# Load Testing on Web Application using Automated Testing Tool: Load Complete

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**ABSTRACT:** Web applications are developed for all type of industries such as e-commerce, travel, biotech, pharmaceutical and other mechanisms. These web applications should be load tested to ensure that they can perform correctly under high load. Load Testing is type of software testing that is used for monitoring performance of web applications under heavy work load. It is used to define the maximum amount of work a system can handle without performance degradation. It design and simulate user traffic which can be used to test application for performance, reliability and scalability. This study focus on the load testing of a web application using load testing tool namely LoadComplete by increasing number of virtual users.

**KEYWORDS:** Load Testing, Web Applications, Load Testing Tool, LoadComplete, Virtual Users.

## I. INTRODUCTION

Use of web applications is increasing day by day; it becomes important to measure the performance of web applications. Many web applications have large amount of traffic of users. Performance testing is non-functional type of testing that is used to determine the performance of system. There are various types of performance testing such as load testing, stress testing, volume testing, endurance testing, spike testing and scalability testing [1].
Load testing is widely used for the analysis of the web applications

Large number of users access web applications; to handle such large number of users it is important to monitor the performance of web applications. The process of monitoring and testing performance of web applications under normal and peak load conditions is done by load testing [2].
There are various load testing tools used for monitoring the performance of web applications and we can calculate various performance parameters like response time, page load time and throughput etc.

## II. LOAD TESTING

Load testing is used to find the changes in system performance with increase in load. The goal of load testing is to find out the functional and performance problems of a system under load. Performance problems are the situations where a system suffers from unexpectedly high response time or low throughput.
Hundreds and thousands users access web applications concurrently, to assure the quality of these applications load testing is required [3].

A load test measures response times, throughput rates, resource-utilization levels, and identifies application's breaking point, assuming that the breaking point occurs below the peak load condition.

Here, "below the peak load condition" suggests a testing methodology that falls within the parameters of a load test unlike a stress test in which, system is tested at and beyond peak load. Load testing can identify system lag, page load issues, and anything else that might went wrong when multiple users access an application with sudden traffic.

### III.   LOAD TESTING ON WEB APPLICATION

Web applications can be defined as computer programs that consists client-server architecture that allows user to submit and retrieve data over the internet using their web browser [4].

Load testing is performed on web applications by simply increasing virtual users for maintaining required load. Each time when user visits the web application, script recorder records information and recorded scripts are replayed by load generator. Replay process consisting of hardware and software statistics like CPU, memory, response time, throughput of system etc. These statistics are monitored and collected by conductor and then load testing report will be generated by analyzing all statistics. Time limit is required to evaluate system performance. If task is not completed within given time limit and conditions then failure report is generated. Fault in running environment can cause failure. Response time, think time, throughput, platform, scalability etc are the parameters that affect load testing.

### IV.   LOAD TESTING TOOL: LOADCOMPLETE

There are various load testing tools available in the software market. The cost of tool varies according their functionality. In this paper LoadComplete load testing tool is used for web application testing. Brief description about the selected tool is given below:

*LoadComplete:* LoadComplete [5] tool is used for stress and load testing for mobile and web applications. It is available in three editions: i) Community edition ii) Pro Edition and iii) Enterprise edition. Community edition is free of cost. It is designed and market by Smartbear Software.
Brief detail of the LoadComplete is given in the following table:

**Table 1: LoadComplete**

| | |
|---|---|
| **Developer** | Smartbear Software |
| **License** | GNU LGPL |
| **Operating System** | Windows |
| **Programming Language Support/Framework** | JavaScript, HTML, C#, Python, .Net |
| **Browser Support** | Mozilla Firefox, Microsoft Internet Explorer, Google Chrome, Safari |

*Features:-*

- **Use record and replay to create load test: -** It record and replay realistic application scenarios in order to create load tests without writing script.

- **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.

- **Testing of variety of web applications: -** It is used to test variety of web applications including those with RIA technologies, .NET, Flex, Ajax and Silverlight.

- **Test performance of native, web or hybrid mobile Apps: -** LoadComplete allows testing performance of native, web and mobile Apps. It simulate large amount of traffic from smartphones and tablets over a variety of network connections.

- **Run load test with external data: -** LoadComplete makes it easier to diversify automated load tests by allowing replacement input parameters with a variety of different values.

- **Customization of load tests as per requirements: -** It allows customizing different properties from the load test, right from the user interface.

- **Run distributed load tests: -** It simulates very high workload by distributing load tests among on premise machine and the cloud.

