

A Study on Performance Analysis of Web Services Using Various Tools

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Abstract – Testing is an important stage of SDLC that determines the performance and accuracy of the software. Performance testing helps to understand the reliability, scalability, responsiveness, and throughput of software under a given workload owing to its popularity. Web services are increasingly used in web applications and testing them is comparatively difficult with regards to traditional applications in terms of unpredictable load, response time etc. This review paper presents a comparative study of web service testing tools by measuring response time and throughput. Moreover, after thorough examination changes are recommended for web services and testing tools.

Keywords- Web services, LDAP, HTTP, generic TCP connections, JMS and native OS processes, GUI

I. INTRODUCTION

Performance Testing is done in order to determine the throughput as well as the response time on any software or application. This also helps in calculating the time required to perform a task or run an application in the whole system. Additionally, performance testing also helps in meeting the non-functional requirements that are listed in SRS (Software Requirement Specification) document. Owing to popularity of websites, it becomes important to test them for performance before their launch. In relation to websites, performance tests can be used to calculate load handling capacity, reliability and speed. Several types of performance tests exist like volume test, strength test, load test and stress test. Testing tools empower a tester to develop, manage and perform test for a specific environment, for a specific test and for a specific application. There are several key issues that are identified in performance testing like the compatibility between the tool and the software, installation and setup of the tool and features available in testing.

Response Time is defined as the time taken by the application or the software to provide response to user's request. During the time of load testing, one should come to know about how much time is been taken by the API, website or application while handling the request and how is the response time fluctuates as per the load.

Throughput tells about the number of transactions an application can handle per second and the amount of transactions produced over time during a test. Lot of users make request for each application to ensure that load and performance are as desired.

The rest of this research paper is structured as follows: The subsequent section talks about the reviews of various

literatures and studies conducted around this area and analyses them. Section 3 describes the experimental study undertaken in order to achieve the objectives of this research. Section 4 finally concludes the section with formulating insights.

II. RELATED WORK

It describes the comparative study of web service testing tool for the parameters response time and throughput.

JMeter - It is created by the Apache Software Foundation (ASF) and is an open-source testing tool that can be used by anyone. Initially developed only to test web applications, JMeter now finds its use in other applications as well. JMeter finds its application mostly in load testing of client/server applications but it can also be used for performance testing as well as in regression testing. JMeter supports the multithreading architecture that allows sampling several threads together like concurrently sampling different thread groups of different functions. To offer high extensibility, pluggable components are also supported by JMeter like visualization plug-ins, samplers and timers. JMeter offers a user-friendly GUI that lets users to configure and set-up a test plan and create testing environment with minimal efforts. The results of JMeter can also be obtained in the form of graphical analysis and statistical reports apart from tabular form. The latest release version of Jmeter is 2.8.

SoapUI - SoapUI is an open source-testing tool to test web services as well as Service Oriented Architecture (SOA). It is offered under the GNU LGPL and is developed by Smart Bear Software. It facilitates not only execution of automated functional tests but also allows quick development of

advanced performance tests. By analyzing the quality as well as performance of applications and services, SoapUI helps in evaluating and improving the performance of web services. SoapUI has an easy-to-use GUI and can perform a wide range of tests by providing numerous features.

Storm - It was developed by Erik Araojo an open-source tool in F# language to test web services. It is distributed under the BSD license and is freely available to anyone who wants to use it. Numerous applications and web services that are written using frameworks like Java, .Net, etc. can be easily tested using this software. Storm has a user-friendly and very simple GUI that saves time and boosts the testing schedule. The latest released version of Storm is r1.1-Adarna.

III. RESEARCH METHODOLOGY

Comparison Approach (Response Time) - To compare the performance of the testing tools, a sample of three web services is taken. The details about the sample web services taken are shown in Table 1. To run and test every web service and gather results, each tool is configured accordingly. The configuration process consists of installing the testing tools, setting up the testing environment and parameters, collecting test data, analysis of reports generated, etc. The tests are performed over a machine having Microsoft Windows 7 ultimate operation system with Intel Core 2 Duo 2.0 GHz processor and 3GB RAM. The machine also had a 2Mbps of DSL internet connection. To obtain fair and transparent results, tests were conducted four times at regular time gaps in a day. It was done to minimize the noise effects in tests rendered because of internet connection and also to obtain realistic results. The internet performance depends on several factors like subscribed users, internet traffic, time of day, etc.

Table 1: Sample web services

ID	Web Service Name	Description	Publisher
W1	TempConvert	Conversions from Fahrenheit to Celsius and vice versa.	W3Schools
W2	Weather	Provisions to obtain weather of the city	CDYNE Corporation
W3	Zip Code	Depending upon the supplied zip code, it returns city states.	Ripe Development LLC

Table 2: Maximum and minimum response time for web services obtained via testing tools

Tool	Web Service ID	Response Time (ms)							
		12:00 AM		6:00 AM		12:00 PM		6:00 PM	
		Min	Max	Min	Max	Min	Max	Min	Max
JMeter	W1	1237	4906	1056	4304	1077	1921	1147	4320
	W2	1880	18276	1121	16087	1595	19056	1523	18984
	W3	954	25660	806	3852	866	10023	912	7052
soapUI	W1	334	1423	300	1158	307	1424	299	4048
	W2	557	60011	315	12062	402	6124	527	16096
	W3	639	7113	534	6750	576	9761	625	7002
Storm	W1	666	3581	577	1482	593	1298	624	1794
	W2	1060	15179	619	99013	718	7318	936	32417
	W3	998	7634	822	2246	852	6895	936	4103

