



QEngine White Paper

Performance Testing Report Analysis

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An automated testing tool for Performance/Load testing,
functional testing of web applications and web services testing.

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Table of Contents

INTRODUCTION.....	3
Prerequisites	3
Audience	3
Report Metrics.....	3
IS MY TEST CONFIGURATION (DURATION / ITERATIONS SETTING) APPROPRIATE?	4
Request / Response Status Summary	4
Interpreting Results	4
DOES MY WEB APPLICATION FUNCTION PROPERLY UNDER THE GIVEN LOAD?	5
Error Rate Graph : Time Vs Error %	5
Interpreting Results	5
Error Distribution	5
Interpreting Results	6
Response Validation Error Details	6
Interpreting Results	6
HOW MANY VIRTUAL USERS WERE GENERATED BY LOAD GENERATOR? ...	7
User Details Graph: (Active Users vs Elapsed Time)	7
Interpreting Results	7
Hits per Second Graph.....	7
Interpreting Results	8
DOES THE RESPONSE TIME MEET MY TARGET REQUIREMENTS?.....	9
Response Time Graphs	9
Response Time Graph (Overall)	9
Interpreting Results	9
Response Time Graph (per Transaction).....	9
Interpreting Results	10
Response Time Graph (Page Wise)	10
Interpreting Results	10
Page Download time Graphs	10
Page Download Time Graph (Per Transaction)	10
Interpreting Results	11
Interpreting Results	11

HOW MANY SIMULTANEOUS USERS CAN MY WEB APPLICATION HANDLE ?.....	12
User Capacity Graph	12
Interpreting Results	12
Response Time Vs User Load Graph (Overall)	13
Interpreting Results	13
Throughput vs User Load	13
Interpreting Results	14
HOW TO CHECK SERVER AND DATABASE PERFORMANCE DURING LOAD TEST?.....	15
Server Monitor Graphs.....	15
Database Performance Graphs	16
Database Transaction Summay.....	16
Database Connection Summary	16
Database Thread Summary	17
Database Query Summary.....	17
CONCLUSION	18

Introduction

The purpose of this paper is to explain the performance reports and graphs that are generated during a load test run, to enable users to quickly and easily interpret the results from them. This will serve as a guide to Interpreting Performance Reports & Results.

For further information about QEngine product see

<http://www.manageengine.com/products/qengine/index.html>

Prerequisites

- Knowledge of Performance (Load / Stress) Testing.
- Working knowledge of using ManageEngine's QEngine tool in testing web applications.
- Understanding of Load testing goals.

Audience

- Quality Assurance Engineers.
- Users of QEngine who need to automate their Web Application Performance tests.

Report Metrics

Report metrics should be well understood before detailed analysis of the graphs and reports .

Response Time: The time taken by the client from connecting to the Application server under test until receiving the last byte of the response. In other words, it is the duration from the start of connection to the end of the response.

Throughput: The average number of bytes per second transmitted from the Application being tested to the Virtual Clients during the last reporting interval.

Page Download Time: The elapsed time between receiving the first byte and the last byte of the response, which includes image, script and stylesheet downloads. Indicates the size of the file or page accessed.

Http Status code: To find details of the http response code and what each status means, refer to the table in <http://libraries.ucsd.edu/about/tools/http-response-codes.html>

Key Performance Testing Questions

The primary goal of performance testing is to study application performance under normal load and heavy load for sustained durations or for short durations. The reports and graphs generated at the end of the test session should provide answers to the critical questions such as:

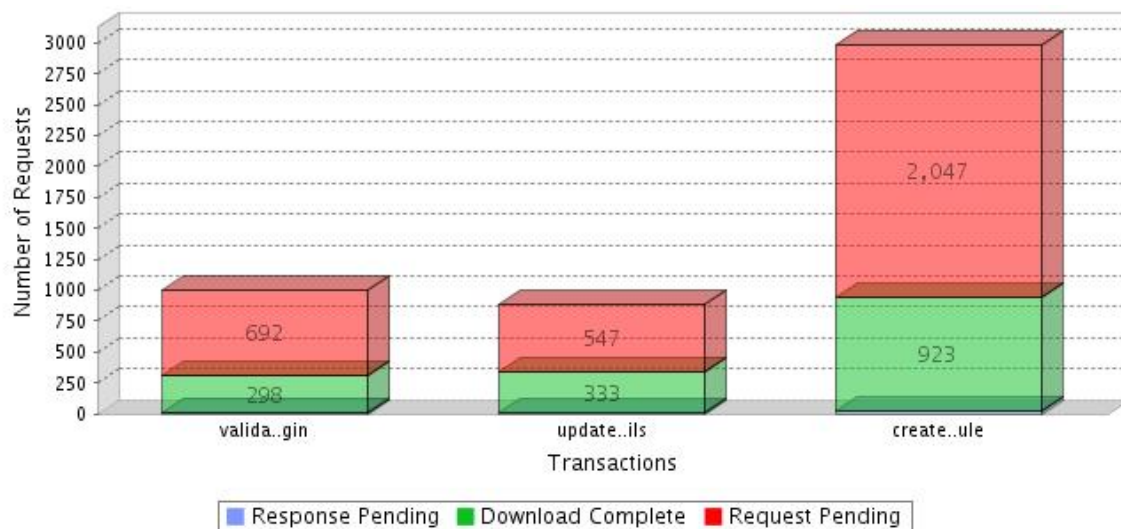
1. Is my Test Configuration (duration / iteration setting) appropriate ?
2. Does my web application function properly under given load ?
3. How many Virtual Users were generated by Load Generator ?
4. Does the response times meet my target requirements ?
5. What was the slowest page on my web site ?
6. What was the Page that had longest download time ?
7. How many simultaneous users can my web application handle ?
8. What is the load generated by the virtual users on the network resources ?
9. What is the Performance of my Server and Database during the load test ?

Is my Test Configuration (duration / iterations setting) appropriate?

The duration of the test should change depending on your testing goals. If you are just trying to get an idea of the speed of certain operations in your web site, useful performance information can be gained for tests that are a few minutes long. If, however, you are trying to stress your web site to see if anything breaks, you might want to run the test over a longer period of time. Iteration count represents one virtual user played once, through to its end. Depending on how long one user iteration takes, the test might be allowed to run for several hours. You can check and adjust the test duration and the iteration count from the Request/Response Status Summary graph that is explained below.