- **Comprehensive analytics and customized reporting: -** Loadcomplete comes with a wide range of client side and server side metrics. Thus it can be sure that both front and back end of the application works as expected.

- **Validate server response data: -** It creates different rules for checking not just server response code, but also the message content received from server.

## V. PROPOSED WORK

In this paper load testing is performed on the web application www.farpointtravel.com using LoadComplete. Load is applied by increasing the number of virtual users. LoadComplete can simulate up to 50 numbers of virtual users.

*System requirement*

All the tests are executed on an Pentium(R) dual core 2.20 GHz processor machine with 3GB RAM, Microsoft Windows 7 with the internet speed 7.2 Mbps. Testing of the tool requires configuration which includes installation, setting up test environment, then selecting the parameters and analytical survey. The sample web application www.farpointtravel.com is tested on the respective configured tool.

*Approach followed*

Web application www.farpointtravel.com is tested using load testing tool LoadComplete. In this work test is firstly conducted for single user. Then number of virtual users is increased by 10. Load tests are conducted for 10 VU, 20 VU, 30 VU, 40 VU and 50 VU.
By increasing the number of virtual users various performance parameters like page load time, CPU utilization, memory utilization and peak memory utilization are monitored.

In this work two types of load tests are conducted using two load profiles: - **i) Stepwise Load      ii) Steady load**

   i) **Steady load: -** This type of load profile allows sending specified number of virtual users at once against the server.

   ii) **Stepwise load: -** This type of load profile allows running certain number of virtual users adding additional user after every 'x' second. In this work 2 virtual users are added after each 1sec.

Two conditions are specified for the both type of Load Test:

   i) **Continues Load: -** This condition specifies the amount of time to check how site behaves with load for that amount of time.

   ii) **Random Think time:-** This helps to simulate the user behavior close to real life taking into account the amount of time user may spend reading and thinking what they want to do n the given page before moving on to the next page.

In this study;
Continues load= 5 min.

Random think time= 0 to 10,000 milliseconds

## VI. RESULT AND DISCUSSION

Load test is conducted for the single virtual user firstly. The result obtained is given in the following figures. Fig 1 shows the run time graphs of throughput, response time, number of requests for single virtual user and Fig. 2 shows the report summaries like page load time and scenario completion time. In table 2 test results of response time, CPU utilization and Memory Utilization are given.
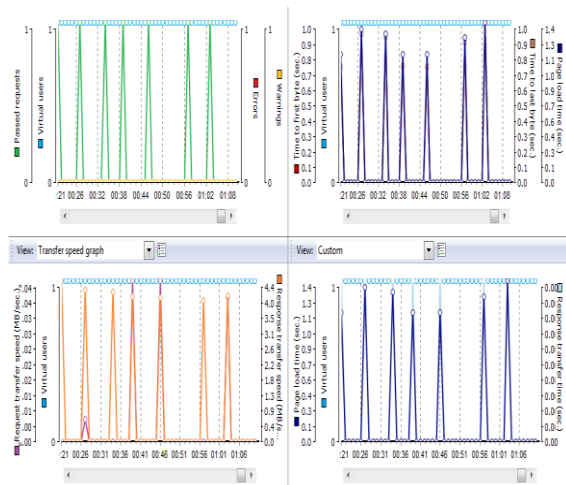


Fig.1 Run Time Graphs for Single Virtual User
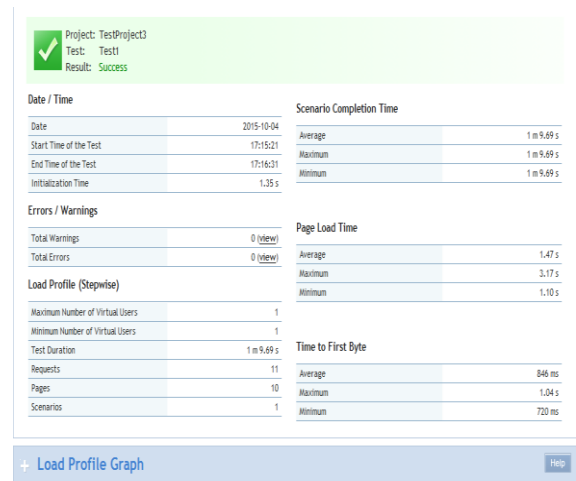


Fig 2. Test Report Summary for Single Virtual User

**Table 2: Test results for Single Virtual User**

| S.No. | Number of Virtual users | Response time(ms) | | | Maximum C.P.U utilization | Maximum memory utilization |
|---|---|---|---|---|---|---|
| | | **Min.** | **Max.** | **Avg** | | |
| 1 | 1 | 1.10 | 3.17 | 1.47 | 31 | 47 |