The internal architecture and process of each tool is different to perform the tasks. On the basis of this factor, a comparison criterion is made to analyze the response time of different tools. The different values of the maximum and the minimum time of different tools at different time intervals in displayed in Table 2. From the table, it can be concluded that the most optimal values are obtained at 6:00 AM. From this observation, it can also be inferred that the internet connection is well connected at his time and this is also reflected in the response time results. The figure below summarizes the average response time for each web service.

It can be observed from the above results that JMeter take maximum time in responding to web services. It is also observed that SoapUI outperforms other testing tools and can thus be considered as the fastest testing tool while computing response time.

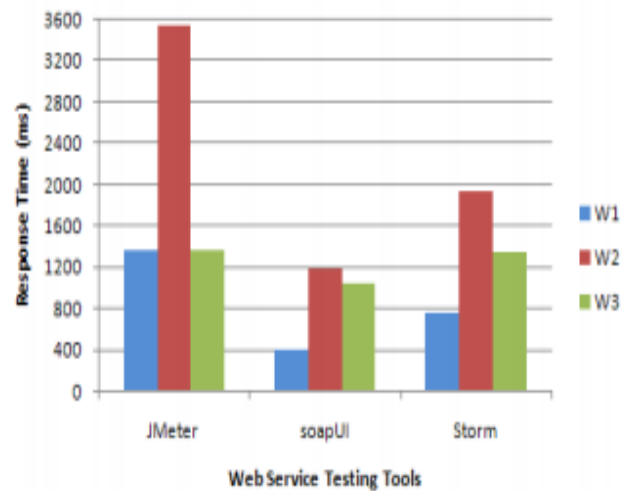


Figure 1: Average response time of sample web services as per different testing tools

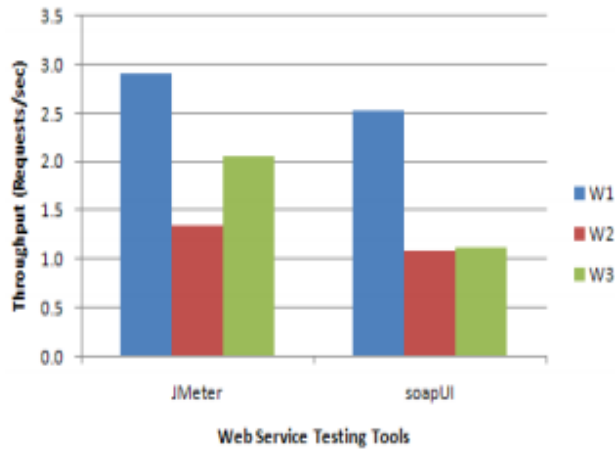


Figure 2: Web service testing tools

1) Comparison Approach (Throughput) - Only SoapUI and JMeter supports the throughput testing. From the below figure, it can be concluded that SoapUI has less throughput than JMeter. While the JMeter shows the increase by 14.5% and 24% in throughput of W1 and W2 web service respectively, it shows 84% more throughput than SoapUI. Thus, JMeter is seen to outperform SoapUI in terms of throughput.

A comparative study showed that SoapUI is the fastest testing tool in the context of response time. (Hussain et. al,)

Jmeter - The tester creates the scenario and records test script. Under Test Plan, the thread group is selected. In this group the number of times the user will hit the site and time is defined. Workbench in Apache Jmeter is like an environment used for rough work. Prior to saving the test plan, the test script is recorded in workbench. After this the work is transferred to Test Plan section and the script is saved. Here the script is recorded and the output is saved in Thread Group. The summary of the recorded script is displayed in Test Plan section.

LoadRunner - The components of LoadRunner used in this research are Virtual User Generator (VUG), Controller and Analyzer. VUG is used to record the script. Controller is used to manage and maintain the scenarios and control VUsers in a single work environment. It is an important component of LoadRunner because LoadRunner uses Controller to emulate the real-time users. Controller configures the number of VUsers, run-time setting, load test duration, start and end of execution of scripts. A detailed analysis of the performance test is undertaken in analyzer component of LoadRunner. Controller creates the dump during the load test execution. This dump holds the overall information in raw version and to generate the results in the form of graphs, it needs to be parsed by an analyzer.

