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Comparative Study on Performance Testing with JMeter

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Abstract: Performance testing is an process of determine the speed or effectiveness of a computer, network, software program or device. The focus of Performance testing is checking a software program's Speed - Determines whether the application responds very quickly, Scalability Determines maximum user load the software application can handle. Stability - Determines if the application is stable under varying loads. Performance testing mainly divided into Stress and Load testing. jMeter is a Open Source testing software. It is 100% pure Java application for load and performance testing. In this paper we discussed performance testing tools and proposed best Performance tool for web application Industry.

Keywords: Performance Testing, Types of performance testing, Load Testing, Stress testing, Volume testing, Scalability testing, JMeter, LoadRunner.

I. INTRODUCTION

Application load testing is a measure of entire web application ability to sustain certain number of simultaneous user transactions while maintaining adequate response time, because it is comprehensive. Load testing is the only way which accurately test end to end performance of a system and website and system prior to going live. Application load testing enable developers to find error in any component of the infrastructure. Two methods for implementing the process are manual and automated testing. Manual testing has several built in challenges, such as to determine how:

- Coordinate operations of users.
- Measure response time.
- Repeat tests in consistent way.
- Compare results.

Because load test is iterative in nature, the tester must identify performance problem, fine tune the system and re test to ensure the tuning had a positive impact countless times. For this reason, manual testing is not a practical option. With load testing tools or automated stress, tests can be easily re run and results can be automatically measured. In this way, automated testing tools provide more efficient ans cost effective solution than manual counterparts and they minimize the risk of human error in testing. Today load testing or automated stress is the preferred choice for load testing a web application. Testing tools use three major components to execute test.
These include:
Control Console: which organize drives and manages the load test.
Virtual users: These are the process which simulates number of connection or users to your server application
Load Servers: These are used to run Virtual users request.
Using load testing tools we can:

- Replace manual testing with automated virtual users.
- Automatically measure transaction response time.
- Easy to load scenarios to perform change and validate design.
- Easily generate reports.
- Simultaneously run many virtual users on a single load generator.

A. Types of performance testing

- Load testing - checks the applications ability to perform under anticipated user loads. The objective is to identify performance bottlenecks before the software an application goes live.
- Stress testing - involves testing an application under extreme workload to see how it handles high traffic or data processing .The objective is to identify breaking point of an application.
- Endurance testing - is done to make the software can handle the expected load over a long period of time.
- Spike testing - tests the software reaction to sudden large spikes in the load generated by users.
- Volume testing - Under Volume Testing large number of Data is populated in database and the overall

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software system's behavior is monitored. The objective is to check software's application's performance under varying database volumes.

- Scalability testing -Objective of scalability testing is to determine the software application's effectiveness in scaling up to support increase in user load. It helps plan capacity addition to your software system.
- Peak test: To analyse the system behaviour when exposed to intensity peaks mixed with regular load, showing the recovery following the increase in load. This sort of situations happen in reality, so it is interesting to analyse the system's behaviour in such cases.

II. LITERATURE SURVEY

Performance Testing is to determine the response time and through put of any web application. The performance testing involves recording and monitoring the performance levels during regular, low and peak hours for any websites. Performance testing tools are used to determine the time required to perform a task by a system.[1]

Generic performance testing process has the following steps:
1. Identifying testing environment.
2. Identifying performance acceptance criteria.
3. Planning and designing performance tests
4. Configuring the test environment
5. Implementation of test design.
6. Run the test
7. Analyse, tune and retest. [2]

Performance testing includes other types of tests which are:

- Load Testing: Testing application for a requested number. The aim is to determine whether the system or site that can sustain this requested number of users with acceptable response time.
- Stress Testing: Load testing for an extended period of time to find stress points. It is testing beyond normal capacity often point to determine the stability for a given system or application
- Capacity Testing: Testing to determine maximum number of users an application can manage. The objective is to check the maximum load of users a system or a site can sustain before experiencing system failure.
- Spike Testing: Spike Testing is suddenly increasing the number of load generated by users by a very large amount and observing the behaviour of system. The goal is to determine the performance degrade, system failure.
- Endurance Testing: It is to check that the system can hold the load for larger number of transactions. For eg: Testing is performed with definite set of users for a longer period of time i.e. 2 to 3 days.[3]