*Case 1: Steady Load Profile*
After taking the load test for single user number of virtual users is increased by 10 and results are obtained for steady load profile. Fig. 3 and Fig. 6 shows the run time graphs of throughput and response time for 10 VU and 50 VU respectively. Also results report of page load time and scenario completion time is shown in Fig. 4 and Fig. 7 for 10VU and 50 VU respectively. CPU utilization and memory utilization for 10 VU and 50 VU is shown in Fig. 5 and Fig. 8. Result taken for 10 to 50 virtual users is summarized in table 3.
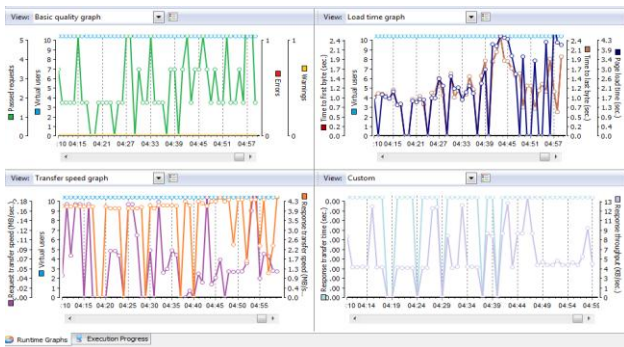
Fig. 3 Run Time Graphs for 10 Virtual users (Steady Load)
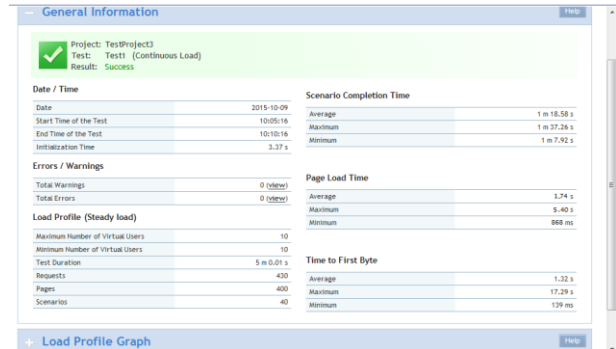


Fig. 4 Test Report Summary for 10 Virtual users (Steady Load)
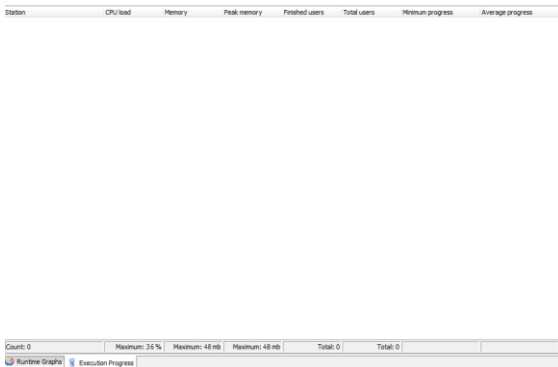


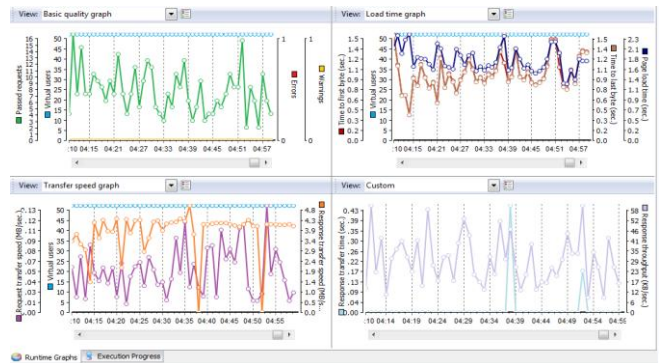Fig. 5 Resource Utilization for 10 Virtual users (Steady Load)



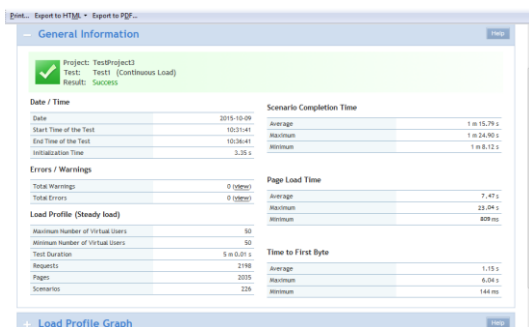Fig. 6 Run Time Graphs for 50 Virtual users (Steady Load)