Web Service Name	Description	Publisher
Loan Calculator	Calculation of monthly loan payment.	Javascript kit
BMI Calculator	Calculation of Body Mass Index	Smart BMI Calculator

Figure 3: Sample Web Services

1) Comparison Approach (Response Time) - The below figure depicts the performance testing results that were obtained from the tests conducted on selected web services. To get a better analysis of the performance results, comparison between the results obtained from different testing tools is necessary

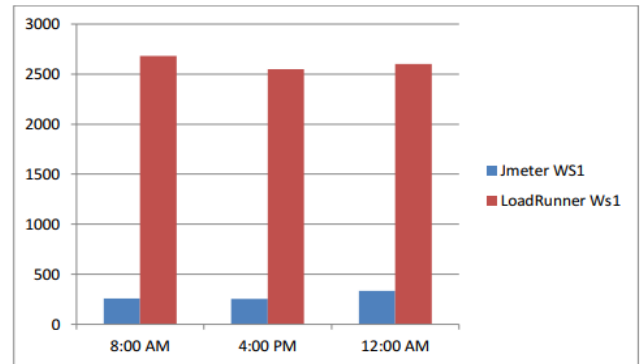


Figure 4: Average Response Time Result for WS1

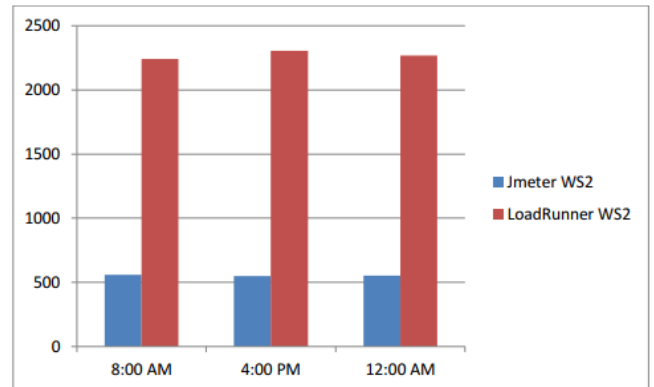


Figure 5: Average Response Time Result for WS2

A comparative study showed that the average response time is better of Apache JMeter than that of HP LoadRunner. (Khan, 2016)

Soapui Pro – This tool was developed under the GNU license by the Smart Bear. It is an open-source testing tool for web services and is developed using java. It has a very simple easy-to-use GUI that makes it easy to work with REST and Soap based web services and it also supports cross-platform testing. It is a next level version of SoapUI with added features that make increases its usability, productivity and efficiency.

Wcf Storm - It is an open-source testing tool, developed in F# framework by Erik Araujo, to test web services. Various web services that are written using Java, .Net or any other framework can be tested using it. The GUI is very user friendly. The speed and productivity is high as multiple web services can be tested simultaneously that not only accelerates speed of execution but also saves time.

Apache Jmeter – It is a load testing tool that is developed by ASF. It is mainly used to measure and analyze the performance of numerous web applications. Additionally, it can also be used for functional testing. The scope of Apache JMeter increases more for offsite developers can the functionality can be easily extended by installing the custom JMeter plug-in.

Wizdl - Developed in C# language, it is a dedicated .Net utility. The import and testing of web services is done a faster way by executing it under the Windows Form GUI. An interface is created dynamically wherein data can be entered as per the test case and service execution can be done post to it. The tool also provides an additional feature of storing the data in Extensible Markup Language (XML) format that can be used later for regression testing purpose.

WebInject - This tool is used to test web services and applications. It offers a report of the testing results at the same time and this makes the monitoring of the application more effective. A wide range of test case can be executed using this tool in a reasonable time. The architecture of this tool includes a GUI and WebInject Engine. The test cases are submitted in the XML format and the results obtained are also present in the same format. This tool can be used as a standalone tester or can be integrated with other applications to increases the scope. The tool is developed using Perl and can be executed on any platform that supports Perl interpreter. The binary executable file this testing tool is available only for MS windows systems.

Comparison Approach (Response Time) - The tests were executed concurrently over the same network. Two types of test cases were included in the input: valid test cases and invalid test cases. To obtain the efficiency of the testing tools, results were collected, compiled and analyzed. The Table 3 shows the results obtained of response time for valid input, i.e., zip code “02111”. Similarly, Table 4 shows the test case results for response time for invalid input like zip code “11111”. Again, Table 5 displays results for valid input country “India” and city “New Delhi”.

Table 3: Response time for valid input of testing tools (zip code “02111”)

S.N	Tool Name	Input	Results											Response Time	
			Zip Code	Success	Response Text	State	City	Weather	ID	Description	Temp	Humidity	Wind	Pressure	Time
1.	Soapui Pro	02111	True	City Found	MA	Boston	Boston	10	Mostly Sunny	32	56	NW 10	29.89F	3720 ms	758
2.	Wcf Storm	02111	True	City Found	MA	Boston	Boston	10	Mostly Sunny	32	56	NW 10	29.89F	2515.3 ms	-
3.	Apache Jmeter	02111	True	City Found	MA	Boston	Boston	10	Mostly Sunny	32	56	NW 10	29.89F	1998 ms	758
4.	Wizdl	02111	True	City Found	MA	Boston	Boston	10	Mostly Sunny	32	56	NW 10	29.89F	3000 ms	-
5.	Web Inject	02111	True	-	-	-	-	-	-	-	-	-	-	3514 ms	-