Request / Response Status Summary

The status summary provides a snapshot of **Requests pending & Response status** such as download started and download completed.



Interpreting Results

If **pending requests** count is high, either **test duration** is not high enough to handle all the requests or **iteration count** may be too high for the given sample interval.

If **pending response** count is high, either **duration of the test** is not high enough to receive all responses or could be because of **server errors** or **connection errors**. Need to check Error Reports to find the exact cause.

You can click on "**request pending**" or "**response pending**" category to get the list of all the virtual users and the URLs in that category as shown.

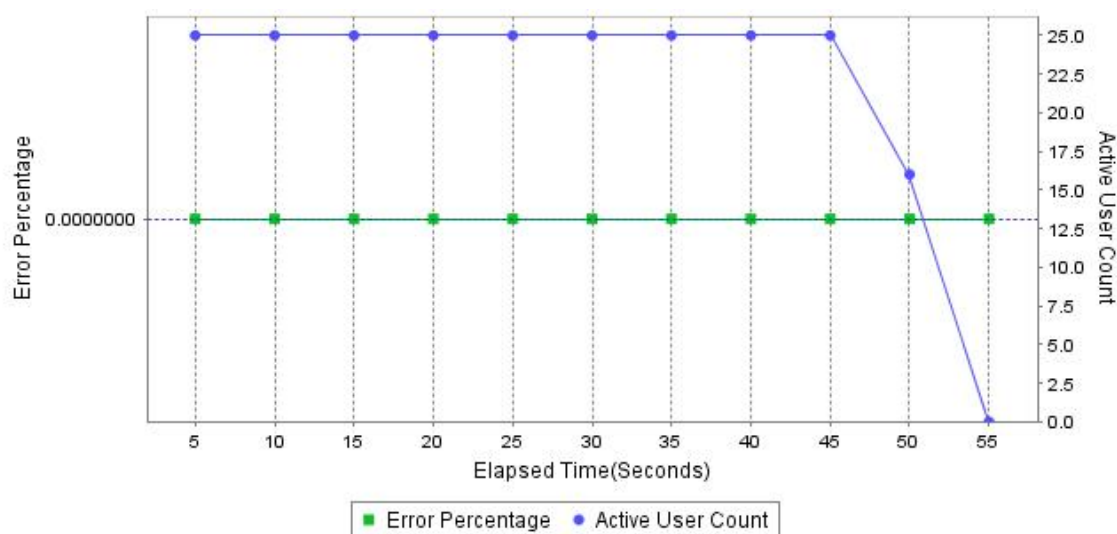
User ID	URLS
41	http://demo.qachoice.com/
42	http://demo.qachoice.com/
43	http://demo.qachoice.com/
44	http://demo.qachoice.com/

Does my web application function properly under the given load?

An important part of a load test process is to analyze the errors and adjust the tests in order to achieve meaningful and accurate results from the test. The following reports and graphs allow you to analyze the load test errors.

Error Rate Graph : Time Vs Error %

Time-based frequency of errors over the duration of the test. Error rate is an important metric in stress testing. This indicates the maximum number of users that can be served correctly, without errors and hence your site capacity. You will also need to watch error rate during the test to verify that the error is within acceptable range even after a long run.

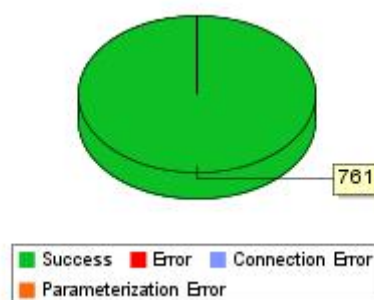


Interpreting Results

Ideally error percentage should be zero throughout the test run. If error percent is high, root cause of the error should be analyzed. It could be because of wrong inputs to the load test, network connectivity problem or the server might have crashed.

Error Distribution

The Error Summary report groups all the errors that occurred during a load test indicating the total number of errors in each of these groups.



Interpreting Results

An ideal test result should have zero error count. This graph indicates error distribution. This will indicate the errors in each category, which includes “**http errors**”, “**server errors**” and “**connection errors**” and “**parameterization errors**”. If clicked on any of the error category, you will get the virtual users and URLs that had the error.

Response Validation Error Details

Sometimes the response to a request may be 200 (Status OK) but the page returned in the response may not be the one that was expected. For instance say an incorrect login data will lead to a response code of 200, but the page returned will read Incorrect Login. Hence it is important to insert response validations to make sure we get the right response for the request.

Response validation report tabulates the result of the expected response against the actual one.

For Transaction - transact01				
URLS	Function	Excepted Value	Success Count	Failure Count
http://it-server/people/PeopleStandAlone.jsp	Check For Title	AdventNet Support Manager 4	20	0
http://web/	Check For Title	Welcome to AdventNet Intranet	20	0

Interpreting Results

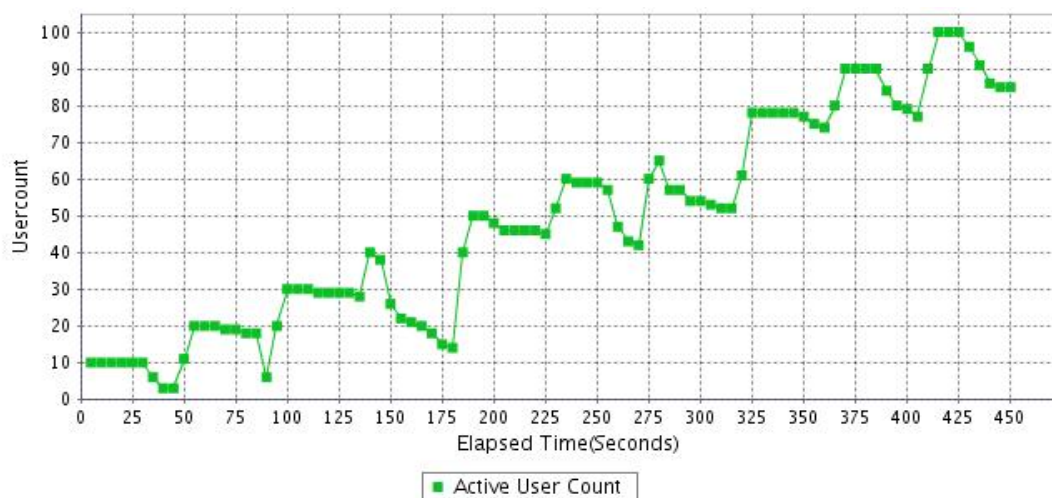
The results are tabulated transaction wise against each url with a link to view the virtual users whose response validation failed. Ideally all response validation check should pass. Response validation failures can be analyzed by looking at the saved pages .