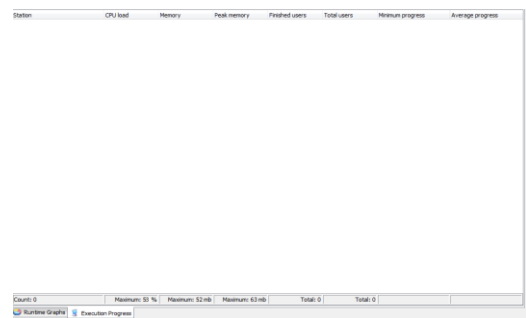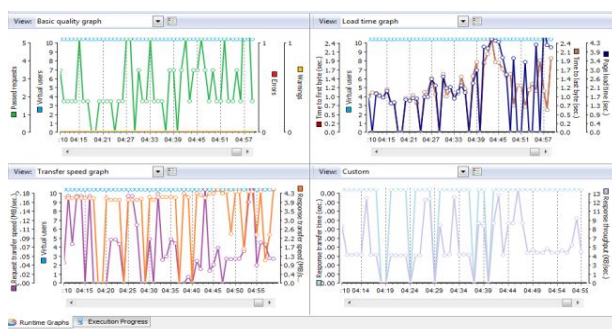Fig. 7 Test Report Summary for 50 Virtual users (Steady Load)



Fig. 8 Resource Utilization for 50 Virtual users (Steady Load)

**Table 3: Test results for 10 to 50 Virtual Users (Steady Load)**

| S.No. | Number of Virtual users | Response time(ms) | | | Maximum C.P.U utilization | Maximum memory utilization(mb) |
|---|---|---|---|---|---|---|
| | | Min. | Max. | Avg | | |
| 1 | 10 | 868 | 5.40 | 1.74 | 36 | 48 |
| 2 | 20 | 836 | 14.91 | 3.95 | 41 | 49 |
| 3 | 30 | 825 | 19.05 | 5.53 | 44 | 50 |
| 4 | 40 | 814 | 21.61 | 6.05 | 49 | 51 |
| 5 | 50 | 809 | 23.04 | 7.47 | 53 | 52 |

### *Case 2: Stepwise Load Profile*

Load testing is performed for stepwise load profile. Results obtained for steady load profile are shown below. In Fig. 9 and Fig. 12 run time graphs of throughput and response time are shown for 10 VU and 50 VU respectively. Also results report of page load time and scenario completion time is shown in Fig. 10 and Fig. 13 for 10VU and 50 VU respectively. CPU utilization and memory utilization for 10 VU and 50 VU is shown in Fig. 11 and Fig. 14. Result taken for 10 to 50 virtual users is summarized in table 4.



Fig. 9 Run Time Graphs for 10 Virtual users (Stepwise Load)
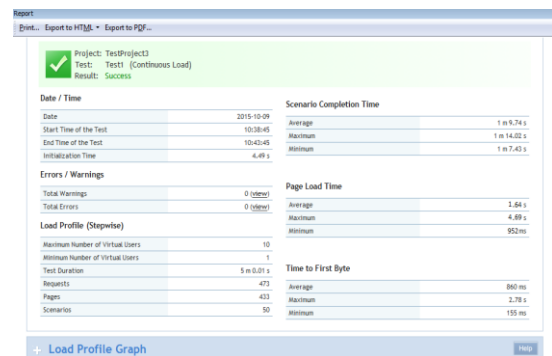


Fig. 10 Test Report Summary for 10 Virtual users (Stepwise Load)
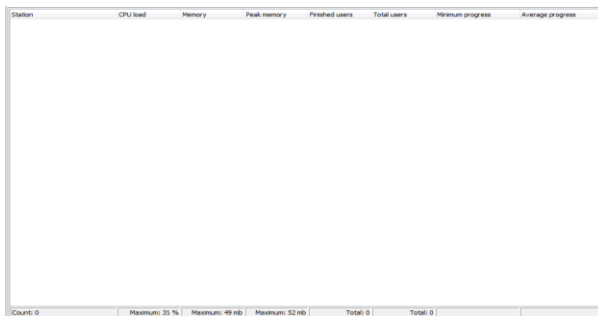


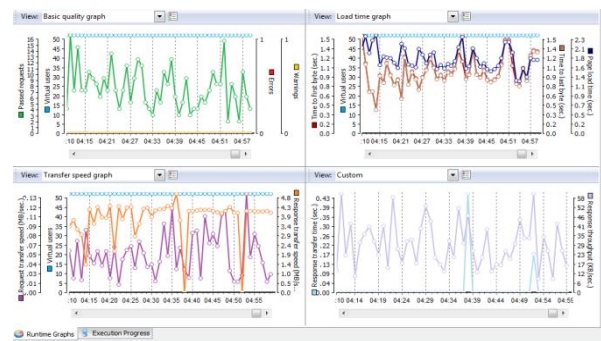Fig. 11 Resource Utilization for 10 Virtual users (Stepwise Load)