S.N	Tool Name	Input	Results													Response Time	
			Zip Code	Success	Response Text	State	City	W. City	ID	Des.	Temp	H	W	P	Time	Byte	
1.	Soapui Pro	11111	False	City could not be found in our weather data. Please connect cdyne for more	-	-	-	-1	-	-	-	-	-	-	3886 ms	707	
2.	Wcf Storm	11111	False	City could not be found in our weather data. Please connect cdyne for more	-	-	-	-1	-	-	-	-	-	-	4180.8ms	-	
3.	Apache Jmeter	11111	False	City could not be found in our weather data. Please connect cdyne for more	-	-	-	-1	-	-	-	-	-	-	1860 ms	707	
4.	Wizdl	11111	False	City could not be found in our weather data. Please connect cdyne for more	-	-	-	-1	-	-	-	-	-	-	4000 ms	-	
5.	Web Inject	11111	False	-	-	-	-	-	-	-	-	-	-	-	1407.9ms	-	

Table 4: Response time for invalid input of testing tools (zip code “11111”)

The results tabulated in above table are based on same input of zip code “02111” to all the testing tools. Weather report is obtained from different testing tools offer and the output includes parameters like response status, name of city and state, name, Humidity, Temperature, Weather forecast, Wind and Pressure. The response time of different tools was observed, and it can be concluded that Apache JMeter was the best among all that took the least time. All the testing tools provided similar results except WebInject that only identified the zip code.

Table 5: Response time for valid input of testing tools (City “New Delhi” and Country India”)

S.N	Tool Name	Input	Results											Response Time	
			Country	City	Loc.	Time	Wind	Visibility	Temp.	Dew Point	Humidity	Pressure	Status	Time	Byte
1.	Soapui Pro	India	New Delhi	New Delhi, India EST:201311 07E233M	Dec 23, 2013 09:30 AM EST:201311 07E233M	From the WSW (250) at 5MPH (SKT):0	Less than 1 mile:0	55F(13c)	53F(12 C)	93%	30.12 in.Hg(102.0 hpa)	Success	2361 ms	1015	
2.	Wcf Storm	India	New Delhi	New Delhi, India EST:201311 07E233M	Dec 23, 2013 09:30 AM EST:201311 07E233M	From the WSW (250) at 5MPH (SKT):0	Less than 1 mile:0	55F(13c)	53F(12 C)	93%	30.12 in.Hg(102.0 hpa)	Success	2293 ms	-	
3.	Apache Jmeter	India	New Delhi	New Delhi, India EST:201311 07E233M	Dec 23, 2013 09:30 AM EST:201311 07E233M	From the WSW (250) at 5MPH (SKT):0	Less than 1 mile:0	55F(13c)	53F(12 C)	93%	30.12 in.Hg(102.0 hpa)	Success	1284 ms	1015	
4.	Wizdl	India	New Delhi	New Delhi, India EST:201311 07E233M	Dec 23, 2013 09:30 AM EST:201311 07E233M	From the WSW (250) at 5MPH (SKT):0	Less than 1 mile:0	55F(13c)	53F(12 C)	93%	30.12 in.Hg(102.0 hpa)	Success	3000 ms	-	
5.	Web Inject	India	New Delhi	-	-	-	-	-	-	-	-	Success	2321 ms	-	

The input format of all the testing tools was same, Zip Code "11111". As the input that was provided to testing tools was invalid, hence no result could be obtained, and this can be seen in form of blank values in the results table (table 4). The ID field value was -1 that indicates that the input provided was invalid. Of all the testing tools, WebInject took the least time.

The testing tools were tested with the city and country values as input as country and city. With the above input values, the weather report output obtained is in the form of time location, visibility, wind, dew point, temperature, pressure, humidity and status. From the above results, it can be concluded that Apache JMeter was the best that took the least time. Also, WebInject displayed an exceptional behavior. It only returned the response time as output and nothing else.

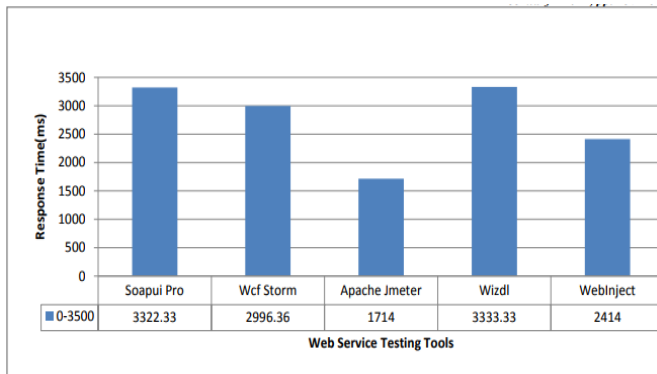


Figure 6: Average Response Time of Testing Tools

A comparative study concluded that Apache Jmeter has the best response time than other tools (Wizdl, Soapui pro, Web inject, wcf storm) that are used for testing. (Wala and Sharma, 2014)

Apache Jmeter – It is a load testing tool that is developed by ASF. It helps to measure and analyze the performance of numerous web applications and services. JMeter can work as a unit testing tool for several applications like JDBC FTP, database connections, Web services, LDAP, HTTP, generic TCP connections, JMS and native OS processes. Functional testing can also be done using Jmeter. The scope of Apache JMeter increases more for offsite developers can the functionality can be easily extended by installing the custom JMeter plug-in.

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with added features that make increases its usability, productivity and efficiency.