How many Virtual Users were generated by Load Generator?

The virtual user traffic to load test a website / application should be as near as possible to real traffic. The site needs to be loaded with virtual users performing tasks that real users would. Before studying the system behavior under varying load, it is very critical to make sure we have right load generated on the system. User Details Graphs help you to find out the active users to the system during the test run.

User Details Graph: (Active Users vs Elapsed Time)

This graph shows the number of active virtual users during the test run. The active user count should basically follow the workload pattern configured.

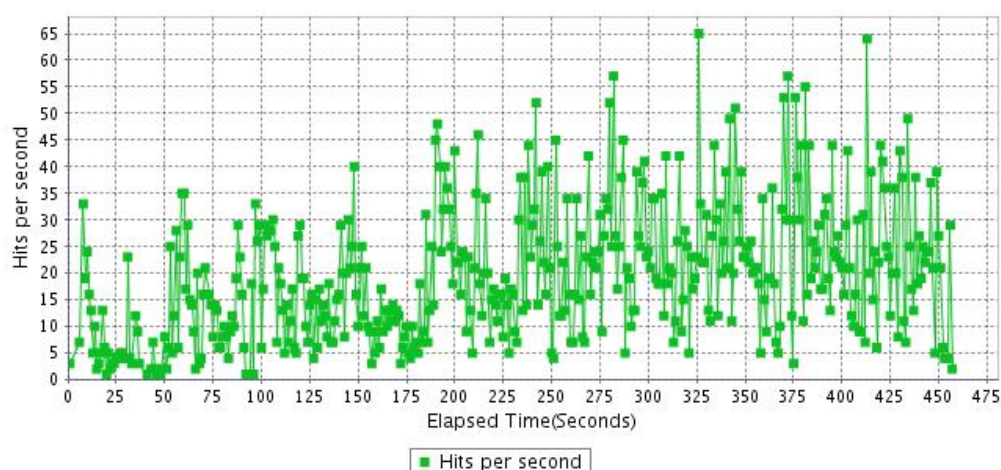


Interpreting Results

The line graph gives you the number of Virtual Users active during the test run. You can verify the Active User Count at various intervals to see to it that the right load has been generated.

Hits per Second Graph

The Hits per Second graph shows the number of HTTP requests made by Virtual users to the Web server during each second of the run. This graph helps you evaluate the amount of load Virtual Users generate, in terms of the number of hits.



Interpreting Results

The line graph helps you evaluate the amount of load Virtual Users generate, in terms of the number of requests to the server. More the number of hits, more is the load on the server.

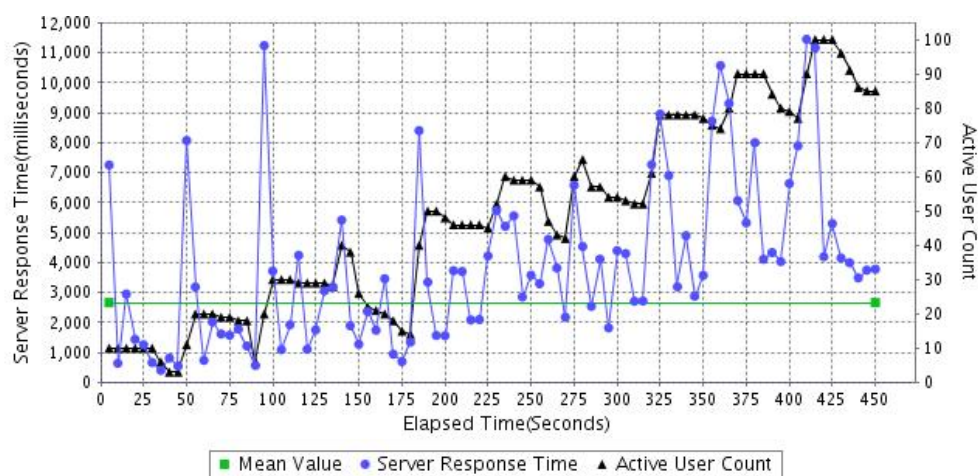
Does the response time meet my target requirements?

Response Time Graphs

Response time is one of the most important characteristics of load testing. Response time reports and graph measures the web user experience as it indicates how long the user waits for the server to respond for his request. This is the time taken, in seconds, to receive full response from the server. It is equivalent to the time taken by the client to connect to the server and receive the response including image, script and stylesheet.

Response Time Graph (Overall)

Response Time versus Elapsed Time report indicates the average response time of the transactions over the elapsed time of the load test as shown.

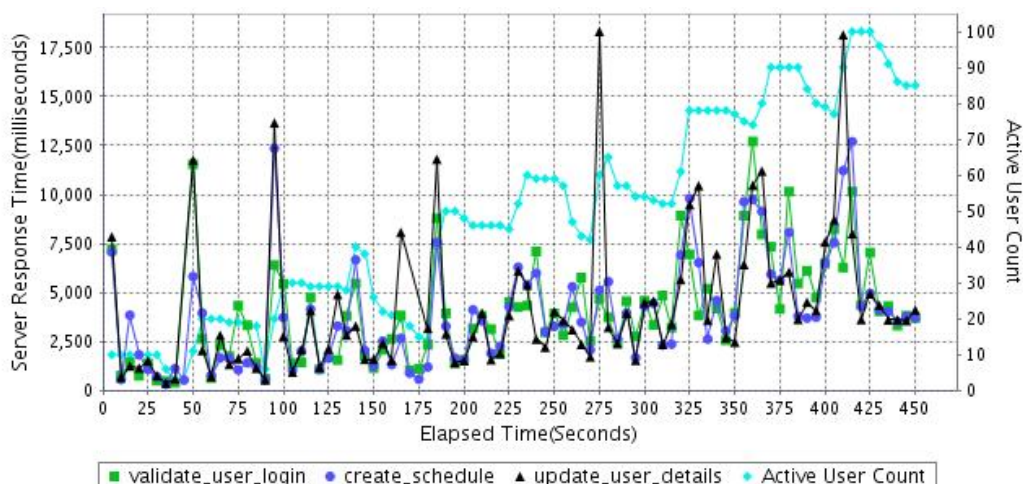


Interpreting Results

From this graph it is possible to identify peaks in the response time over a period of time. Helps to identify issues when server is continuously loaded for long duration of time.