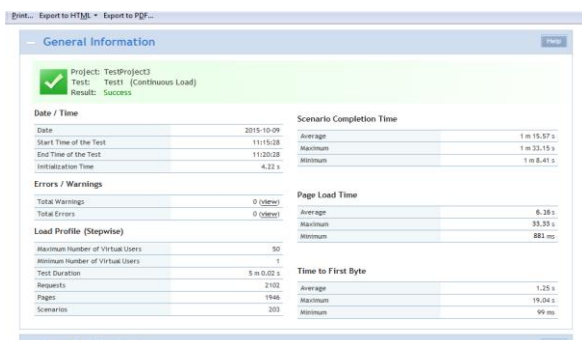Fig. 12 Run Time Graphs for 50 Virtual users (Stepwise Load)



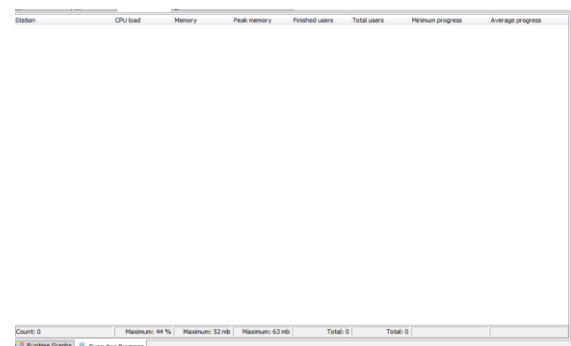Fig. 13 Test Report Summary for 50 Virtual users (Stepwise Load)



Fig. 14 Resource Utilization for 50 Virtual users (Stepwise Load)

**Table 4: Test results for 10 to 50 Virtual Users (Stepwise Load)**

| S.No. | Number of Virtual users | Response time(ms) | | | Maximum C.P.U utilization | Maximum memory utilization(mb) |
|---|---|---|---|---|---|---|
| | | Min. | Max. | Avg | | |
| 1 | 10 | 952 | 4.69 | 1.64 | 35 | 49 |
| 2 | 20 | 886 | 14.78 | 3.08 | 37 | 50 |
| 3 | 30 | 885 | 25.48 | 4.35 | 39 | 51 |
| 4 | 40 | 883 | 28.51 | 5.14 | 41 | 52 |
| 5 | 50 | 881 | 33.33 | 6.16 | 44 | 52 |

From the above results the effect of load can be monitored by calculating response time, C.P.U utilization and memory utilization.

*Response Time:* Time for downloading pages and performing transactions on the user side and of the back end system side.

*C.P.U utilization:* CPU utilization refers to the computer's usage of processing resources, or the amount of work handled by CPU.

*Memory Utilization:* Memory utilization refers to the amount of storage space used by the users.

Observed data can be represented in the form of graphs. Fig. 15 shows the graph of average response time obtained for 10 to 50 virtual users for steady load profile. It shows that response time increases as the load is increased in both cases (stepwise load and steady load). Also Fig. 16 and Fig. 17 show the graph for CPU utilization and memory utilization for steady load.
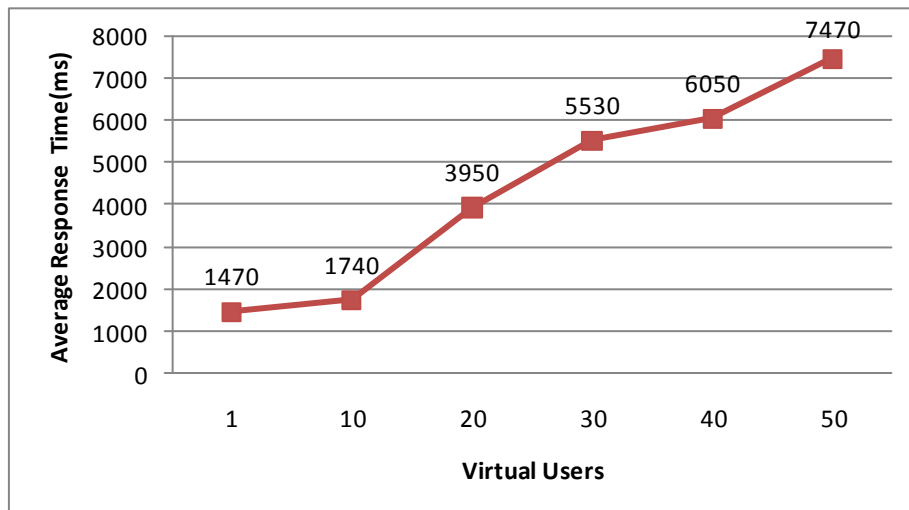