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Comparison Approach (Response Time) - The tests were executed simultaneously on different testing tools over the same network speed. The requests were made through a browser using a proxy server and this in turn also acts as a test script. The input for the tests were ran on the same website. The results of the executed tests consisted of different parameters like throughput and the response. Response time was used as a measure to evaluate the performance of testing tools. From the results it was inferred that owing to the different architecture and processes of different testing tools, a comparative study can be formed after analyzing their response time.

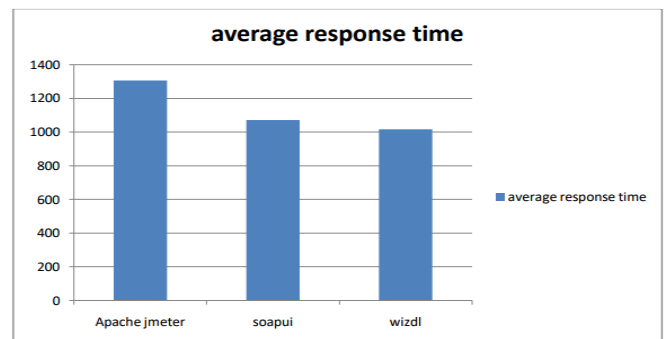
Table 6: Results obtained from testing tools in the initial run

Sr.no	Tool name	Response time	Throughput	Latency
1	Apache jmeter	1150	1.664/min	1148
2	Soapui	1120.45	-	-
3	Wizdl	1016.32	-	-

It can be observed from Table 6 that the response time for Wizdl is the least. Also, Wizdl and SoapUI only give one parameter i.e. response time. Apache Jmeter on the other hand gives three parameters i.e. latency, throughput and response time.

Table 7: Results obtained from testing tools in the second run

Sr.no	Tool name	Response time	Throughput	Latency
1	Apache jmeter	1461	1.655/min	1450
2	Soapui	1020	-	-
3	Wizdl	1015.36	-	-



It can be observed from Table 7 that the response time for Wizdl is the least. Also, Wizdl and SoapUI only give one parameter i.e. response time. Apache Jmeter on the other hand gives three parameters i.e. Response time, throughput and latency.

A comparative study concluded that Apache Jmeter has the best response time than other tools (Wizdl, Soapui pro) that are used for testing. (Sharma et. al, 2017)

Neoload – It is a performance and load testing tool that helps to improve and optimize web application's performance. It analyses web application's performance by increasing the website traffic and then performance under a heavy load can be computed. The number of users and application's capacity can also be found out simultaneously.

LoadImpact - By simulating users, this tool fluctuates web traffic for the website to determine the maximum load and stress capacity the application can handle. The tool consists of two components: load testing tool and page analyzer. The three types of load testing that are supported by this tool are Timeout, Ramp up and Fixed. A page analyzer works just like a web browser and it provides information about the website's productivity and performance..

Loadster – It is comprehensive load testing solution for web services, web apps and websites. It simulates individual users and collects data separately for each virtual user.

LoadUI – This tool is usually used to execute a fast API load test. This tool can be used for an existing functional API test or a single web service endpoint that is created in SoapUI NG. It can verify the scalability and speed of new versions of APIs that are deployed in a few minutes, can preview the behavior of API performance prior to production release and provide useful insights to developers about performance to enable them to develop more resilient codebase..

Webload – It supports several enterprise, mobile, and web protocols as well as technologies like Web Socket, HTTP/HTTPS, AJAX, PUSH, HTML5, SOAP, etc.

Comparison Approach (Response Time) - Figure 1 depicts that the tool with the highest response time is LoadUI. Second highest response time is of LoadImpact. LoadUI shows substantial difference in response time with varying number of users. Loadster, Neoload, Webload, LoadImpact shows minimal difference in response time. The tool with lowest response time is Webload. Webload shows best performance in term of response time.

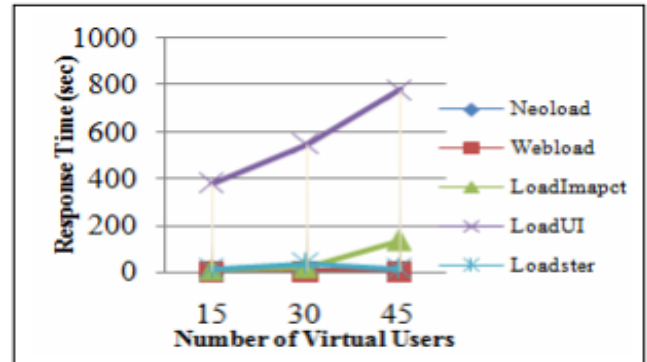


Figure 7: Response Time of Testing Tools

Comparison Approach (Throughput) - Throughput determines the number of requests per minute the server has processed. From Figure 2, it can be observed that Webload has maximum throughput. By increasing the count of users, the throughput is also found to increase. The tool with lowest throughput is LoadImpact. Webload shows best performance in terms of throughput.