Response Time Graph (per Transaction)

Response Time versus Elapsed Time report indicates the average response time of the transactions over the elapsed time of the load test as shown.

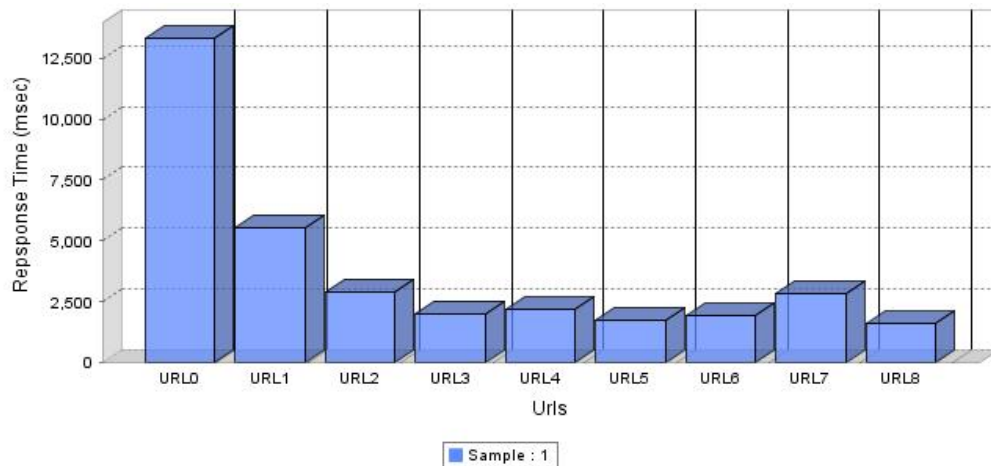


Interpreting Results

From this graph it is possible to identify peaks in the response time for transactions and then proceed to analyze the response times of individual pages.

Response Time Graph (Page Wise)

This line graph indicates average response time for the each page through time. Each bar in the graph is the average server response time for each page.



Interpreting Results

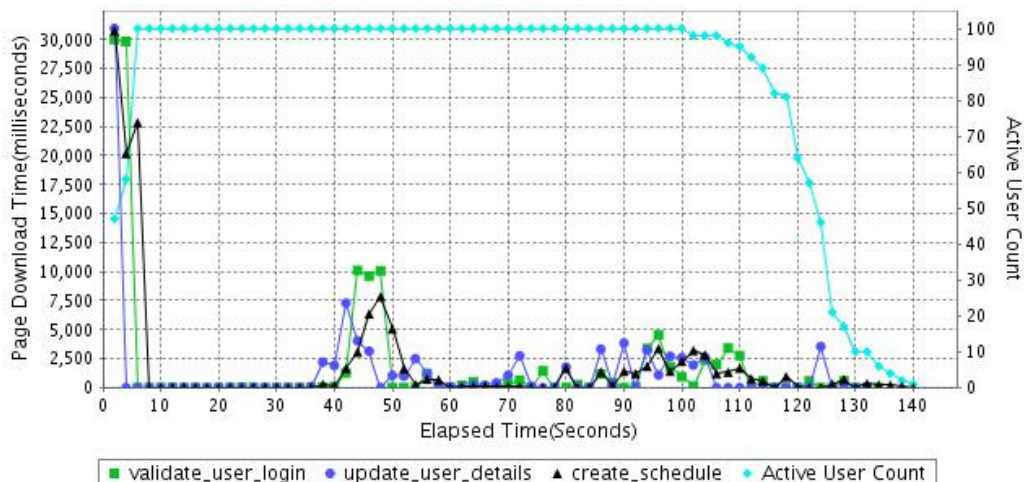
From this graph it possible to identify peaks in the response time for critical pages. Ideal behavior of response time graph is that response time does not increase with load. The point at which the graph increases sharply indicates beyond this load server cannot serve the request and users will see no response or a very slow response

Page Download time Graphs

The page download time is the time taken, in seconds, to receive the full response of the page including image, script and stylesheet from the first byte of the server response.

Page Download Time Graph (Per Transaction)

Page Download time versus Elapsed Time report indicates the average time taken for all the pages of a transactions to get downloaded at any point during the load test.

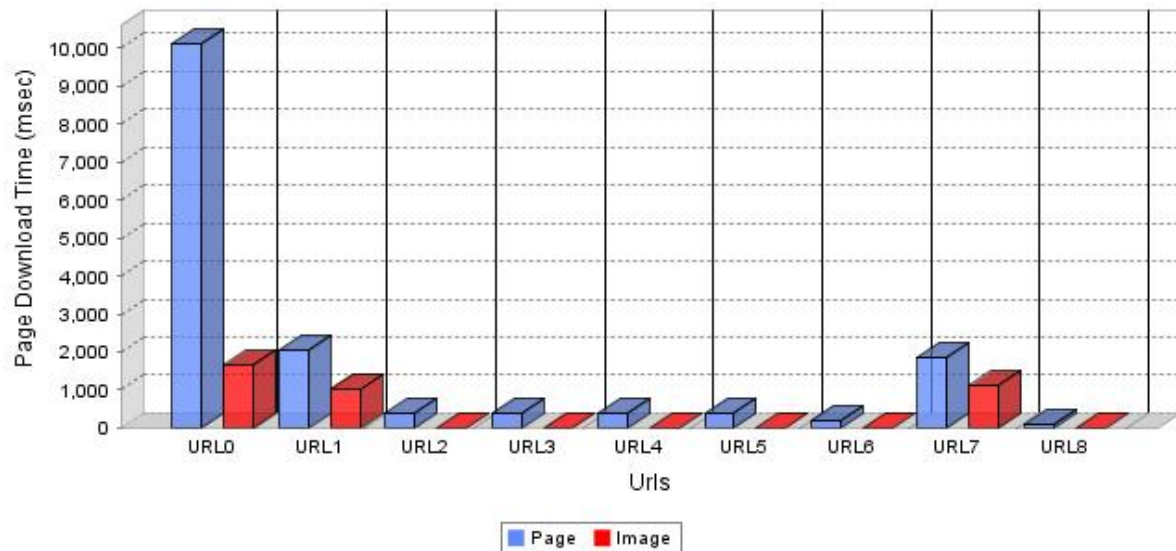


Interpreting Results

From this graph it possible to identify in the transactions that have very large download time. Each point in the graph is the average of the page download time during that interval. Page Download time graph of individual pages help you to identify the exact page that has high download time.

