



Comparative Study of Web Performance Testing Tools

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Abstract- *Web Applications started to take a major part in the software industry. As the use of web applications is growing, maintenance of web applications is mandatory. Web performance testing is performed to determine the behavior of web applications under workload. Because of the limitations of manual testing for web applications, automated testing tools are used to determine the performance metrics like throughput, response time, transactions per second and download time of web applications. These tools provide the quality of service analysis and help to evaluate the service performance in real time network. This study aims to provide an evaluation and comparative analysis of six web performance testing tools namely JMeter, NeoLoad, WAPT, Loadster, WebLOAD and LoadComplete. The comparison of these tools is done on the basis of various features provided by them.*

Keywords- *Performance Testing, JMeter, NeoLoad, WAPT, Loadster, WebLOAD, LoadComplete*

I. INTRODUCTION

The aim of software testing process is to identify all the defects existing in a software product. It is the process of exercising and evaluating a system or system components to verify that it satisfies specified requirements or to identify differences between expected and actual results^[3]. Software testing is very important and crucial phase in the software development life cycle process that consumes 40% to 70% of software development process^[7]. There are two types of testing methodology i.e. Black-Box testing and White-Box testing. In Black-Box Testing, tests are based on requirements and functionality. In White-Box Testing, tests are based on coverage of code statements, branches, paths, conditions^[11].

Web applications^[2] can be considered as a distributed system, with a client-server or multi-tier architecture, including a wide number of users, web servers and web browsers, network connections, operating systems. Web applications are the fastest growing classes of software systems today. Web applications^[1] are being used to support wide range of important activities such as business transaction, scientific activities like information sharing, and medical systems such as expert system-based diagnoses. Web applications have been deployed at a fast pace and have helped in fast adoption but they have also decreased the quality of software. Therefore, all entities of web applications must be tested^[12].

Web-Performance testing is a type of testing that is performed to determine the reliability, throughput, interoperability and scalability of a web application under a given workload. Performance testing identifies bottlenecks of system and provides good quality of service to users. Performance testing is a non-functional type of testing performed to determine the speed, stability, reliability and scalability of the system. There are different types of web performance tests: stress tests, load tests, strength tests and volume tests^[10].

Core activities of Performance-Testing^[8]:

- 1) Identify Test Environment.
- 2) Identify Performance Test.
- 3) Plan and Design Tests.
- 4) Configure Test Environment.
- 5) Implement Test Design.
- 6) Execute Tests.
- 7) Analyze Report and Retest.

In the fast changing and highly competitive web-based business environment, it is critical for organizations to test their web sites and web applications using a manual testing tool. So an automated web testing should ensure that the functionality of web applications/web sites/web services is correct and provides the ability to reuse and extend the tests across multiple browsers / platforms/ languages / databases / servers and ensure that all the users accessing the web applications get results in an acceptable time^[7].

II. TESTING TOOLS

Software testing is the process of executing a program to verify its functionality and correctness. Software testing is mostly deployed by programmers and testers.

Manual testing is a process which is carried out manually by the tester; usually follow a test plan comprised of test cases. On the other hand, automated testing is done with the help of automated test tools.

There are many benefits of automated testing like: i) Performance testing can be done without the need of many computers and test engineers ii) Improvement in quality and reliability of software iii) Test reports can be generated automatically for later analysis and corrective action.

In this paper six web performance testing tools namely JMeter, NeoLoad, WAPT, Loadster, WebLOAD, LoadComplete have been considered. Theoretical analysis of these tools is done for their study.

III. A BRIEF OVERVIEW TESTING TOOLS

There are a number of performance testing tools available in the software market. Although the functions of these tools are similar, but they are differ in features, usability and interoperability.

Keeping in view the above-mentioned aspects, representative web performance testing tools are selected for comparison. A brief description of each of them is presented below.

A. JMeter

The Apache JMeter^[4] is pure Java open source software, which was first developed by Stefano Mazzocchi of Apache Software Foundation designed to load test functional behavior and measure performance. It was originally designed to test Web Applications but has since expanded to test other functions.

General Feature:

1. JMeter has ability to load and performance test on many different server/ protocols types like HTTP, HTTPS SOAP/REST, FTP, JDBC, LDAP, JSM,SMTP(S), POP3(S) and IMAP(S),TCP.
2. It is totally free, allows developer to use the source code for development.
3. It allows concurrent and simultaneously sampling of different functions by a separate thread group.
4. JMeter is 100% pure Java desktop application. So it can run on multiple platforms.
5. It is highly extensible, so it is easy to write own tests. JMeter also supports visualization plug-ins that allows extending testing.

