and models. To explore QoS of real-world web services and to offer reusable research data sets for future research, we carry out numerous large-scale assessments on real-world web services. Initially, addresses of 21,358 web services are gained from the Internet. Then, three large-scale real-world assessments are carried out. In our evaluations, more than 30 million real-world web service invocations are performed on web services in more than 80 countries by users from more than 30 counties. Comprehensive evaluation results are provided in this paper and complete web service QoS data sets are openly released online.**

***Keywords:*** **Web service; quality of service; service evaluation; QoS data set.**

## I. INTRODUCTION

WEB services have been emerging in current years and are by now one of the most admired methods for erecting distributed systems. Service-oriented systems can be built resourcefully by vigorously creating diverse web services, which are offered by new organizations. The quality-of-service (QoS)-oriented systems are extremely dependent on the quality of utilized web services. With the occurrence of web services on the Internet, examining quality of web services is becoming more and more vital.

QoS is extensively utilized for describing nonfunctional qualities of web services. With the increasing number of web services, QoS has become a significant distinguishing point of diverse functionally corresponding web services. Web service QoS comprises a number of properties, such as response time, throughput, failure probability, availability, price, popularity, and so on [1]. Values of server-side QoS properties (e.g., price, popularity) are typically publicized by service providers and indistinguishable for dissimilar users. Alternatively, values of the user-studied QoS properties (e.g., user-observed response time, throughput, failure probability) can differ extensively for dissimilar users, subjective to the changeable Internet connections and the mixed user environments [1].

In the field of service computing [2], a number of QoS based techniques have been employed for web service proposal [3], [4], [5], service composition [6], [7], fault-tolerant web services [8], [9], [10], web service search [11], and so on. Though, there is yet a need of widespread real-world web service QoS data sets for validating diverse QoS-based techniques. To get user-experimental QoS values of real-world web services, which are offered by dissimilar companies and vigorously employed by other organizations, assessments from diverse geographic locations under different network conditions are entailed. Though, it is not a simple job to perform large-scale web service assessments from distributed locations, because 1) web service invocations use resources of both service users and service providers; 2) it is time-consuming and exclusive to carry out real-world estimations on all the service candidates while the number of candidates is great; and 3) it is tricky to gather web service QoS data from distributed service users.

On the other hand, devoid of comprehensive real-world estimations, adequate web service QoS values cannot be gathered. It is therefore tricky to authenticate the probability and effectiveness of diverse QoS-based schemes in service computing. To attack this serious dispute, we perform a huge effort to carry out three large-scale distributed estimations on real world web services, collect widespread web service QoS data sets, and openly release these reusable data sets for future research. Initially, 21,358 web service addresses are gained by creeping web service information from the Internet. Then three web service assessments are performed. In the initial evaluation, failure probability of 100 web services is evaluated by 150 distributed service users. In the second appraisal, response time and throughput of 5,825 web services are estimated by 339 distributed service users. And in the third estimation, QoS changing of 4,532 web services with time is learned by conducting 30,287,611 web service invocations by 142 users in 64 time slots with a time interval of 15 minutes.

First hand practices on real world web service QoS are offered in this paper and reusable QoS research data sets are openly released for future research.1 Expanded from its preceding conference version [12], which states the experimental results of the first two assessments, the extensions of this journal version include: 1) offering thorough investigation and debates on the relationship between QoS values and time, and 2) illustrating the applicability of our data sets though engaging research topics of QoS prediction, web service selection, web service search, and fault-tolerant web services. Fig.1 shows the various locations of web services.

**Fig: 1. Locations of web services**

The remainder of this paper is organized as follows: Section 2 introduces related work. Section 3 presents our distributed QoS evaluations of web services and Section 4 concludes the paper.