Page Download Time Graph (Page Wise Report)

This indicates average page download time for the each page. This analysis is especially useful if your load increases during the test.



Interpreting Results

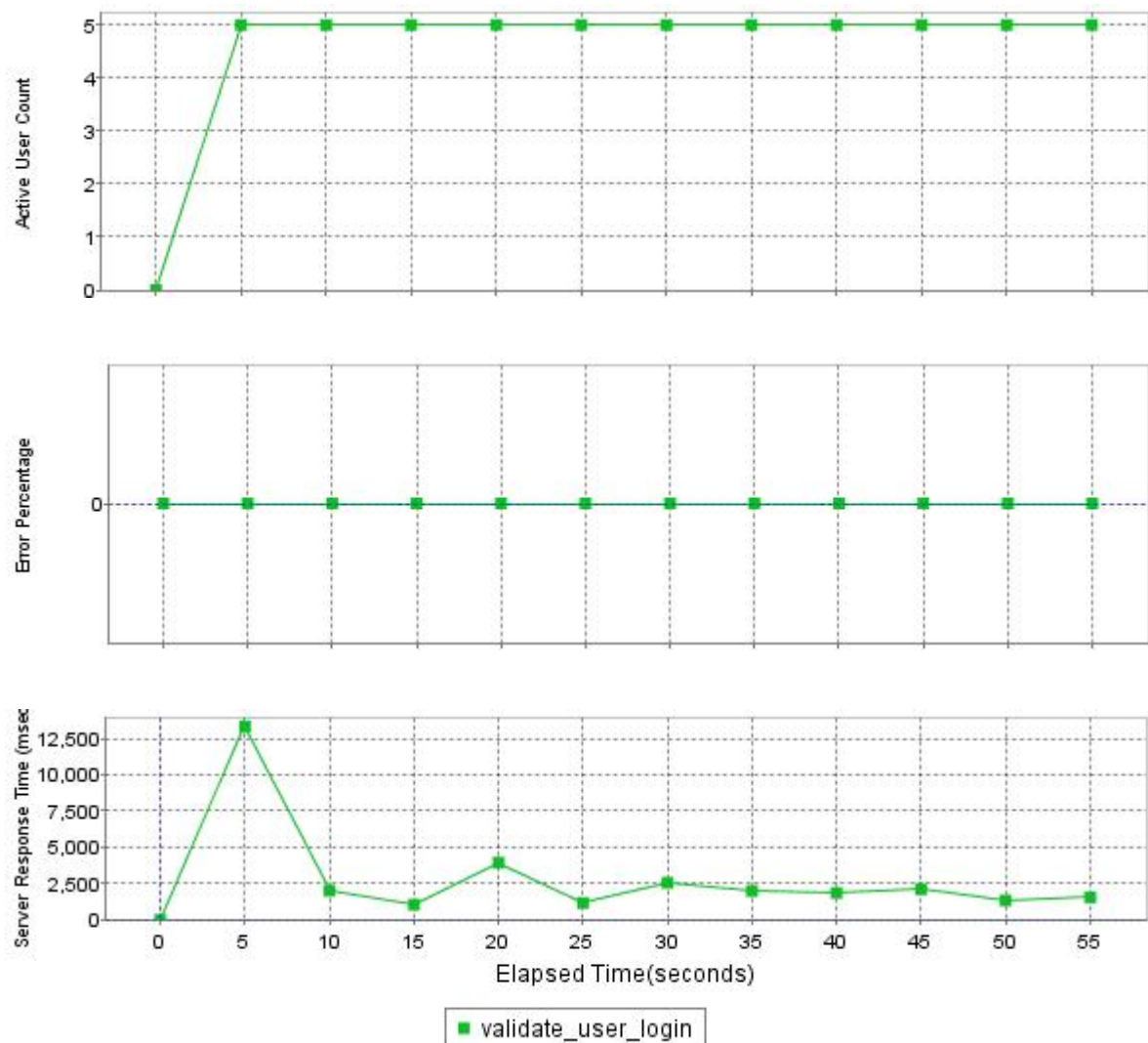
From this graph it possible to identify page that takes longer download time. Web pages become large when they include too much code, content and scripts. Pictures and graphics need to be reduced in size to increase the download time. User experience will be poor for pages that have very high download time.

How many simultaneous users can my web application handle ?

One of the main goals of stress testing *is to* determine how many of users the web server can handle before producing error messages or response time shooting beyond acceptable levels. With the information gathered during the load test, User Capacity Graph is created.

User Capacity Graph

This graph overlaps response time, error percentage and active users count at each interval. The system capacity in terms of simultaneous users is the point on the graph after which neither the error percentage nor the response time goes beyond acceptable levels.