B. NeoLoad

NeoLoad^[9] is load and stress testing tool to measure the performance of web and mobile applications. NeoLoad is designed, developed and marketed by Neotys. It is proprietary tool and only supports Windows, Linux and Solaris.

General Features:

1. NeoLoad works by simulating millions number of users in order to determine application performance under load and analyze response.
2. NeoLoad scripts are developed via GUI. Java scripts may be inserted for more advanced uses.
3. NeoLoad can record HTTPS requests and play them back.
4. NeoLoad supports ActiveX components as long as communication with the server is via HTTP protocols.
5. NeoLoad support many Web Applications including those using J2EE, .NET, AJAX, Flex, Silverlight, GWT and SOAP.
6. NeoLoad support hybrid and native mobile applications.
7. NeoLoad supports video (HTTP streaming and RTMP).

C. WAPT

WAPT^[13] (Web Application Performance Testing) tool is a load and stress testing tool that provides an easy way to use and cost effective way to test any web sites, including business applications, mobile sites, web portals etc. WAPT is available in version:-

- Standard version
 - Professional version (WAPT Pro) as stress and performance tool.
- WAPT is designed and market by Softlogica LLC.

General Features:

1. WAPT provides accurate simulation of real users.
2. In WAPT different behavior for each type of user can be specified and add to the test as many user types needed.
3. It can be used to test web sites implemented with any modern technology including AJAX, ASP, ASP.NET, Java, Perl, PHP, Python and Ruby etc.
4. WAPT supports the testing of web sites and applications secured by SSL

D. Loadster

Loadster^[6] is load and stress testing tool for testing dynamic web applications, websites and HTTP web services. It has having script recorder that record HTTP and HTTPS scripts from web browser easily. Loadster is provided by Brickyard Technologies, Inc. dba Loadster performance (LP).

General Features:

1. Avoid extensive crashes, slowness and downtime by simulating peak traffic conditions
2. It tests from both side of firewall. It works equally well on private networks and the public networks.
3. Scripts can be created by using graphical script editor.

4. It provides parameterization of scripts to handle dynamic content with validation rules, customer header and response capturing.

E. WebLOAD

WebLOAD^[14] is load testing tool to test Web Applications. It combines performance, scalability and integrity as a single process for the verification of web and mobile applications. It is developed and market by Readview Software

General Features:

1. Test creation is easy with graphical scripting language. No coding requires.
2. With WebLOAD it is simple to turn a recorded script into an execution ready test with automatic identification of dynamic values.
3. WebLOAD is used for cloud load generation.
4. WebLOAD analyzes multiple sources and types of data in order to precisely indentify bottleneck and root causes
5. Web applications in mobile and multi-device environments can be tested with WebLOAD. Also script can be directly recorded from the mobile device or from a simulator.

F. LoadComplete

LoadComplete^[5] tool is used for stress and load testing for mobile and web applications. Its community edition is free to use. It is designed and market by Smartbear Software.

General Features:

1. It record and replay realistic application scenarios in order to create load tests without writing script.
2. It creates different rules for checking not just server response code, but also the message content received from server.
3. Comprehensive analytics and customized reporting.
4. On demand load generation from the cloud. With LoadComplete load can be generated as much as needed for public or private cloud within just few seconds.
5. LoadComplete allows testing performance of native, web and mobile Applications. It simulate large amount of traffic from smart phones and tablets over a variety of network connections.

IV. FEATURES FOR COMPARISON

For the evaluation of tools various features provided by the tools are selected. The features, which are important for the effective performance testing, are considered for the study. The main features considered for analysis are as:-

- Technologies support.
- Operating system support.
- System requirements.
- Protocols support.
- Scripting Interface.
- Record and playback.
- Monitoring.
- Load generation.
- Correlation
- Reporting and Analysis.
- License.
- Cost.

• Technologies Support:

Many new technologies AJAX, Flex, Siverlight have been developed in nowadays. These technologies provide the advanced features to create highly interactive and intuitive web applications.

• Operating system support.

There are many operating systems. Performance of tool can be evaluated on these operating systems. It is essential to study the compatibility of tool with operating system.

• System requirements.

Various hardware and software requirements are there that need to study before implementing the tool. System requirements specify the minimum requirements to install and to implement the tool.

• Protocols support.

The communication protocols that can be captured manipulated and replayed by the tool. It is necessary to study the Protocols supported by the tool in order to check which type of web applications can be tested using a particular tool.