## II. RELATED WORK

In service computing [2], numerous QoS-based techniques have been employed for web service recommendation [3], [4], [5], service composition [6], [7], fault-tolerant web services [8], [9], [10], web service search [11], and so on. Still, there is a shortage of real-world web service QoS data sets for validating these schemes. Exclusive of large-scale web service data sets, uniqueness of real-world web service QoS cannot be entirely mined, and diverse QoS-based schemes are thus tricky to be practical. In the earlier work [9], real-world web service estimation has been carried out by five service users on eight widely accessible web services. As the level of this trial is too small, the experimental results are not much helpful for future research. Al-Masri and Mahmoud [13] released a web service QoS data set that is viewed by only one service user on 2,507 web services. The actuality that dissimilar users will watch quite diverse QoS of the similar web service bounds the applicability of this data set. Our released data sets of this paper, alternatively, comprise QoS information examined from distributed service users, and in diverse time slots. Vieira et al. [14] performed an experimental assessment of security vulnerabilities in 300 openly existing web services. Security vulnerabilities are generally exist at the server-side and are user-independent (diverse users examine the equivalent security vulnerabilities on the aimed web service). Dissimilar from Vieira's work [14], this paper principally focuses on examining user-observed QoS belongings (i.e., failure probability, response time, and throughput), which can differ extensively among diverse users.

## III. QOS EVALUATION OF WEB SERVICES

Axis2 is employed to generate client-side web service invocation codes and test cases automatically. To evaluate real-world web services from distributed locations, we employ a number of distributed computers from PlanetLab4 to serve as service users. By deploying the web service evaluation codes to the PlanetLab computers, we can monitor the QoS of real-world web services from distributed locations. Since 2009, we have conducted three QoS evaluations and obtained three comprehensive research data sets which are provided in the following subsections.

***3.1. Data Set 1: Failure Probability:***

This evaluation concentrates on learning QoS property of failure probability, which is defined as the probability that an invocation on a definite web service by a user will fail. The value of failure probability can be roughly computed by dividing the number of failed invocations by the total number of invocations carried out by a user on a web service. In this estimation, each service user invokes all the 100 chosen web services for 100 times and proofs the detailed QoS values. A total of 1,542,884 web service invocations are carried out by the service users. By dealing out the experimental results, we achieve a 150 x 100 user-item matrix, where an entry $f_{x,y}$ in the matrix is the failure probability of web service y observed by service user x. The mean and standard deviation of all the 15,000 failure probabilities observed by 150 users on 100 web services are 4.05 and 17.32 percent, respectively, indicating that the failure probabilities of diverse web services perceived by diverse service users show a great deviation. Fig. 2 demonstrates the value distribution of failure probability, where although 85.68 percent of all the failure probability values are little than 1 percent, a huge part (8.34 percent) of failure probabilities still meet poor performance with values greater than 16 percent.

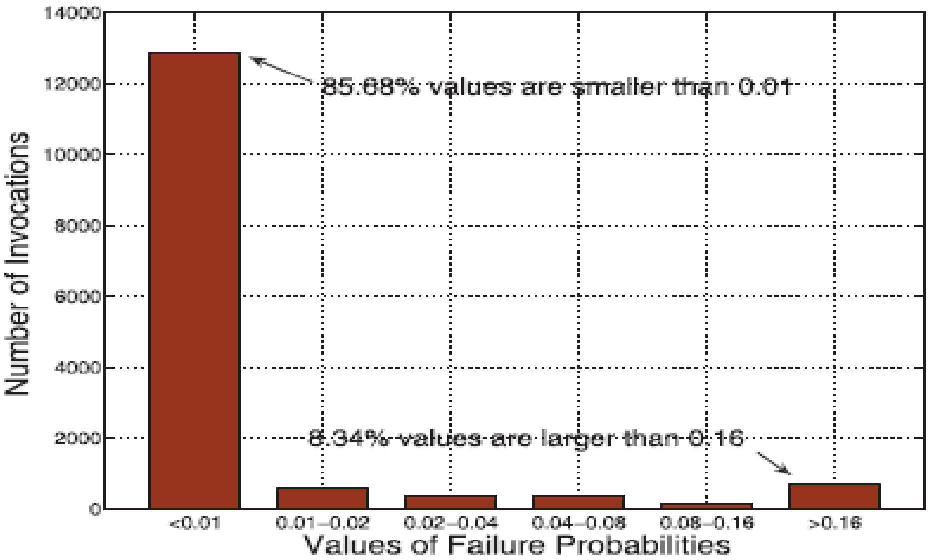



**Fig: 2. Value distributions of data set 1**

As demonstrated in table 4, amongst all the 1,542,884 web service invocations, there are a total of 58,184 invocation failures. The detailed failure information is summarized in table 1. These experimental observations on invocation failures demonstrate that 1) web service invocations can be unsuccessful simply, which can be sourced by gateway errors, networking errors, and server errors; and 2) in the service- oriented environment, offering trustworthy web services is not adequate for building trustworthy service-oriented system, because most invocation failures are originated by network errors.