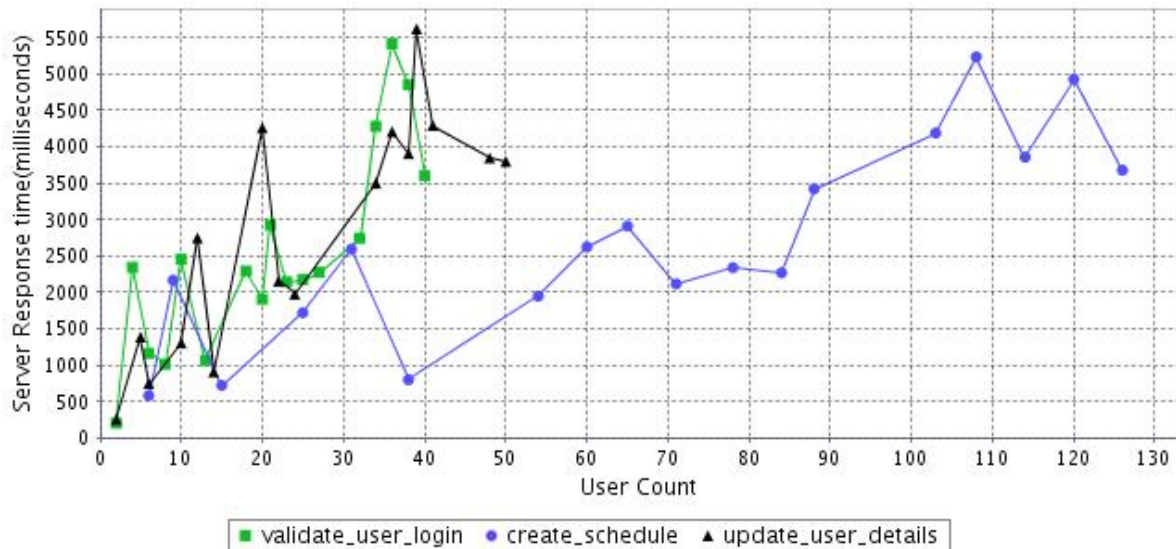


Interpreting Results

From this graph it possible to identify the maximum simultaneous users the application can server served quickly and correctly, without errors. The active user count point on the graph at which response time or error percentage goes beyond the set limit is the maximum capacity of the system.

Response Time Vs User Load Graph (Overall)

The Response Time graph shows the time the server took for responding as the load is increased. The peak indicates that the server has reached its capacity to serve data, and is unable to scale further.

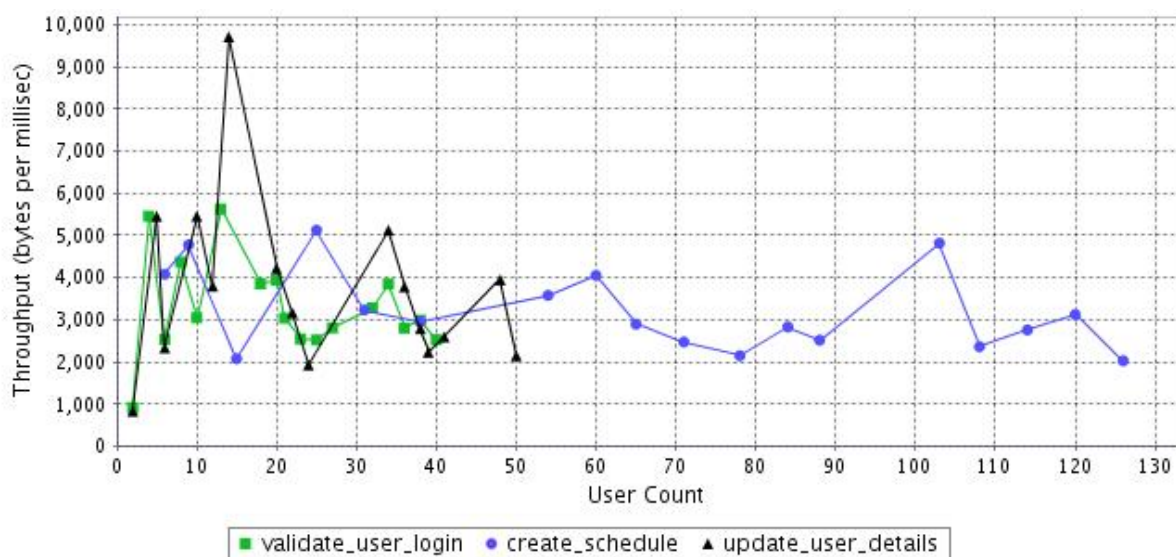


Interpreting Results

From this graph it is possible to identify peaks in the response time as the load increased. Helps to identify the capacity in terms of number of users the server can serve without much degradation in response time.

Throughput vs User Load

Throughput rate will vary depending upon the load (number of users) and the type of user activity the user performs. For example, downloading files requires higher throughput than browsing text-based Web pages. It is important to study how much throughput the server was able to sustain under an increasing load.



Interpreting Results

This graph helps testers evaluate the amount of load users generate in terms of server throughput. The graph shows the amount of data in bytes that the Virtual users received from the server in a second. When we compare this with the response time, as throughput decreased, the response time also decreased. As the load is increased the throughput starts leveling. The leveling out of the throughput indicates that the server has reached it's capacity to serve data, and is unable to scale further.

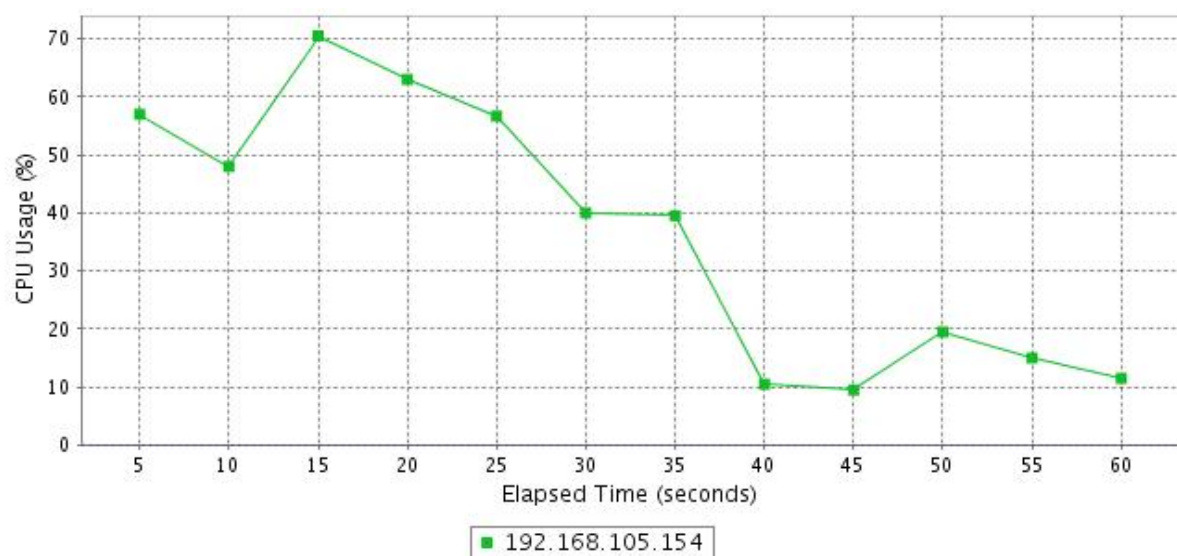
How to Check Server and Database Performance during load test?