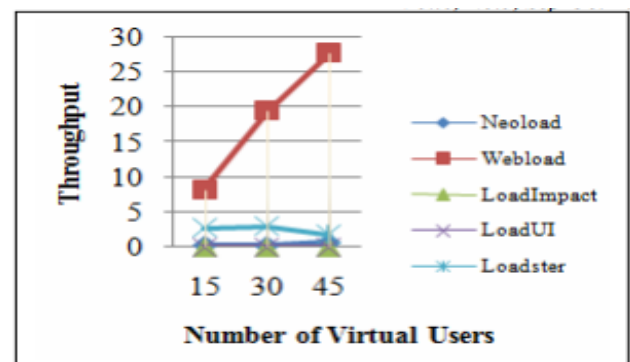


Figure 8: Throughput of Testing Tools

A comparative study showed that Webload has better performance compare to other's LoadUI, LoadImpact, Loadster and Neoload. (Bhatia and Ganpati, 2016)

ApacheJmeter – It is a load testing tool that is developed by ASF. It helps to measure and analyze the performance of numerous web applications and services. JMeter can work as a unit testing tool for several applications like JDBC FTP, database connections, Web services, LDAP, HTTP, generic TCP connections, JMS and native OS processes. Functional testing can also be done using Jmeter. The scope of Apache JMeter increases more for offsite developers can the functionality can be easily extended by installing the custom JMeter plug-in. JMeter not only provides different performance parameters like throughput, response time, response bytes, latency and load time but it can also provide results in the form of graph, table or tree. Such results can be stored and used further in other test plans.

Http Rider - It is an open-source lightweight testing tool to test stress levels as well as performance of web applications. It is developed using C# framework. Fiddler proxy is used to record different http scenarios by firing different http requests and multiple thread architecture is also supported by it. All the requests fired over the browser are recorded by the Http rider and is imitated for multiple concurrent users. Moreover, requests can be configured as per user convenience and can also be saved on the disk.

Fast Web Performance Testing Tool (FWPTT) - It is a performance testing application for web applications. Not only it can record normal and Ajax requests, but it can also record browsing actions using a proxy server. The recorded dataset can be stored in XML format and can be reused later to again call the same http requests. The user can execute the test case using the C# testing class with the help of test runner. The proxy server can record browsing actions over multiple browsers like Opera, Firefox or IE. The C# class can be altered as it has some built-in functions to reconfigure post/query parameters or to add new request parameters. However, this tool does not provide a graphic viewer.

Comparison Approach (Response Time) - Execution of the test cases was simultaneously over the same network speed. Proxy server was used to record the executed requests. This recording is treated like a test script. The same script is run at three different times of a day to observe the behavior of the tool. Differences are seen in the test results. Same website is used as an input for all these executed tests.

Table 8: Response obtained from testing tools at 1100 hrs.

S.no	Tool name	Response time(ms)	Throughput	Latency
1	ApacheJmeter	2648	22.7/min	1295
2	Fwptt	9218.78	-	-
3	Httpprider	1583.34	-	-

Table a captures results of a test conducted at 1100 hrs. On 25th March 2015. It can be observed response time is minimum for Httpprider. It is also observed that Fwptt behaves entirely different. It is observed that While Apache Jmeter provides three parameters namely latency, throughput and response time while http rider and Fwptt only offer response time.

Table 9: Response obtained from testing tools at 1500 hrs.

S.no	Tool name	Response time(ms)	Throughput	Latency
1	ApacheJmeter	2100	28.6/min	832
2	Fwptt	9060.78	-	-
3	Httpprider	1161.56	-	-

Similar behavior of Fwptt is seen when the test is performed at 1500 hrs on 25th March 2015. It is observed that http rider gives the minimum response time. Therefore, it can be observed from table A and table B that http rider performs the best. It is also observed that the response time for all three tools is decreased for a test conducted at 1500 hrs. as compared to the test conducted at 1100 hrs.

Table 10: Response obtained from testing tools at 1800 hrs.

S.no	Tool name	Response time(ms)	Throughput	latency
1	ApacheJmeter	2042	29.4/min	737
2	Fwptt	9843.2	-	-
3	Httpprider	1593.57	-	-

The same test is again conducted at 1800 hrs on 25th March 2015 and results are recorded in Table. In this test also similar behavior is observed. Again Fwptt gives maximum response time while http rider gives minimum response time and behaves best among others. In all three tests, same recording done with the help of proxy server is used as input to get the results.

Table A, Table B and Table C shows the results taken at 1100 hrs. 1500 hrs. And 1800 hrs. respectively. It can be observed from these results that http rider has given minimum response times 1583.34, 1161.56 and 1593.57 but only gives one parameter i.e. response time. ApacheJmeter gives response times as 2648, 2100 and 2042. It also gives other parameters like latency and throughput which http rider and Fwptt are unable to provide. Contrary to all others Fwptt gives maximum response times as 9218.78, 9060.78 and 9843.2 which totally vary from ApacheJmeter and http rider. From Table A, Table B and Table C average response time for a website www.orbitz.com can be calculated and is presented below in Table D.

Table 11: Average response time for website

ApacheJmeter	Httpprider	Fwptt
2263.33ms	1446.15ms	9374.25ms

A comparative study concluded that http rider is best performing tool in terms of response time while Fwptt is worst performing tool with maximum average response time. (Bhardwaj and Sharma, 2016)

Neoload – It is a comprehensive tool that offers several features required to do load testing and for result analysis. Simultaneous simulation of a large number of users done that allows the test to study both the Infrastructure's statistics like network components, web server, database etc. and the response time. This tool performs faster and efficient testing. This tool can test internet applications like RTMP, GWT, Java Serialization, and AJAX and can run over

different operating systems like Solaris, Linux and Microsoft Windows.