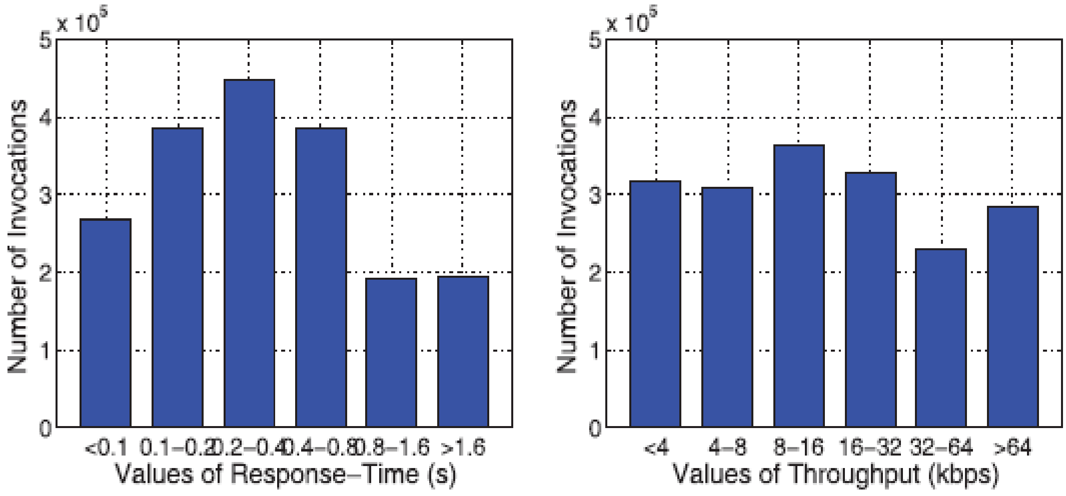
***3.2 Data Set 2: Response Time and Throughput:***

The second evaluation focuses on investigating the response time and throughput performance of web services. Response time is defined as the time duration between a service user sending a request and receiving the equivalent response, while throughput is defined as the average rate of successful message size (here in bits) delivery over a communication channel per second. As illustrated in table 5, a total of 1,974,675 real-world web service invocations are performed by 339 service users from 30 countries on 5,825 real-world web services in 73 countries in this assessment.

By processing the web service invocation results, we attain two 339 x 5,825 matrices for response time and throughput, correspondingly. Each entry in a matrix signifies the response-time value or throughput value perceived by a user on a web service. The mean and standard deviation of response time are 1.43 and 31.9 seconds, respectively, while the mean and standard deviation of throughput are 102.86 and 531.85 kbps, correspondingly. The large standard deviation values

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 1, pp: (358-363), Month: January - March 2015, Available at: www.researchpublish.com

indicate that response time and throughput include a wide range of values which are somewhat dissimilar with each other. Fig. 3 illustrates the value distributions of response time and throughput. Fig.3a demonstrates that most of the response-time values are smaller than 1.6 seconds and fig. 3b shows that most throughput values are smaller than 64 kbps.




(a) (b)

**Fig: 3. Value distributions of data set 2**

To present detailed illustration of the web service response-time and throughput values observed by dissimilar service users, we arbitrarily select two users (User 1 from the US and User 2 from Japan) to compare their response time and throughput performance on diverse web services. Although invoking the similar web services, values of response time and throughput are somewhat different of these two users. For an instance, response-time values of User 1 are around 6 seconds on the majority of the web services, while response-time values of User 2 is less than 2 seconds on the majority of the web services. The extended response time of user 1 may be originated by the poor client-side network condition. This experimental study specifies that diverse users may have dissimilar usage experiences on the similar web service, influenced by the network connections and the heterogeneous client-side atmospheres. As a result, distributed web service evaluation is significant for attaining precise user-studied QoS of web services.

