

# Research of Load Testing and Result Application Based on LoadRunner

Zhang Hui-li

Dept of Electronic Information  
Zhengzhou Electric Power College  
Zhengzhou, China  
huiliwelcome@yeah.net

Zhang Shu

Dept of Substation  
Henan Shangqiu Power Supply Company  
Shangqiu, China  
6363512@qq.com

Li Xiao-jie

Dept of Electronic Information  
Zhengzhou Electric Power College  
Zhengzhou, China

Zhang Pei

Dept of Electronic Information  
Zhengzhou Electric Power College  
Zhengzhou, China

Liu Shao-bo

Dept of Electronic Information  
Zhengzhou Electric Power College  
Zhengzhou, China

**Abstract**—In this paper, we made the plan of a load testing, and got results by means of the LoadRunner which is an automatic testing tool. We fully considered the characteristics of the electronic commerce application, designed the reasonable test cases, and simulated the practical scenario. In the process of running LoadRunner, we arranged the appropriate transactions and rendezvous, and designed the truthful test network environment. The plan was applied to the load testing phase of the telecommunication equipment sales system of special products. We analyzed the load testing results, proposed the improving measures, and realized the optimization of the telecommunication equipment sales system.

**Keywords**- load testing; automatic testing tool; transaction; test script; telecommunication equipment

## I. INTRODUCTION

The application of electronic commerce become more and more wide in the Internet. With the increase in the number of the Internet registered users, the traffic of electronic commerce system is more and more big. This put forward higher request to the B/S application system performance about the electronic commerce.

For example: whenever the holiday sales on the Taobao, the pages of the specials on the Taobao will answer slowly, users always wait anxiously. So the performance test of the B/S application system before release is very important, the load testing is the important part of the performance testing. An electronic commerce system looks perfect, and the functions can accurately be realized. However, some problems can be found by means of the load testing, such as the pressure resistance of the system and the user experience. The effective implementation of the system load testing can predict bottleneck during the congested traffic, and can solve the problem before releasing the system.

This paper selected the electronic commerce system of telecommunication equipment sales as the test object, introduced the process of the load testing using the

LoadRunner as test tools, and found out restriction factor of the system operation based on the analysis of the test results, and then put forward the system improved scheme.

## II. LOAD TESTING

### A. Importance of Load Testing

Load testing is the process that set the service request web client number in the input, and gradually increase the client number of the web service request. The tester can get the client average response time, and compare the average response time after the client number is increased every time. The load testing of web applications will be able to evaluate the operation of all parts of the Web server, including the CPU, memory, process, hard disk response time, etc. Load testing can also evaluate the network movement situation, and monitor the cause of the delay caused by the network. The result of load testing can provide basis for the optimization of the web application system, and provide suggestions for overcoming the trouble of Internet delay.

The company should ensure that the release of the electronic commerce system can be successful operate, and this system must be able to load the access of a large number of users. So load testing is particularly import in all kinds of tests before releasing the system.

### B. Load Testing Tools LoadRunner

LoadRunner is a kind of load testing tools that can forecast the behavior and properties of the system. LoadRunner find and make sure the problem, through the simulation of millions of users implement concurrent load and real-time performance monitoring. Through the use of LoadRunner, enterprise can shorten test time in maximum limit, optimize performance , and speed up the release cycle of the application system.

The main steps of the load testing by means of LoadRunner include: making load test plan, test scripts, create running scene,

---

H.S. thanks Chinese Henan SheKeLian research project fund (SKL-2011-2740).

the running of load testing, monitoring scene, the analysis of results. LoadRunner contains many components, some important common are Visual User Generator (hereinafter referred to as VuGen), Controller, Analysis. LoadRunner advantages include: testers can create virtual users by means of the VuGen easily and set up test scripts; testers can quickly build the test plan of multiple virtual users by meaning of Controller; testers can observe the performance of the application system by means of the LoadRunner real-time monitor; testers can quickly find the position and the reason of the system's error by means of Analysis tools, and make the corresponding modification.