Fig 15 Average response time for steady load

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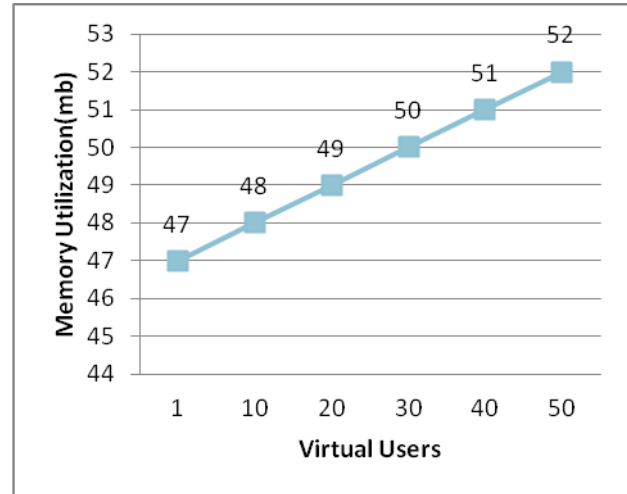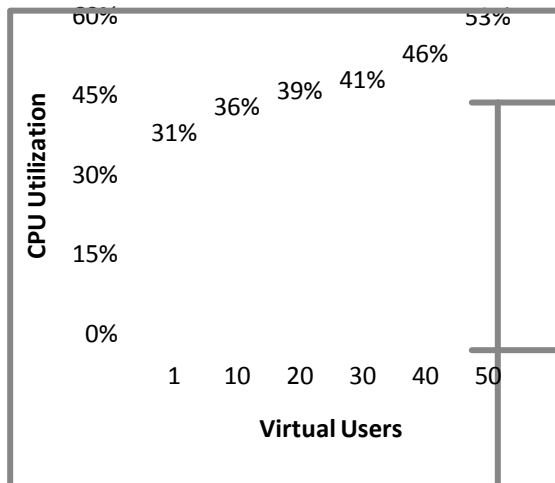**Vol. 3, Issue 10, October 2015**



Fig. 16 CPU utilization for Steady Load



Fig. 17 Memory utilization for Steady load

In Fig. 18 graph of average response time is shown that is obtained for 10 to 50 virtual users for stepwise load profile. It shows that response time increases as the load is increased. Also Fig. 19 and Fig. 120 show the graph for CPU utilization and memory utilization for stepwise load.
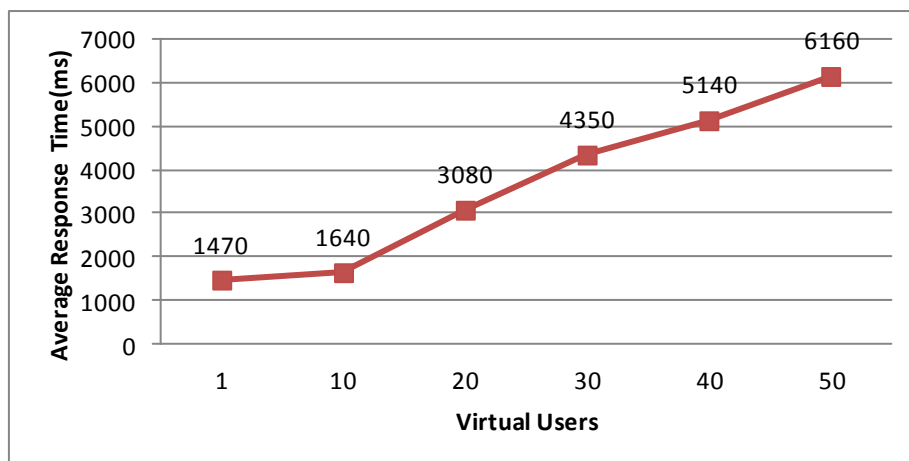