**TABLE I: Invocation Failures of Data Set 1**

| **Descriptions** | **Numbers** |
|---|---|
| *(400) Bad Request* | *3* |
| *(500) Internal Server Error* | *26* |
| *(502) Bad Gateway* | *33* |
| *(503) Service Unavailable* | *609* |
| *java.net.SocketException: Network is Unreachable* | *3* |
| *java.net.SocketException: Connection reset* | *1,175* |
| *java.net.NoRouteToHostException: No route to host* | *415* |
| *java.net.ConnectException: Connection refused* | *619* |
| *java.net.SocketTimeoutException: Read timed out* | *4,606* |
| *java.net.UnknownHostException:* | *5,847* |
| *java.net.SocketTimeoutException: Connect timed out* | *44,809* |
| *Other errors* | *39* |
| *Total* | *58,184* |

***3.3 Data Set 3: Time-Aware Performance:***

As Internet is extremely dynamic, the user-examined performance (e.g., response time, throughput) of web services is varying from time to time, controlled by the user atmosphere, network condition, server workload, and so on. The third assessment of web services concentrates on examining time-aware performance of web services. In a total of 4,532 publicly available real-world web services from 57 countries which are monitored by 142 computers located in 22 countries in 64 diverse time slots. The time interval between neighboring time slots is 15 minutes. The complete response-time and throughput values of the 64 time slots are gathered. Wholly 30,287,611 real-world web service invocations are accomplished in this assessment. The means of response time and throughput are 3.165 seconds and 9.609 kbps, correspondingly. The standard deviations of response time and throughput are 6.12 seconds and 50.11 kbps, in that order. The large standard deviation specifies that these QoS properties embrace a wide range of values. The distributions of the response time and throughput are illustrated in figure 5. From the figure, we can perceive that most response-time values are between 0.1 and 0.8 seconds and most throughput values are between 0.8 and 3.2 kbps. In the vastly dynamic Internet environment, QoS of web services may vary from time to time. To examine the QoS value changing with time, we utilize the following equation to estimate the varying rate of QoS values between two adjacent time slots.

$$R_i = (Q_i - Q_{i-1})/Q_{i-1} \qquad (1)$$

Where $Q_i$ and $Q_{i-1}$ characterize the QoS values of the time slots i and i-1 respectively, and $R_i$ signifies the changing rate between these two time slots. To offer a detailed illustration of the web service response time changing with time, we arbitrarily choose a user and plot his/her experimental response time values on three dissimilar web services in the 64 time slots. Fig. 4 shows the response time values of these three web services in dissimilar time slots. From the figure, we can observe that 1) the user-observed response time performance of web services can vary dynamically with time. For an instance, web service 1 in the figure has relatively dissimilar response time values at diverse time slots. 2) The similar user may experience fairly diverse response time varying models on diverse web services. For an instance, response-time performance of web service 1 is more dynamic than web service 3 in the figure. This research observation specifies that QoS changing relates to web services, as dissimilar web services exhibit moderately dissimilar changing patterns for the same user.