SoapUI is an API testing tool that is open source and cross platform. With easy to use graphical interface and enterprise class features, it allows easily and rapidly creating and executing automated functional, regression and loading test. SoapUI is not just API testing tool but also lets us perform non functional testing such as security test.[4]

LoadRunner: This is a HP product which is used as performance testing tool, It is very usefull in understanding and determining the performance and outcome of a system when then is actual load. HP LoadRunner can simulate thousands of concurrent users to put the application through the heavy user loads while collecting information from components (Wen servers, database servers).
The results can be analysed in detail to explore the reason for particular behaviour. This tool enables to gather required information with performance and also based on infrastructure. The LoadRunner consist of different tools such as Controller, Load Generator, Virtual User Generator and Analysis.[5]

JMeter can be used as unit test tool for JDBC database connection, FTP, LDAP, Web Services JMS, HTTP and generic TCP connections. JMeter can be configured as a monitor, although this is typically considered an ad-hoc solution in lieu of advanced monitoring solutions.[6]

Load testing tool is used for testing web applications under different load conditions. There are numerous different users accessing at same time, it is important to test the web applications so that performance improves and identify that which element degrade the performance of web application. [7]

The principle of load testing tool is to simulate behavior of real users with "virtual" users. The load-testing tool can then record behavior of the site under the load and give information on the virtual users experiences.[8]

LoadRunner: HP LoadRunner is an industry standard based an automated performance and test automation product from HP for load testing of application: that examines system performance and behaviour. HP LoadRunner works by using the virtual users. It also simulates thousands of concurrent users to put the application through various real life user loads and analyses the results in detail to discover the particular behaviour.[9]

Performance tool is used for different types of performance testing including load test, stress test, volume test and endurance test. These tools are open source or proprietary tools. For this research, three performance testing tools Neoload, WAPT and Loadster, have been selected.[10]

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Load Tests are end to end performance test under anticipated production load. The objective of such tests is to determine the response time for various time critical transaction and business processes. This will ensure compliance with documented expectations or Service Level Agreements.[11]

Performance testing is validation that the system meets performance requirements. This can be as simplistic as ensuring that web page loads in less than eight seconds or can be as complex as requiring[12]

Performance testing of such web applications using UAP poses some unique challenges because the Jmeter script does not capture all the dynamic values, such as SAML Request, Relay State, Signature Algorithm, Authorization State, Cookie Time, Persistent ID (PID), JSession ID and Shibboleth, generated using single sign-on mechanism of Unified Authentication Platform. This paper explains some of the challenges & experiences to identify an appropriate solution for conducting performance testing on such web application.[14]

Web services testing has become important in Service oriented architecture (SOA).organizations have developed generic component that have been used across multiple client project implementations. They require human intervention for evaluating and testing Web service which may include new development and enhancement of components. For this kind of process we required Jmeter as per authors discussion.[15]

Scalability of a multitier enterprise system is limited resources that become a bottleneck, by the presence of software and hardware resource bottlenecks. Bottlenecks usually occur at larger number of users. From an IT industry point of view, deployment process of enterprise applications becomes simpler if these bottlenecks are known appropriately during the performance testing itself.[16]

Software testing is a vital activity that is undertaken during software engineering life cycle to ensure software quality and reliability. Performance testing is a type of software testing that is done to shows how web application behaves under a certain workload.In this paper, performance TaaS framework for web applications is introduced which provides all performance testing activities including automatic test case generation and test execution. In addition, the proposed framework addresses many issues as: maximize resource utilization and continuous monitoring to ensure system reliability.[17]