Different factors can affect the performance of an application including network traffic, System capacity and Database capacity. Monitoring Web server, Database server during the load testing help in identify the bottlenecks. Performance result analysis will not be complete without analyzing Server Parameters and database parameters.

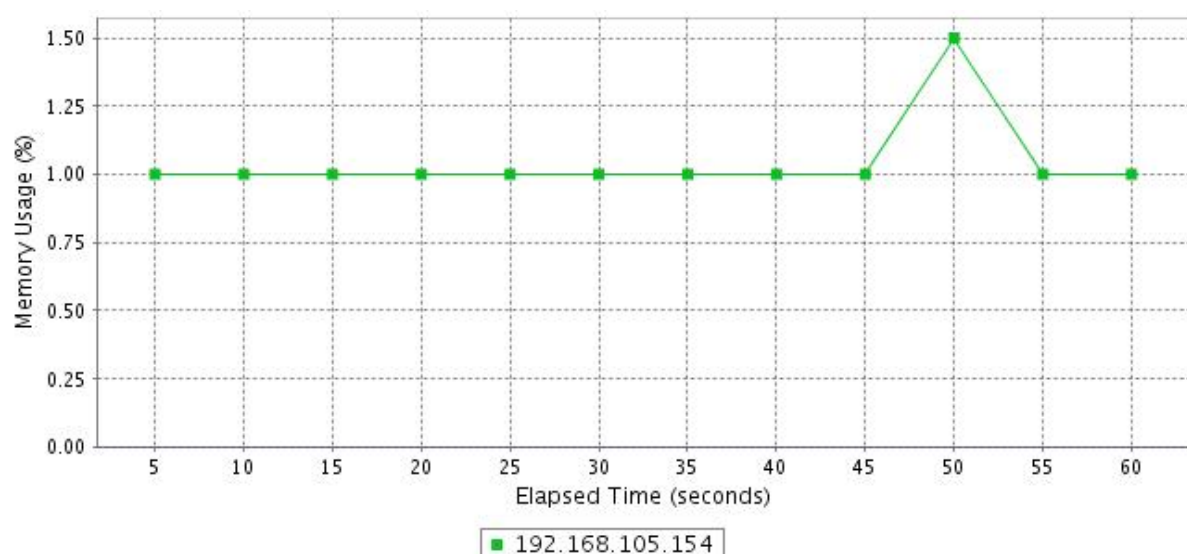
Server Monitor Graphs

Server monitors can be configured to monitor the resource utilization such as, CPU and memory usage of your web servers. The graphs below indicate the resource utilization during the test execution.