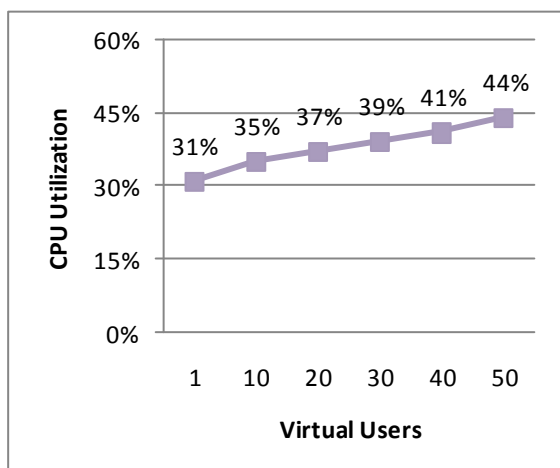Fig 18 Average response time for stepwise load
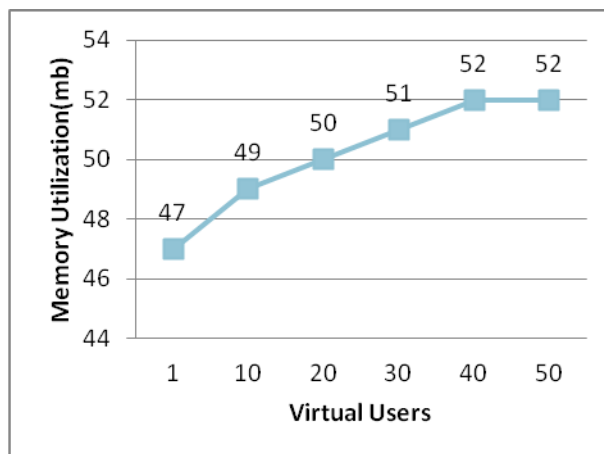
Fig. 19 CPU utilization for Stepwise Load



Fig. 20 Memory utilization for Stepwise load

From the above results it is observed that response time, cpu utilization and memory utilizations increases in both load tests (Steady Load and Stepwise Load) as load is increased by simulating number of virtual users.

## VII.  COMPARISON BETWEEN LOAD TESTS

In this work load tests are created for two load profiles- i) Steady Load  ii) Stepwise Load
Comparison can be made between these load tests by comparing average response time CPU utilization and memory utilization.
Average response time, CPU utilization and memory utilization results are shown as:

**Table 5: Average Response Time for 10 to 50 Virtual Users (Steady Load and Stepwise Load)**

| S.No. | Number of virtual users | Average response time(ms) | |
|---|---|---|---|
| | | **Steady load** | **Stepwise load** |
| 1 | 10 | 1740 | 1640 |
| 2 | 20 | 3950 | 3080 |
| 3 | 30 | 5530 | 4350 |
| 4 | 40 | 6050 | 5140 |
| 5 | 50 | 7470 | 6160 |

Table 5 shows the average response time for steady load and stepwise load. Average response time for steady load and stepwise load can be represented in the form of graph. Fig 21 shows the average response time for steady load and stepwise load. From the Fig. 21 it is clear that response time for steady load is more than stepwise load as we increase the number of virtual users.
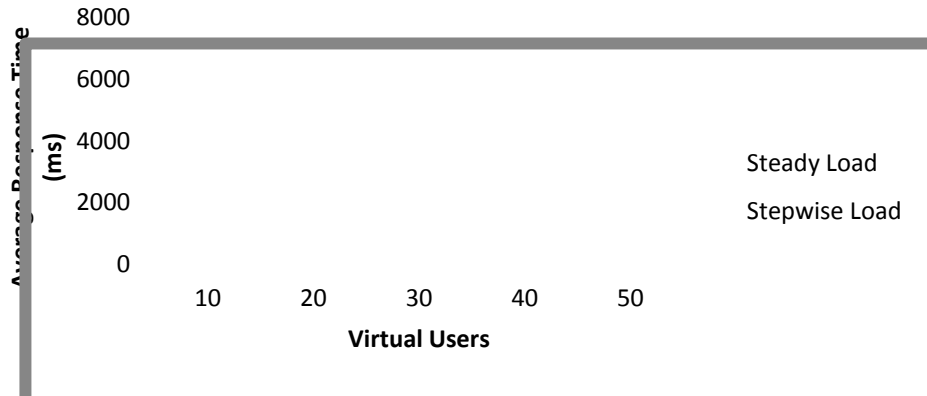
Fig. 21 Average response time for steady load and stepwise load

CPU utilization results for Steady load and Stepwise load is given in the table 5

**Table 6: CPU utilization for 10 to 50 Virtual Users (Steady Load and Stepwise Load)**

| S.No. | Number of virtual users | CPU Utilization | |
|-------|------------------------|-----------------|-----------------|
| | | **Steady load** | **Stepwise load** |
| 1 | 10 | 36 | 35 |
| 2 | 20 | 39 | 37 |
| 3 | 30 | 41 | 39 |
| 4 | 40 | 46 | 41 |
| 5 | 50 | 53 | 44 |