• **Scripting Interface.**

Scripting in the tool can be done by programming or by using graphical user interface. Scripting interface is the interface supplied by the tool application for the purpose of script editing.

• **Record and playback.**

Record the server request and response to browser and replay the script.

• **Monitoring.**

Resource information is captured during execution. It can be shown during execution and used to build performance reports. CPU usage, memory usage or network bandwidth are monitored.

• **Load generation.**

Primary task of a web-application performance-testing tool is to generate load. Load to a web application is generated by simulating network interaction between the client browser and the application server.

• **Correlation.**

It is the task of substituting values in dynamic data to enable successful playback. Most tools support automatic correlation of user session variables. The feature is very important for scripting complex applications such as enterprise class specifications.

• **Reporting and Analysis.**

It is the facility to examine and investigate the result of a test including timers and monitoring resources and display the result in graphical format. Based on this report, it is possible to evaluate the test session and the behavior of the tested application under the load.

• **License:**

It is a legal instrument governing use of redistribution of software. Under United States Copyright Law all software is copyright protested except material in the public domain.

• **Cost:**

It is the cost of tool, commercial tools include cost for:

- Controller
- Monitors
- Tuning modules

Trial versions of commercial tools can be downloaded from their vendor’s website.

V. COMPARISON OF TOOLS

Six tools namely JMeter, NeoLoad, WAPT, Loadster, WebLOAD and LoadComplete are selected for analysis. These tools are validated for all the features that are discussed in previous section.

The analysis of tools is done by validating them for the features that are considered important for the selection of a performance testing tool. A comparative evaluation of tools is presented in the given table.

Table1. Comparison of Web Performance Testing Tools

Features	Tools					
	JMeter	NeoLoad	WAPT	Loadster	WebLOAD	LoadComplete
Application support	Websites, database, LDAPs, Web services	Mobile applications, Web applications implemented with Silverlight, Flex, Ajax, .NET, J2EE	Mobile and web applications implemented with Ajax, ASP, ASP.NET, ColdFusion PHP, Python, Ruby, RIA applications	Web applications and HTTP web services	Web 2.0 technologies like web services, SOA, Ajax	Web applications, RIA technologies, Adobe Flash, Flex, and Microsoft Silverlight.
System requirements for installation	JDK 1.6+, no minimum requirement for disk space and operating system	2GHz or fast processor, 1GB RAM 500MB disk space.	50-500 MB disk space, 2 GB RAM, Pentium4/ Athlon or better CPU, Gigabit Ethernet	2GHz or fast processor, 1GB RAM, 1GB disk space	800 MHz or faster processor, 1GB RAM, 2 GB hard disk	2 GHz of faster processor, 1GB RAM, 1GB of Hard Disk

Operating System	Cross platform	Windows, Linux, Solaris	Windows	Windows, Mac, Linux	Windows, Linux	Windows
Protocol support	HTTP, HTTPS, JSM, IMAP, SOAP, FTP, SMTP, TCP, JDBC, LDAP, POP3	HTTP, HTTPS, GWT, RTMP, SOAP, SPDY,	HTTP(S)/ SSL	HTTP	LDAP, FTP,HTTP, HTTP, HTTPS, POP3, SMTP, IMAP, SSH, TCP, UDP	HTTP, HTTPS, AMF Protocol, SOAP, JSON.
Scripting interface	Use BeanShell Scripting Sampler	Script less design. use only drag and drop functions into script (Java Script can be used for most advance cases)	Script less, code free interface and no scripting language is required	Script editor is used for scripting that support Java Scripts	Support scripting scenario and edit script using GUI	Provide User Interface for script editing, no scripting language is required.
Record and playback	Record HTTP(S) scripts using HTTP recorder	Record all the server requests and responses. Also record HTTPS requests and play them back	Record and playback HTTP(S)/SSL pages	Record and playback HTTP and HTTPS scripts	Provide mobile and HTTP script recording and playback feature	Record HTTP scripts
Monitoring	No inbuilt feature for server monitoring. It can be achieved by using JMeter Plug-ins	Collect the information from the server infrastructure via its monitoring module	Measure various parameters of the web server performance using WMI ,SNMP protocols	Monitor server and provide throughput, response time, CPU usage and errors	Collect client and server side parameters with the help of PMM (performance measurement manager)	LoadComplete Test engine are used to track server parameters.
Load Generation	Load can be increased by distributing the load generation to multiple JMeter servers.	NeoLoad's distribution architecture allows applying high loads on server up to million virtual users at a time. On premise load generators are provided without extra charges	WAPT Pro allows using two systems for load generation. Load can be increased by purchasing additional load agents license	Generate load using virtual users from both dedicated load engines and Loadster Cloud.	Generate unlimited load using WebLoad generator by simulating hundreds of virtual user	Generate load using cloud, virtual machines and on-premise computers
Correlation	Correlation is done manually. It can be achieved by using Regular Expression Extractor in Jmeter	Provide automatic correlation. Provide Smart extraction of data and dynamic links from pages without any scripts	Provide automatic correlation for dynamic values	Provide automatic correlation	Provide automatic correlation for dynamic values	Provide automatic correlation for dynamic parameters and manual correlation for RIA technologies
Reporting	CSV, XML, Tables, graphs, trees and log files	HTML, PDF, Microsoft word or XML format	HTML and MS Excel format	HTML format	Provide customized report format that may be HTML,DOC ,XLS,PDF,C	Provide the detailed reports with response time, throughput and error metrics.