Server CPU vs Elapsed time

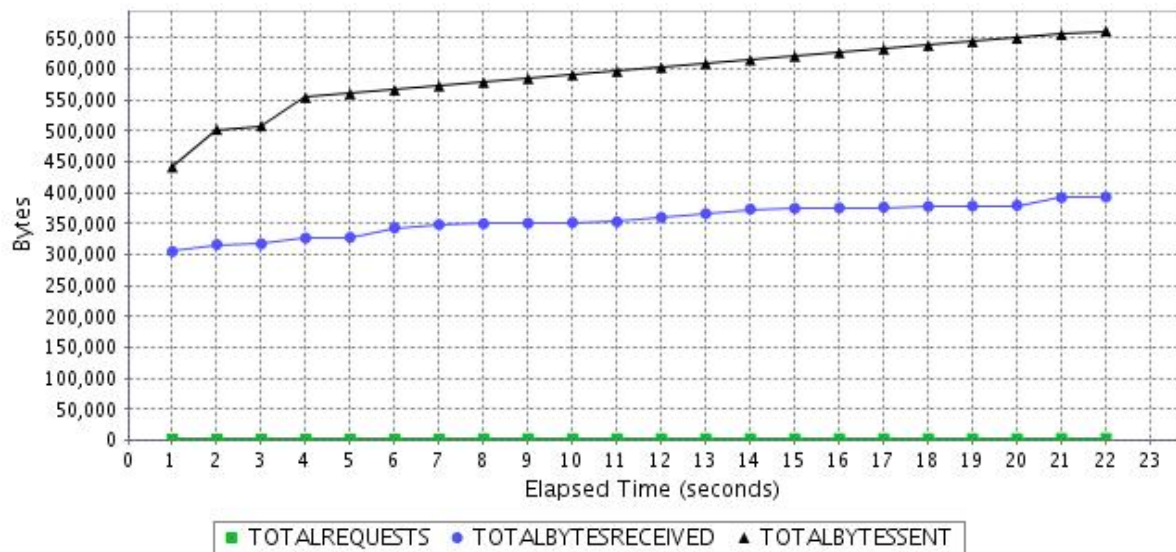


Server Memory vs Elapsed time



Database Performance Graphs

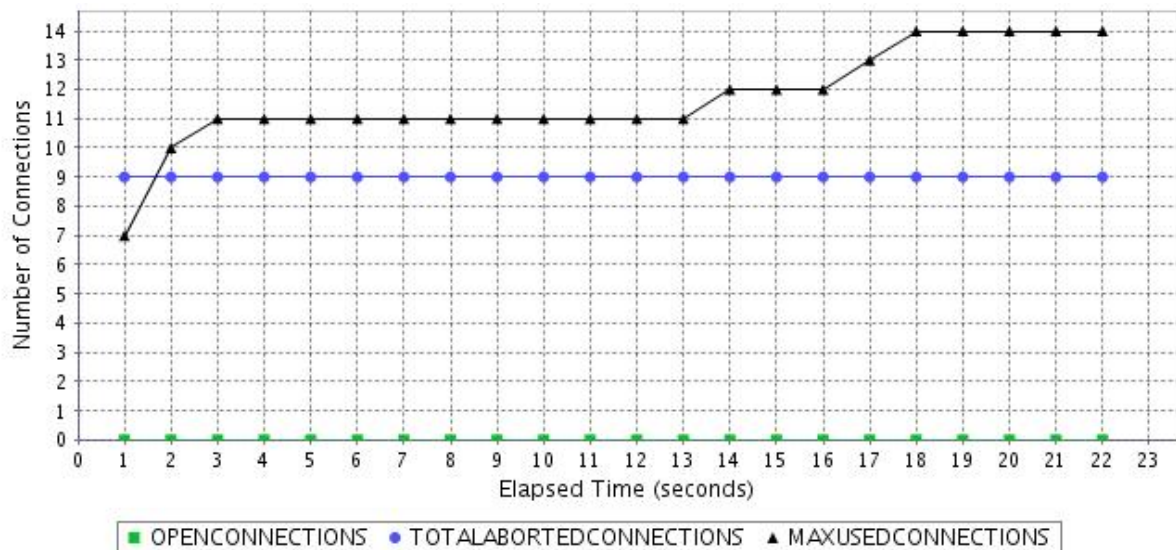
Database Transaction Summay



This graph shows the total requests, total bytes sent and total bytes received. Total requests, bytes sent and bytes received are plotted in the Y-axis and Elapsed time is plotted in the X-axis.

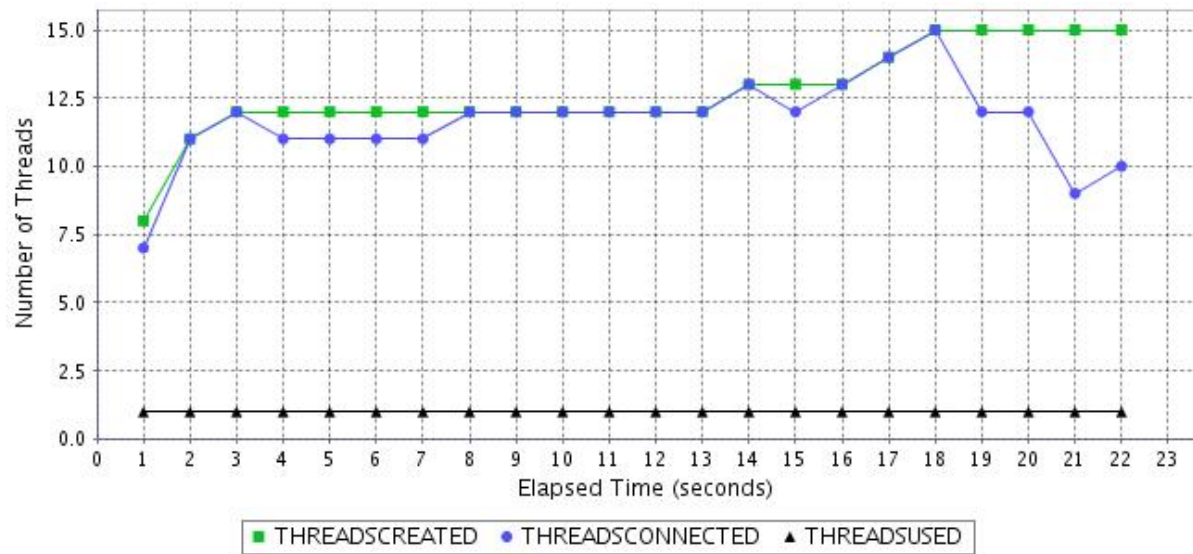
Database Connection Summary

This bar graph shows the number of open connections and the total number of aborted connections. Total open connections and total aborted connections are plotted in the Y-axis and Elapsed time is plotted in the X-axis.



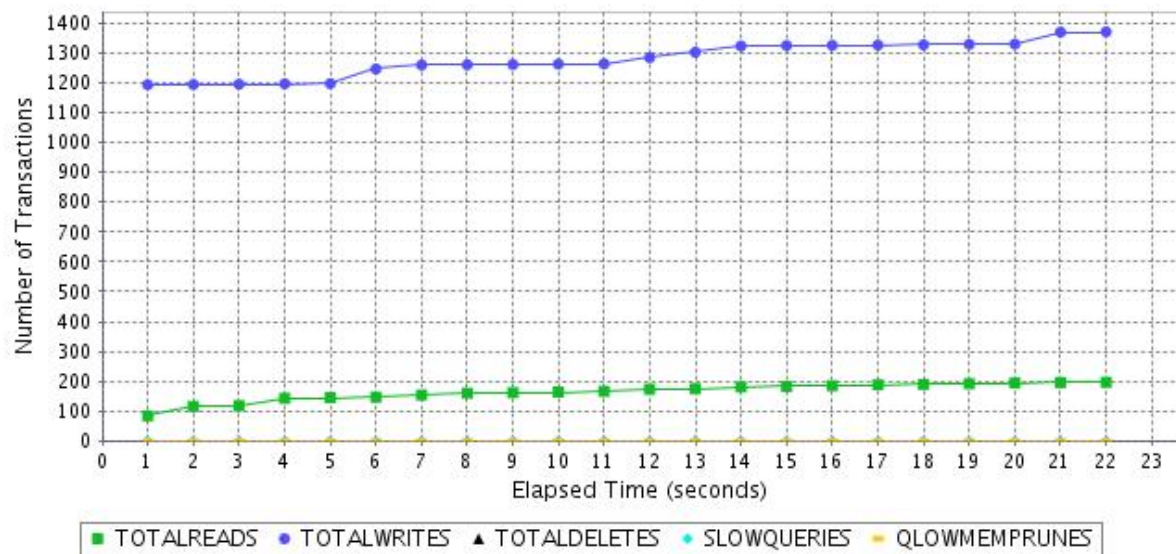
Database Thread Summary

This line graph shows Threads created, used and connected count over the period of load test run.



Database Query Summary

This line graph shows Query count in each type reads, writes and deletes during load test execution.



Conclusion

Thank you. This concludes the paper on interpreting web performance test reports. We hope that you now have a better understanding of the performance report analysis. If you have further questions, please feel free to mail us at qengine-support@manageengine.com and we will be happy to answer your queries.

If you would like to try ManageEngine QEngine, we have a fully-functional 15-day trial [download](#). You can try out the same and experience for yourself how automated load testing with QEngine can improve the performance of your web applications.