III.APACHE JMETER

ApacheJmeter is developed by Apache Software Foundation (ASF). It is open source performance testing tool. It is a Java desktop application with a graphical user interface can run on any environment or workstation accepting a Java virtual machine for example Windows, Linux and Mac. It can be used as a load testing tool for analyzing and measuring the performance of variety of services mainly web application. It can also be used for unit testing for Java applications, FTP,, LDAP, Web services, HTTP, generic TCP connections and Operating System processes. It is also be used for functional testing. It can be used to simulate heavy load on server by generating multiple user threads at the same time to test strength or to analyze overall performance under different load types. It also supports recoding browser session through proxy server and replay it to give different performance parameters like response time, throughput, latency, response bytes and load time. It gives different representations of the results either as a tree, table or graphs. These view are also simultaneously available to use. Test plans can be stored in XML format and can be reused.[6]

IV.LOAD RUNNER

LoadRunner is a software testing tool from HP Enterprise. It is used to test applications, measuring system behaviour and performance under load. LoadRunner works by creating virtual users who take the place of real users operating client software, such as sending request using the HTTP protocol to IIS or Apache web servers. Requests from virtual user client is generated by Load Generators in order to create a load on various servers under test those load generator agent are started and stopped by Mercurys Controller program. The Controller controls load test runs based on Scenario invoking compiled script and associated Run time Settings. Scripts are crafted using Mercury's "Virtual user script Generator (named "V U Gen"), It generate C-language script code to be executed by virtual users by capturing network traffic between Internet application client and server. With Java clients, VuGen captures calls by hooking within a client JVM. During run, the status of each machine is monitored by the Controller. At the end of each run, the Controller combine their monitoring log with logs obtained from load generators, and makes them available to the "Analysis" program, which can then create run result report and graphs for Microsoft Word, Crystal Reports, or an HTML webpage browser.

V. PROBLEM STATEMENT

Testing is important part of the software development process. Different software testing tools are currently in the market.Some of these are only to perform specific kinds of testing. It is important to create list of requirements that help us in choosing tool for performance. We have evaluated two major testing tools that are apache Jmeter and Load Runner. These tools are

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evaluated on the basis of speed, performance, throughput an Evaluation Study. [13]

TABLE1: Comparison Table of JMeter with LoadRunner

ITEM	LOAD RUNNER	JMETER
UNLIMITED LOAD GENERATOR	NO	YES
EASE OF INSTALLATION	NO	YES
LARGE DOWNLOAD PERFORMANCE	YES	NO
RESULT REPORTING	YES	NO
COST	NO	YES
TECHNICAL LEVEL	YES	YES
STABILITY	NEUTRAL	NO

VI. COMPARING JMETER WITH LOADRUNNER

A. Jmeter

a) Pros:

1. Very light weight tool and can be easily installed.
2. Simple load of 50-100 can be easily applied or monitored.
3. Of course it is free no license costs.
4. Easy to add plugins to get suitable reports. One can search for plugins in google.
5. No infrastructure to install, one can install on his desktop and can learn
6. Good if used during unit testing hence performance glitches can be identified at earlier stage.

b) Cons:

1. Can be used only web applications.
2. Stress testing result can be ambiguous as performance results can be affected if Jmeter consume more resources. Distributed testing is compulsory in these cases.
3. One must follow best practices to get better results.ex:command line execution, minimum reports.
4. If scenarios is complex. it may get difficult with Jmeter.
5. One shall technical understanding of web applications before using Jmeter like client-server mechanisms.
6. Recording procedure is complex as it involves starting proxy server, alter browser settings, manual add think time, etc.