CPU utilization for steady load and stepwise load can be represented in the form of graph. Fig 22 shows the CPU utilization for steady load and stepwise load. From the Fig. 22 it is clear that CPU utilization for steady load is more than stepwise load as we increase the number of virtual users.
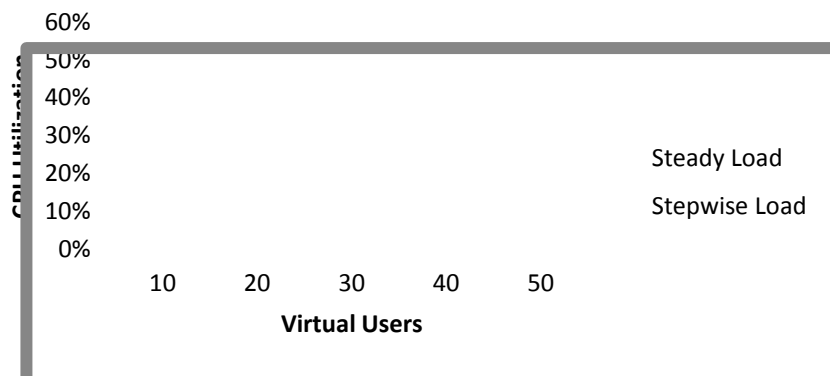


Fig. 22 CPU utilization for Steady load and Stepwise load

Memory Utilization results for steady load and stepwise load are given in Table 6. Observed data of memory utilization for steady load and stepwise load can be represented in the form of graph. Fig 23 shows the memory utilization for steady load and stepwise load. From the Fig. 23 it is clear that memory utilization for steady load is less than stepwise load.

**Table 7: Memory utilization for 10 to 50 Virtual Users (Steady Load and Stepwise Load)**

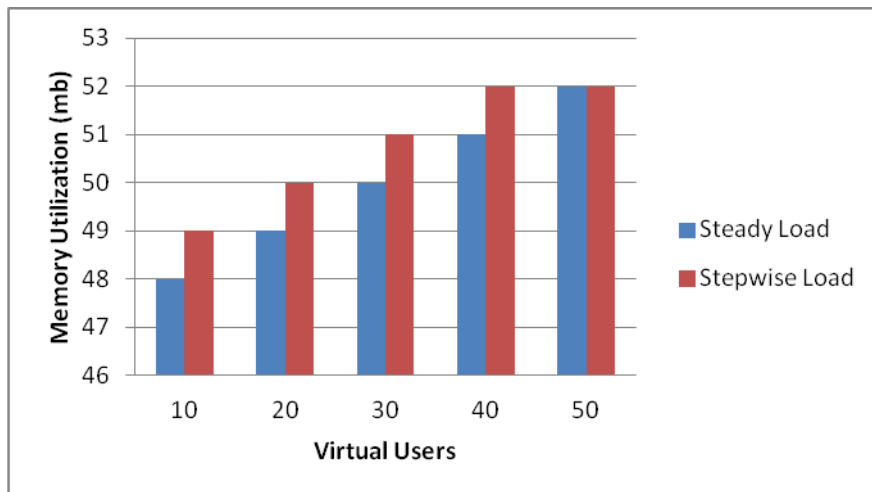| S.No. | Number of virtual users | Memory Utilization (mb) | |
|---|---|---|---|
| | | **Steady load** | **Stepwise load** |
| 1 | 10 | 48 | 49 |
| 2 | 20 | 49 | 50 |
| 3 | 30 | 50 | 51 |
| 4 | 40 | 51 | 52 |
| 5 | 50 | 52 | 52 |



Fig. 23 Memory utilization for Steady load and Stepwise load

From the above results it is observed that response time and CPU utilization is high for steady load as compare to stepwise load and memory utilization is less for steady load than for stepwise load. It shows that response time and CPU utilization is high if virtual users run at once as compared to the situation when virtual users are increased after a specific period.

## VIII. CONCLUSION

Load testing is used to find the bottlenecks of web application system under pressure.
In this study load testing is performed on the web application using automated load testing tool Load Complete. Load is applied by increasing the number of virtual users. Two load profiles steady load and stepwise load are studied. Various performance parameters like response time, CPU utilization and memory utilization are monitored.
From this study it is observed that response time, CPU utilization and memory utilization increases as load is applied by simulating the virtual users. Also it is observed that response time is high for the steady load as compared to stepwise load.

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