### III. THE IMPLEMENTATION OF THE LOAD TESTING

#### A. Making Load Test Plan

##### 1) Load testing goal

This paper implemented load testing for the e-commerce applications system by means of LoadRunner, analysed results, and improved the performance of the system based on the test results. The features of Electronic commerce application system: according to the increase of business, the access pressure of the system is more and more big. So the load testing goal is to find the bottleneck of the system during running the system, and ensure that the electronic commerce system can provide efficient access platform for the company.

This paper analogs the common operation process of the electronic commerce application system, such as browse, search goods, goods online shopping the conventional operation, and holiday sales promotion activity, limited discount, group buying and so on. This paper will create various running scene, find the bottleneck of the system, and put forward the system improvement measures.

##### 2) Design test case

When testers design load test cases, the testers should take the application characteristics of the electronic commerce system into consideration. At present, users accessing e-commerce sites are divided into three categories: browse the goods, according to a keyword search, online shopping goods. According to the survey, among them, 70% of users only browse the goods, but not do other operating; 26% of users use search column for commodities; only 5% of the users buy online.

Combining with the above the application characteristics of the electronic commerce system, after understanding the main function of the electronic commerce system in special products, testers design the load testing cases of the Web system. The load testing cases are shown in figure 1.

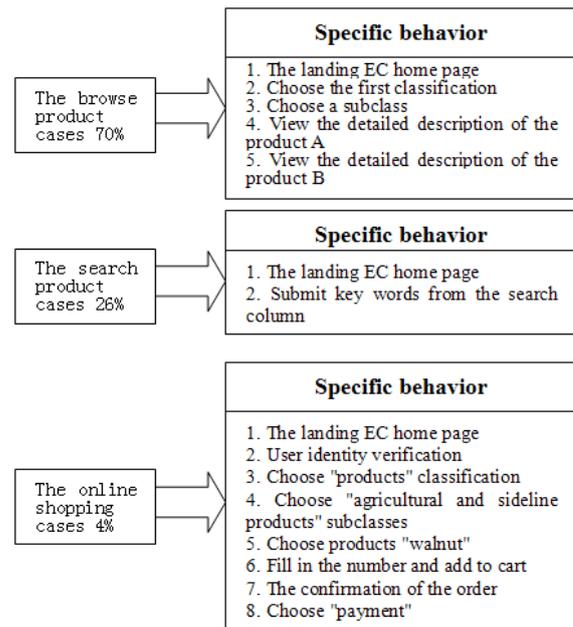


Figure 1. load testing cases

##### 3) The construction of the load testing environment

The load testing object of the telecommunication equipment sales system will be deployed on the server, so the network environment of the load testing simulated the practical environment of the running system. Considering the characteristics of the server's network environment, we built the open environment for load testing, instead of the local area network environment. The network topology for load testing is shown in figure 2.

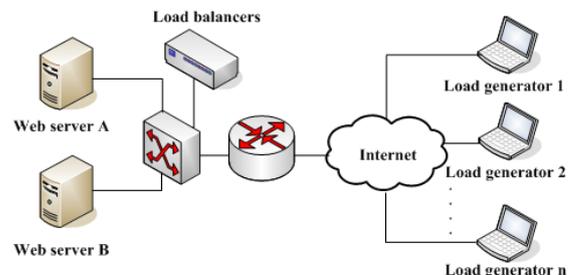


Figure 2. Load testing network topology

In figure 2, it is known that the load test environment including: web server, routers, switches, some computers running load generator, and Internet network environment. The network company providing leasing server business, will provide server load balance business generally, and the customer may put forward load balancing requirements according to needs.