WAPT – It lets users to conduct performance, stress and load testing of web applications using a web interface. It comprises of flexible load agents that can be deployed anywhere and controlled remotely and a workplace component. It uses SNMP and WMI interfaces for information collection from database and server. Dynamic request parameterization is also provided using custom java script code. GUI approach is used to create and execute tests. The tools have JSDN format testing, ADOBE FLASH tests and ASP.NET testing modules and are compatible with Microsoft Windows.

Loadster - It is a stress and load testing tool to test dynamic HTTP web services, websites and web application. It has a script recorder to record http and https requests and with the help of its graphic editor, scripts can be created easily. Simultaneous testing of a large number of virtual users is testing using multiple user flows. Test reports of html requests are generated. The tool also provides parameterization of scripts so as to handle run time content with custom header and validation rule and also to capture response. This tool is compatible with Mac and Windows operating system.

The performance parameters of different tools are compared in different browsers as mentioned below:

Table 12: Different tools compared in different browsers
Internet Explorer

	NeoLoad	Loadster	WAPT
Total pages	206	1894	701
Total hits	527	1894	1055
Avg response/sec	1.3	3.17	0.46
Error	0	0	0
Total Iteration	113	1894	347 session
Average hit/sec	4.4	2.21	-
Average throughput	220000 bytes	2247.75 bytes	-
Max throughput	1340000 bytes	85250000 bytes	-
Average page/sec	1.7	2.21	-

Total bytes	-	1937562	13489 KB
CPU utilization	19.5 avg 93 max	-	14
Memory utilization	17.7 avg 23 max	-	84

Google Chrome

	NeoLoad	Loadster	WAPT
Total pages	103	1025	606
Total hits	391	1025	606
Avg response/sec	3.33	5.83	0.71
Error	0	0	0
Total Iteration	29	1025	94 session
Average hit/sec	3.2	1.19	-
Average throughput	370000 bytes	504.03 bytes	-
Max throughput	4790000 bytes	1487.50 bytes	-
Average page/sec	0.9	1.19	-
Total bytes	-	435485 bytes	5296 KB
CPU utilization	18.6 avg 93max	-	6
Memory utilization	14 avg 20 max	-	87

Mozilla Firefox

	NeoLoad	Loadster	WAPT
Total pages	142	18	295
Total hits	428	39	1024
Avg response/sec	1.23	248.84	0.35
Error	0	82	0
Total Iteration	28	10	95 session
Average hit/sec	3.5	0.07	-
Average throughput	350000 bytes	2236.73	-
Max throughput	5630000bytes	9014.58	-
Average page/sec	1.2	0.03	-
Total bytes	-	1682021 bytes	8582 KB
CPU utilization	21.2 avg 84 max	-	39
Memory utilization	18.5 avg 22 max	-	85

A comparative study concluded that WAPT have smaller average response time as compared to Neoload and Loadster. WAPT is found to be better performance testing tool among all the three performance testing tools. (Rina and Tyagi, 2013)

Apache Jmeter - It is a load testing tool that is developed by ASF. It helps to measure and analyze the performance of numerous web applications and services. JMeter can work as a unit testing tool for several applications like JDBC FTP, database connections, Web services, LDAP, HTTP, generic TCP connections, JMS and native OS processes. Functional testing can also be done using Jmeter. The scope of Apache JMeter increases more for offsite developers can the functionality can be easily extended by installing the custom JMeter plug-in. JMeter not only provides different performance parameters like throughput, response time, response bytes, latency and load time but it can also provide results in the form of graph, table or tree. Such results can be stored and used further in other test plans.

Grinder – This tool is used to test the interface of Web Service using protocols like XML-RPC and SOAP. The data is collated from worker processes and can be saved into a spreadsheet for further analysis using a different tool.

Statistics like the count of requests made and the response time obtained is also recorded. Module wise testing of the scripts can also be done along with separate statistics reports generated against them. Pre-defined charts during monitoring of test also show the number of requests, test status (fail/pass), maximum, minimum and average values of response time for each test.

HttpRider - It is an open-source lightweight testing tool to test stress levels as well as performance of web applications. It is developed using C# framework. Fiddler proxy is used to record different http scenarios by firing different http requests and multiple thread architecture is also supported by it. All the requests fired over the browser are recorded by the Http rider and is imitated for multiple concurrent users. Moreover, requests can be configured as per user convenience and can also be saved on the disk.

Comparison Approach (Response Time) - The results observed show that the internal processes and architecture of each tool is different. This insight constructs the foundation of comparative study between tools in the context of response time.

Table 13: Results obtained after first time execution

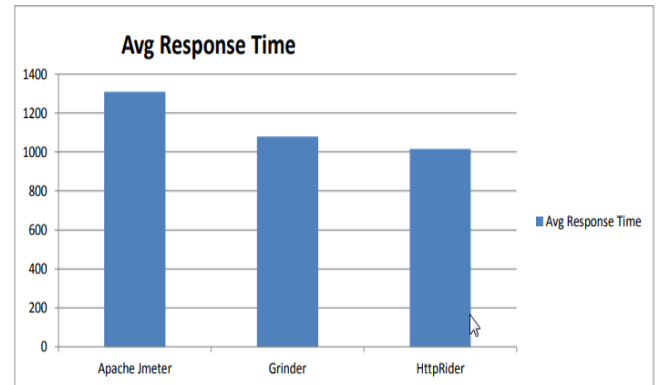
S.no	Tool name	Response time(ms)	Throughput	Latency
1	Apache Jmeter	1148	1.662/min	1148
2	Grinder	1109.45	.	.
3	HttpRider	1016.32	.	.