B. LOADRUNNER

a) Advantages:

1. No need to install it on the server under test. It uses native monitors. For Ex: performance for windows or rstatd daemon for Unix
2. Uses ANSI C as the default programming language1 and other languages like Java and VB.
3. Excellent monitoring, analysis interface where we can see reports in easy to understand coloured charts and graphics.
4. Supports most of the protocols2.
5. Makes correlation3 much easier. We will dig into correlation through a series of posts later.
6. Nice GUI generated script through a one click recording, of course you would need to modify the script according to your needs.
7. Excellent tutorials, exhaustive documentation and active tool support from HP.

b) Disadvantages

The disadvantage I can think is the prohibitive cost associated with the tool but that can also be compensated in long run when you start getting good ROI from the tool.

1. Programming/Scripting language is used to represent the protocol data and manipulate the data for play back.
2. Protocol is a language that your client uses to communicate with system.
3. Correlation is an way to substitute values in dynamic data to enable successful playback.

TABLE2: Comparison Parameters of JMeter with LoadRunner

Parameters	JMeter	Loadrunner / HP Performance Center
Platform	Java (Platform independent)	Microsoft Windows (server parts require ASP.NET) Performance Center requires several Windows Servers. Unix/Linux for load-generator is supported though.
Tool Architecture	Local script authoring UI with Load generation capabilities. UI-less load generator option exits.	Desktop clients for Load script authoring (Virtual User Generator) and result analysis (Analysis). Controller and Load genearator for test execution.
Remote load generators	Multiple Remote Load generators hosts are supported.	Distributed (even multi-region) load generator hosts. Over-firewall solutions.
Cloud-capability	Third-party Amazon image for cloud-based testing is available.	Via installing Load Generators on the cloud. Separate Cloud-test offering from HP is available.

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Resource monitoring	Missing/limited	Performance centre supports a variety of platforms/applications. N.B. JMX monitoring requires extra HP software (Sitescope). Resource metrics can be conveniently tracked with other metrics in the Analysis tool and on the online dashboard on Performance Center.
Documentation	Apache website provides documentation. Quality: mixed.	Context sensitive help ("press F1") Quality: good
Community	Open source software community, mailing list.	Official forum on HP site. Activity is low/medium.
Scripting	A script is actually a graphical tree of nodes, with limited editing capabilities. Supports BeanShell for evaluations, checks, etc.	C (primarily) and Java. TruClient protocol: javascript.
HTTP traffic capturing	HTTP Proxy	Network capture of local applications. HTTP Proxy for remote applications. TCP dump for mobile/webservice protocols.
Script pacing	Via number of Threads setting. Timers provide (approximate) TPS control by automatic pacing.	Via the number of Virtual Users and iteration pacing.
Scenario composition	One script can contain multiple thread groups and form the scenario.	Separate scripts can be configured to constitute a scenario
Script runtime configuration	Via command-line parameter	Via command-line parameter, performance center automatically manages it.
Repointing test to a different AUT host	No out-of-the-box support. Script has to take over configuration parameter value.	No out-of-the-box support. Script has to take over configuration parameter value.
Protocol coverage	Focus primarily on HTTP and Java-related protocols (JMS, JDBC). Also supports FTP, LDAP, SOAP.	Broad coverage from plain HTTP-based protocols through proprietary enterprise products.
Extensibility	Java plugins	SDK

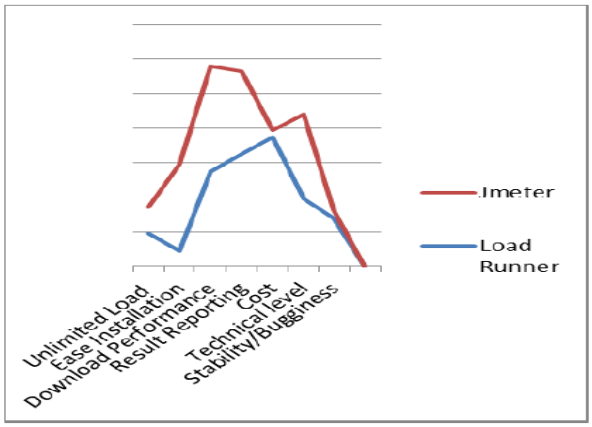

Fig.1 Comparison Parameters of JMeter with LoadRunner [13]