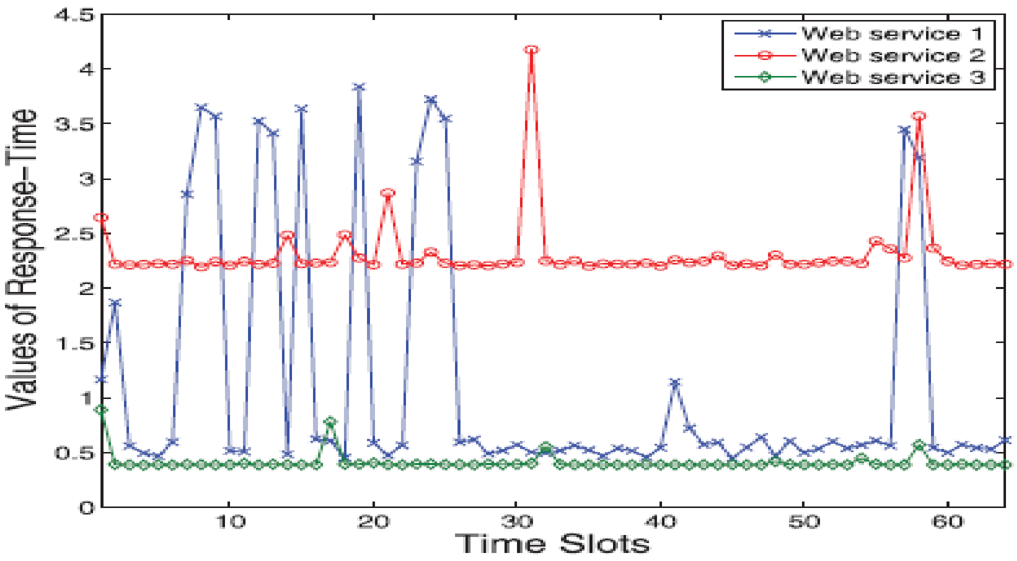



**Fig: 4. Response time of three web services**

## IV. CONCLUSION AND FUTURE WORK

This paper performs assessments on user-studied QoS of web services from distributed positions. A huge number of web service invocations are carried out by service users under heterogeneous environments on real-world web services. Complete experimental results are provided and reusable data sets are released. In our future work, in addition to failure probability, response time, and throughput, extra QoS properties will be explored.

## REFERENCES

[1] D.A. Menasce, "QoS Issues in Web Services," IEEE Internet Computing, vol. 6, no. 6, pp. 72-75, Nov./Dec. 2002.

[2] L.-J. Zhang, J. Zhang, and H. Cai, Services Computing. Springer, 2007.

[3] X. Chen, Z. Zheng, X. Liu, Z. Huang, and H. Sun, "Personalized QoS-Aware Web Service Recommendation and Visualization," IEEE Trans. Services Computing, vol. 6, no. 1, pp. 35-47, 2011.

[4] Z. Zheng, H. Ma, M.R. Lyu, and I. King, "QoS-Aware Web Service Recommendation by Collaborative Filtering," IEEE Trans. Service Computing, vol. 4, no. 2, pp. 140-152, Apr.-June 2011.

[5] Z. Zheng, H. Ma, M.R. Lyu, and I. King, "Collaborative Web Service QoS Prediction via Neighborhood Integrated Matrix Factorization," IEEE Trans. Service Computing, vol. 6, no. 3, pp. 289-299, July-Sept. 2013.

[6] M. Alrifai and T. Risse, "Combining Global Optimization with Local Selection for Efficient QoS-Aware Service Composition," Proc. 18th Int'l Conf. World Wide Web (WWW '09), pp. 881-890, 2009.

[7] L. Zeng, B. Benatallah, A.H. Ngu, M. Dumas, J. Kalagnanam, and H. Chang, "QoS-Aware Middleware for Web Services Composition," IEEE Trans. Software Eng., vol. 30, no. 5, pp. 311-327, May 2004.

[8] C.L. Fang, D. Liang, F. Lin, and C.-C. Lin, "Fault-Tolerant Web Services," J. System Architecture, vol. 53, no. 1, pp. 21-38, Jan. 2007.

[9] Z. Zheng and M.R. Lyu, "A Distributed Replication Strategy Evaluation and Selection Framework for Fault-Tolerant Web Services," Proc. Sixth Int'l Conf. Web Services (ICWS '08), pp. 145- 152, 2008.

[10] Z. Zheng and M.R. Lyu, "A QoS-Aware Fault Tolerant Middleware for Dependable Service Composition," Proc. 39th Int'l Conf. Dependable Systems and Networks (DSN '09), pp. 239-248, 2009.

[11] Y. Zhang, Z. Zheng, and M.R. Lyu, "WSExpress: A QoS-Aware Search Engine for Web Services," Proc. Eighth Int'l Conf. Web Services (ICWS '10), pp. 91-98, 2010.

[12] Z. Zheng, Y. Zhang, and M.R. Lyu, "Distributed QoS Evaluation for Real-World Web Services," Proc. Eighth Int'l Conf. Web Services (ICWS '10), pp. 83-90, 2010.

[13] E. Al-Masri and Q.H. Mahmoud, "Investigating Web Services on the World Wide Web," Proc. 17th Int'l Conf. World Wide Web (WWW '08), pp. 795-804, 2008.

[14] M. Vieira, N. Antunes, and H. Madeira, "Using Web Security Scanners to Detect Vulnerabilities in Web Services," Proc. 39th Int'l Conf. Dependable Systems and Networks (DSN '09), pp. 566-571, 2009.