					SV,RAW, ODT etc.	
License	Apache license 2.0	Proprietary tool	Proprietary tool	Proprietary tool	Proprietary tool	GNU LGPL
Cost	Free	Depends on number of virtual users	\$700- \$1200	\$79- \$499	Depends on number of V. U.	Free

VI. CONCLUSION AND FUTURE SCOPE

In this paper six web performance testing tools Apache JMeter, NeoLoad, WAPT, Loadster, WebLOAD and LoadComplete are compared on the basis of their features. Each tool has its own specification and selection of tools depends on the features like cost, operating system support, monitoring, reporting etc. It is observed that NeoLoad, WAPT, Loadster and WebLOAD provide more features than JMeter and Load Complete; on the other hand JMeter and LoadComplete are free of cost. JMeter and LoadComplete can be used to test small web applications and others can be used to test enterprise web applications.

The evaluation of tools is based on their theoretical analysis. The products are still evolving and their capabilities change with each release. Only six tools have been used for the study but there are number of performance testing tools that provide more features and functionalities other than the ones mentioned here. So research can be extended by adding more tools and more functionality for evaluation.

However, in the present study it is concluded that NeoLoad is the best tool among the selected tools based on the parameters considered for evaluation of the tools.

REFERENCES

- [1] Dr. S.M. Afroz, N. Elezabeth rani, N. Indira Priyadarshini, "Web Application: A Study on comparing Software Testing Tools", International Journal of Computer Science and Telecommunications, Volume 2, Issue 3, 2011.
- [2] Gleseppe A. Dihucca, Anna Rita Fasolino, "Testing Web Based Applications: The state of the art and future trends", Science direct, Vol. 48, No. 12, December 2006.
- [3] Innovative approaches of automated tools in software testing and current technology as compared to manual testing, Global journal of enterprise of information system, jan 2009-june 2009.
- [4] JMeter, <http://jmeter.apache.org/>, accessed on 7 Jan. 2015 at 800 hrs.
- [5] LoadComplete, <http://smartbear.com/product/loadcomplete/overview/>, <http://loaduiweb.org/>, accessed on 5 April, 2015 at 1100 hrs.
- [6] Loadster, <https://www.loadsterperformance.com/>, accessed on 10 March, 2015 at 1400 hrs.
- [7] Monika Sharma, Rigzin Angno, "Web Based Automation Testing and Tools", International Journal of Computer Science and Information Technologies, Volume 5, Issue 1, 2014.
- [8] Ms. S. Sharmila, Dr. E. Ramadevi, "Analysis of Performance Testing on Web Applications", International Journal of Computer and Communication Engineering, Volume 3, Issue 3, March 2014.
- [9] NeoLoad, <http://www.neotys.com/product/overview-neoload.html>, accessed on 21 Jan. 2015 at 1300 hrs.
- [10] Rina, Sanjay Tyagi, "A Comparative study of Performance Testing tools", international Journal of Advance Research in Computer Science and Software Engineering, Volume 3, Issue 5, May 2015.
- [11] Shivkumar Hasmukhrai Trivedi, "Software Testing Techniques", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 10, October 2012.
- [12] Vinayak Hegde, Pallavi MS, "Web Performance Testing: Methodologies, Tools and Challenges, International Journal of Scientific Engineering and Research, Volume 2, Issue 1, January 2014.
- [13] WAPT, <http://www.loadtestingtool.com/>, accessed on 15 Feb. 2015 at 1500 hrs.
- [14] WebLOAD, <http://radview.com/>, accessed on 25 March, 2015 at 1100 hrs.