#### B. Build Test Scripts

##### 1) Record test scripts

According to the above test cases, we recorded three test scripts by means of the Visual User Generator which is a

component of the LoadRunner. The three test scripts are the script of browsing commodity, the script of searching commodity, and the script of online shopping. Recording the script of browsing commodity refer to the specific behavior of "commodity browsing", recording the script of searching commodity refer to the specific behavior of "commodity search", and recording the script of online shopping script refer to the specific behavior of "online shopping".

Because the load testing object is B/S structure applications, we choice Web (HTTP/HTML) during record the scripts, and added the Web application system address. The VuGen script is divided into three parts: vuser\_init, vuser\_end and Action. If the tester will insert set-points into a script, they must record script to the Action part, because only the action part can be inserted set-points in the three parts of the VuGen.

### 2) The deployment of affairs

The usability of the basic script is generally not useful, tests need deploy affairs perfect script in the basic script, in order to analyze the response time of the typical operation, and to increase the script availability. There are two ways of the deploying affairs in the Script: first, during record the test script, testers will insert the Start Transaction of the affairs in the front of the sequence of operations, and insert the End Transaction of the affairs in the rear of the sequence of operations by means of the toolbar; Second, after record the script, testers insert the start and end points of the affairs in proper position according to the script meaning.

In order to check the load operation performance of the server, in the basic script the definition of key operation business is very necessary. In this paper, the load test, we perfected the three basic scripts. In the sc-browse, we defined the start point of T-browse before "the choice advocate classification", and defined the end point of T-browse after "check the detailed description of the product". In the sc-search, we defined the start and end point of T-browse at "search column submit key word". In the sc-buy, we defined the start point of T-buy before "user identity verification", and defined the end point of T-buy after "select a payment option".

### 3) The deployment of the set-points

The purpose of the deployment of the set-points in the test script is to measure the server performance index under the big pressure. In the test plan, the Web application system can handle up to 2000 people submitted at the same time request, can realize the load test and the effect of pressure using the method of LoadRunner adding set-point.

The deployment method of the set-point: testers insert a set-point before submission requests in the test script, when virtual users are running to the set-point, LoadRunner will check the numbers of users running to the set-point, if less than 2000 users, LoadRunner will command users reached the set-point to wait here, when the numbers of users reached the set-point is to 2000, LoadRunner orders 2000 users to submit the request to the Web server, testers realize the aim of the pressure test. The timing of the deployment of the set-points: testers can insert a set-point during record a script, also can insert a set-point after recording a script.

### C. Create Running Scene

Before running the load testing, in order to simulate the actual operation environment preferably, testers must create a reasonable operation scene by considering the reality.

In this paper the design scheme of the operation scene: there are 1000 virtual users in the operation scene, among them, 70% of the virtual users run the browsing script; 26% of virtual users run the searching script; 5% of virtual users run the online shopping script. Actual operation environment: 70% of the users only browse goods, and don't other operation; 26% of users search goods by the searching column; only 5% of the users order. The scheme fits the actual operation environment.

Because the amount of the 1000 virtual users is larger, if tester only configure a load generator, this will lead to the computer configured the generator overload, and most users scripts operate unsuccessful. Therefore, the system configured 10 load generators, and were running the script of 100 virtual users respectively.

There are three main stages during building the test schedule: pressure, duration and pressure. The configuration of the pressure has two kinds of cases: at the same time pressure, every two seconds 2 Vusers pressure. The configuration of the last time: scripts run completely, a scene operation continues to move 20 minutes; The configuration of the reduced pressure: LoadRunner stops all Vuser at the same time, LoadRunner releases 2 Vuser every 2 seconds. In the 10 generators, LoadRunner set up various scene generation, and there were no a repeat plan.

## IV. RESULT ANALYSIS

After starting the load testing, LoadRunner monitors the operation situation of the servers, through adding performance counters in the operation scene. LoadRunner can monitor the Web server, database server, network delay time operation indicators. The indicators monitored by LoadRunner include: Available Mbytes, Page/sec, etc. During scene operation, the resources figure of the Web server installed Windows server operating system is shown in figure 3.

