Some Aspects of Implementation of Web Services in Load Balancing Cluster-Based Web Server

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ABSTRACT

We have designed, developed, and implemented SOAP-based web services in load balancing cluster-based web server and carried out load testing over the system. The roles of web services, such as client, broker, and service provider are segregated among different services. The system is monitored through a load testing tool, Mercury LoadRunner. The recorded system metrics are evaluated to study the overall performance and reliability aspects against different massive level of users. This article presents in detail the system architecture, testing methodology, and recorded system metrics. The statistical analysis is carried out to validate and correlate the overall assessment. This article also provides insights of some aspects of system metrics for deploying web services with segregated roles by using a cluster-based web server. It is observed that service with segregated roles is better than the service with merged roles. As a result, performance and reliability of the proposed system is observed to be better than other generic techniques for such deployment.

KEYWORDS

Load Balancing Cluster-Based Web Server, Load Testing, Service Oriented Computing, SOAP, Statistical Analysis, Web Service

1. INTRODUCTION

Globalizations of businesses through internet and service-oriented computing have provided the flexible opportunity to the users and enterprises to develop and deliver their services over network. These services, popularly termed as web services are becoming a promising technology to deliver interoperable services. They follow service-oriented architecture with some specific roles (Jones, 2005). The web services serve as: (i) service provider, (ii) requester, and (iii) broker. However, with the rapid growth of internet users, it is a good practice to serve consumers of web services without any server load errors. The inclusion of load balancing technique of clustering web server enhances the web server capacity to increase the server-side performances. However, clustering web server may impute some impact on the performance and reliability aspect of hosting web services. As such,

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evaluating such a system is an important concern from the perspective of end users. The software testers are the key persons who vigorously test the service-oriented computing based system. The concerned person should have a familiar knowledge about the system and the inputs to the operating environment to carry out the system testing effectively (Whittaker, 2000). A highly important factor is to verify that the system is scalable, stable and reliable against massive growth of web service consumers. As such, rigorous testing and statistical analysis are considered to be a good candidature for evaluating the overall quality of service-oriented system (Kalita et al., 2011). However, a data sample needs to be collected which describes the behavior of the running applications (Kallepalli et al., 2001). This work is an extended part of our study which is discussed elsewhere (Bora et al., 2013, Bora et al., 2015). In our previous work, we had deployed the architecture of client, broker and child web services in non-cluster-based web server and carried out the study over that. However, this paper presents the system metrics by deploying the web services in cluster-based load balancing web server. The experiment is carried out by gradually increasing the load over the cluster-based load balancing web server. This study considers such an architecture since now-a-days the software industries deploy multiple web services with different roles for computational implementation towards a goal. In this paper, the Simple Object Access Protocol (SOAP) based web services are deployed in load balancing cluster-based Tomcat web server. The novelty of the study is the highlights of the performance and reliability metrics of multi web services execution by using different cluster sizes of load balancing web server. A novel methodology is deployed which mimics the system’s behavior against different stresses of users if deployed in single server machine with different cluster sizes of web server. The system mimic can be defined as the way the web server machine with web service or other web architectures will perform as closely as possible like live server over internet. It gives an idea about the real-time assessment of web service-oriented system. The paper is also trying to cover the performance and reliability aspects of load balancing cluster-based web server for massive requests while executing multiple web services that can play the individual role as client, broker and service provider. The stability of cluster-based web server is better than non-cluster-based web server (Bezboruah et al., 2015), but what will be the quality aspects of cluster-based web server beyond and within its capacity limit? A detailed discussion on an experimental arrangement, testing results and statistical analysis is presented here.

The rest of the paper is ordered as follows: Section 2 describes an overview of related work followed by a classification of past studies. Section 3 describes the objectives and methodology of the proposed work. Section 4 describes the testing and evaluation of recorded metrics of web service execution. Section 5 describes the statistical analysis of the recorded performance metrics. The overview of results is discussed in section 6. Subsequently, a conclusion is made in section 7.

2. RELATED WORK

Over the years, many authors had discussed the importance of quality aspects of WS for service delivery over network-based protocol. Some of the authors had proposed complex scenario of measuring environment while the others had tried to solve specific issues. Some authors had highlighted the security aspects of service execution for delivering authenticated data to end users while the others had proposed the experimental arrangement for security implementation in WS execution. However, with rapid growth of consumers, the load over server-side execution is increasing exponentially. Nowadays, such deployment demands a specific care for handling massive service request. However, many approaches were made and discussed about the implementation techniques of load balancing cluster-based web server for handling massive growth of users. Cardellini et al. (2001) discussed a performance model of web cluster to highlight the quality aspects of service execution. They emphasized that different methodology for segregation of services over network server can be deployed to achieve better performance. In the study of Zhu et al. (2001), a discussion was carried out on a methodology for service differentiation by using cluster-based network server. The model delivers
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