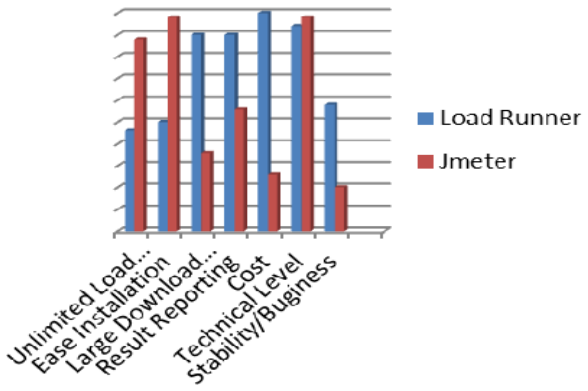

Fig.2 Comparison Parameters of JMeter with LoadRunner [13]

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In brief performance test reveal how a system behaves and responds during various situations. A system may run well with only 1,000 concurrent users, how would it run with 100,000? In terms of performance, we wish to achieve high speed, scalability and stability of a system. There are several types of performance tests in which each simulates different possible scenario. The below figure demonstrates how some of them work. (Ref: abstracta.us)

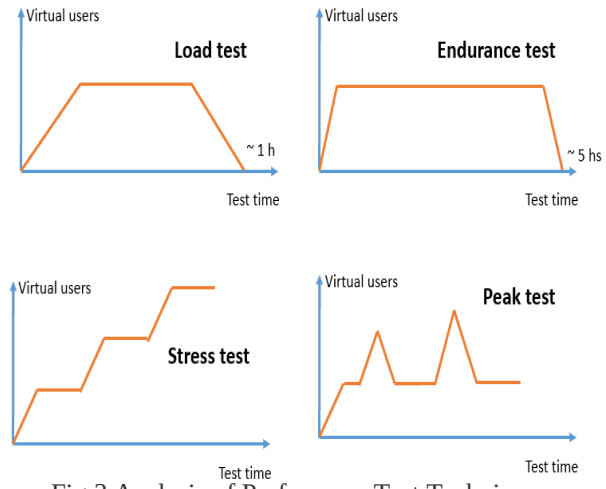

Fig.3 Analysis of Performnce Test Techniques

A. Most importantly, the faster the website, the more revenue it will generate.

Sites that loads fastest have competitive advantage. Since everything on the internet is just a click away, it is vital to have quick load time to keep customers on site and not your competitor's. "Two hundred and fifty milliseconds, either slowest or fastest, is close to the magic number for competitive advantage on the Web.

B. Importance of Performance Testing in web Aapplications::Scalability

Not only speed an important goal for performance, but scalability tests are extremely important if you want more users to interact with a system. How many more users can you support if you add another CPU to the database server? How long will a page take to load with this addition? These are all important things to know.

C. Importance of Performance Testing in web applications: Stability

Obviously, we want your application to work at all times. There will be some times when it is under more stress than others. Black Friday, for ex, is not when you want your e-commerce website to crash. For high profile companies, even a few minutes of downtime can have extremely costly and can become big news. As per the analysis and research we are recommending JMeter is suitable for web application Performance testing.

VII. CONCLUSION

Performance testing is a process of determining speed or effectiveness of a computer, network, software program or device. As per the analysis and research we are recommending JMeter is suitable for web application Performance testing. Very light weight tool and can be easily installed. Simple load of 50-100 can be easily applied and monitored. Of course it is free, so no license costs. Easy to add plugins to get suitable reports. One can search for plugins on Google. No infrastructure to install, one can install on his desktop and can learn Good if used during unit testing so performance glitches can be identified at earlier stages. Its pure Java tool, which allows to execute this tool in any platform (i.e. platform independent), this tool mainly used for performance testing (load, stress), User can apply automation frame work (data driven, parameter).

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