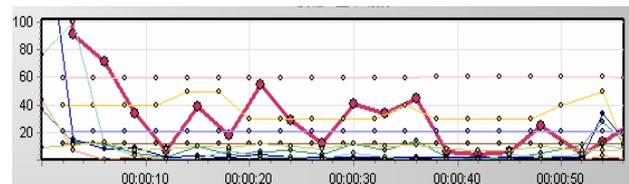


Figure 3. the resources figure of the Web server

## V. APPLICATION RESULTS

The application of the analysis results includes three main areas. First, testers analysed the response time of the affairs, so as to find the most slow response of affairs, consider solution from the network and code. The testers analysed the performance index of the server at the set-point, and find the best point of server resources utilization. During the running of the load testing, the testers analysed the resources consumption of the Web server, and optimized the server

operating system. In the load test results, affairs response time is shown in table 1.

TABLE I. AFFAIRS RESPONSE TIME

affair	Vuser number	response time (s)		
		Min	Max	average
T-browse	700	13.041	56.453	17.508
T-search	260	3.452	33.237	17.459
T- buy	40	4.307	23.649	13.493

We explained the application of test, by means of analysing affairs response time. In the three affairs of the script, the response time of the T-search affair is the longest. After analysis, the database access of searching operation is the most times, that leads to frequently access database application system, and the affairs response time become long.

According to T-search affairs response time longer, this paper put forward the improvement measures.

First, the Linq To SQL technology improved the efficiency of database access instead of the original ADO in the database access technology. Second, we set the storage process for the key searching word in the application system design. Third, in database design, we built the database index in order to speed up the database access speed. Fourth, we disintegrated the complex operation, and improved the system efficiency on the demand. Fifth, we improved the transmission medium, and introduced the high performance network equipment and the higher stability server on the network structure.

## VI. CONCLUSION

The load testing of the B/S application system is the necessary test process before releasing the system, and can find the bottlenecks of the Web application system under pressure.

We Combined with the characteristics of the electronic commerce system, and did the load testing and analysis the results of load test by means of the LoadRunner , and found the defect of the system when the massive users access the system, and guided the system improvement using the test results.

The load test plan and the application method are versatile, and widely value.

## REFERENCES

- [1] T. Wijayasiriwardhane,R. Lai,K.C. Kang et al.Effort estimation of component-based software development - a survey[J].IET software,2011,5(2):216-228.
- [2] E. Devaraj,S. Kumar,T. Kavi et al.Predicting the software performance during feasibility study[J].IET software,2011,5(2):201-215.
- [3] N. Upadhyay,B.M. Deshpande,V.P. Agrawal et al.Concurrent usability evaluation and design of software component: a digraph and matrix approach[J].IET software,2011,5(2):188-200.
- [4] T. Martinez-Ruiz,F. Garcia,M. Piattini et al.Modelling software process variability: an empirical study[J].IET software,2011,5(2):172-187.
- [5] R.R. Palacio,A. Vizcaino,A.L. Moran et al.Tool to facilitate appropriate interaction in global software development[J].IET software,2011,5(2):157-171.
- [6] Quan Zhou,Ruixiang Bian,Yuchun Pan et al.Design Of Electric Power Web System Based On Comet[C].//2009 Second International Conference on Intelligent Computation Technology and Automation (ICICTA 2009). Volume 3A.2009:42-45.
- [7] Guangzhu Jiang,Shujuan Jiang.A Quick Testing Model of Web Performance Based on Testing Flow and its Application[C].//2009 Sixth Web Information Systems and Applications Conference (WISA 2009).2009:57-61.
- [8] Guangzhu Jiang,Shujuan Jiang.A Quick Testing Model of Web Performance Based on Testing Flow and its Application[C].//2009 Sixth Web Information Systems and Applications Conference (WISA 2009).2009:57-61.