From the above table, it can be inferred that HttpRider has the least response time. Latency, throughput and response time are three parameters of Apache Jmeter, HttpRider and grinder only provide response time.

Table 14: Results obtained after second time execution

S.no	Tool name	Response time(ms)	Throughput	Latency
1	Apache Jmeter	1471	1.643/min	1470
2	Grinder	1050	.	.
3	HttpRider	1015.36	.	.

From the above table, it can be inferred that HttpRider has the least response time. Response time, throughput and latency are three parameters of Apache Jmeter, grinder and HttpRider only give response time.



IV. CONCLUSION

In this case study, performance testing tools are compared on the basis of response time and throughput. From the results obtained in the entire test, it can be inferred that the algorithm and the internal structure of each tool is different to calculate the performance parameters. This fact forms the basis of comparison of the different results that are obtained. A comparative study conducted by Hussain et. al (2016) showed that SoapUI fastest tool in terms of response time while another study showed that the average response time of HP LoadRunner is more than Apache JMeter (Khan, 2016). While Wala and Sharma (2014) showed that Apache Jmeter is found to have a better response time than Web inject x, Wizdl, wcf storm, Web inject that are used for testing. Sharma et. al (2017) showed that Apache Jmeter is found to have a better response time than Wizdl and Soapui pro that are used for testing while Bhatia and Ganpati (2016) showed Webload has better performance from LoadUI, LoadImpact, Loadster and Neoload. However, Bhardwaj and Sharma (2016) concluded that HttpRider is best performing tool in terms of response time but Rina and Tyagi (2013) found that WAPT has better average response time than Neoload and Loadster. Hence, the performance of WAPT testing tool is better than all other testing tools. However, Dhiman and Sharma (2016) showed that HttpRider is found to have a better response time than Grinder and Apache JMeter that are used for testing (Dhiman and Sharma, 2016).

REFERENCES

- [1]. R. Bhatia, A. Ganpati, "In Depth Analysis of Web Performance Testing Tools", Engineering Science and Technology: An International Journal, Vol.6, Issue.5, pp.15-19, 2016.
- [2]. S. Bhardwaj, A. K. Sharma, "Performance Testing Tools: A Comparative Analysis", International Journal of Engineering Technology, Management and Applied Sciences, Vol.3, Issue.4, pp.100-105, 2015.
- [3]. M. Chen, A. N. K. Chen, B. B. M. Shao, "The implications and impacts of web services to electronic commerce research and practices", Journal of Electronic Commerce Research, Vol.4, Issue.4, pp.128-139, 2003.

- [4]. S. Dhiman, P. Sharma, "Performance Testing: A Comparative Study and Analysis of Web Service Testing Tools", International Journal of Computer Science and Mobile Computing, Vol.5, Issue.6, pp.507-512, 2016.
- [5]. D. Kelkar, K. Kandalgaonkar, "Analysis and Comparison of Performance Testing Tools", International Journal of Advanced Research in Computer Engineering & Technology, Vol.4, Issue.5, pp.1880-1883, 2015.
- [6]. D. A. Menascé, "Response-time analysis of composite Web services", Institute of Electrical and Electronics Engineers Internet computing, Vol.8, Issue.1, pp.90-92, 2004.
- [7]. S. Mumbaikar, P. Padiya, "Web services based on soap and rest principles", International Journal of Scientific and Research Publications, Vol.3, Issue.5, pp.1-4, 2013.
- [8]. N. M, K. Kumar, A. Saha, D. Chahar, "Comparative Study on Performance Testing with Jmeter", International Journal of Advanced Research in Computer and Communication Engineering, Vol.5, Issue.2, pp.70-76, 2016.
- [9]. Rina, S. Tyagi, "A Comparative Study of Performance Testing Tools", International Journal of Advanced Research in Computer Science and Software Engineering Research, Vol.3, Issue.5, pp.1300-1307, 2013.
- [10]. N. Sharma, P. Sharma, H. Singh, "A Comparative Study of Web Service Testing Tool", International Journal of Engineering Development and Research, Vol.5, Issue.2, pp. 1457-1460, 2017.
- [11]. T. Wala, A. K. Sharma, "A Comparative Study of Web Service Testing Tools", International Journal of Advanced Research in Computer Science and Software Engineering, Vol.2, Issue.2, pp.257-261, 2014.
- [12]. S. Kannan, T. Pushparaj, "A Review: Software Security Testing", International Journal of Computer Science and Engineering, Vol.4, Issue.9, pp.1-8, 2017.
- [13]. M. Sharma, H.P. Singh, V. Pathak, "Critical Software Testing Using Cloud Computing Tools", International Journal of Computer Sciences and Engineering, Vol.6, Issue.7, pp.1141-1146, 2018.

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