##### Performance Evaluation Report of

SHB Mobil Marknadsinfo, v2.0.0-BETA

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# Revision History

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| --- | --- | --- | --- |
| Ver | Date | Author | Description |
| PA1 | 2010-11-03 | Mikael Andersson | A first version of an NFR report |

# Introduction

This report summarizes the results of the performance tests that have been conducted in the Mobil Marknadsinfo-project for Handelsbanken. It contains a description of the test activities carried out, a presentation of the results and a brief analysis of the results.

Tests have been performed on the Cybercom Test environment on the 2.0.0-BETA version.

# Performance tests

This section describes the used test setup and the performed test cases.

## Test setup

This series of performance tests have been conducted in the Cybercom SHB-TEST environment, publicly accessible at [http://193.108.42.231](http://193.108.42.231/).

Apache JMeter, version 2.4 r961953, was used as a load generator. The test cases where regular JMeter test suites. The next section describes the test cases in detail.

The Cybercom SHB-TEST target environment is a virtual server with sub-optimal performance compared to production-like environments. Version 2.0.0-BETA of the bank-service-war application was installed on the environment.

## Test cases

Two different series of tests were performed, load tests and page tests, as described below.

### Load tests

Measurements of the system’s ability to handle a large amount of concurrent users/actions have been performed. Separate Jmeter-scripts are developed for load related non functional requirements. Measurements give relative values used to follow up that the results are maintained or improved over releases and can be used for comparisons of different environments.

The load tests have been run towards the “Marknadsinfo”-related pages of the Handelsbanken application. The server answers differently depending on the type of client request, thus two different load tests have been performed, one where the load emulates the load of simulatenous app (such as Android/iPhone) users, and one where the load emulates regulate webapp users.

### Page tests

Measurements of key metrics for all specific pages have been performed. Note that these tests have not been used in a load test perspective, only to get a sense of individual pages’ performance compared to all other pages.

Just like the load tests, the page tests have been performed for both app and webapp user-like traffic.

### Key metrics

The following key metrics were recorded and shown in this report:

# samples: The number of samples a certain test case was run.

Average: The average response time for the test case.

Median: The median of the response times for the test case.

90% line: The response time that 90 percent of the requests in the test case were below.

Min: The minimum response time for the test case.

Max: The maximum response time for the test case.

Error %: The percentage of erroneous requests for the test case.

Throughput: The average number of successful requests per second for the test case.

KB/sec: The average number of kilobytes per second received for the test case.

### Requested pages

The table below shows the pages that where requested. Note, even if the page name is identical to that of another page, the supplied parameter can give different threads of execution in the server, which is why it is important to test the same page with different parameters (e.g. instruments?type=XYZ).

All pages where requested in a round-robin fashion without any think time between requests.

|  |  |
| --- | --- |
| **App pages** | **Webapp pages** |
| **instruments-gainerslosers** | market |
| **instruments-list** | instruments-gainerslosers |
| **instrument-details?id=4966&stockListId=35207** | instruments-list |
| **instrument-details?id=125334&type=1907** | instrument-details?id=4966&stockListId=35207 |
| **instruments?stockListId=35207** | instrument-details?id=125334&type=1907 |
| **instruments?type=1901** | instruments?stockListId=35207 |
| **instruments?type=1902** | instruments?type=1901 |
| **instruments?type=1903** | instruments?type=1902 |
| **instruments?type=1904** | instruments?type=1903 |
| **instruments?type=1905** | instruments?type=1904 |
| **instruments?type=1906** | instruments?type=1905 |
| **instruments?type=1907** | instruments?type=1906 |
| **instruments?type=1908** | instruments?type=1907 |
| **instruments?type=1909** | instruments?type=1908 |
| **instruments?type=1910** | instruments?type=1909 |
| **instruments-light** | instruments?type=1910 |
| **instruments-multi?type=1911** | market-news |
| **market-news** | market-about |
| **market-about** | |

# Page test results

This section contains a summary of the performed tests and analysis of the test results. Results are mainly presented as graphs followed by some comments on the figures.

## App requests

This section contains the page test results where the client emulated an app user (such as Android/iPhone).

### Key metrics

The table below shows the result of the key metric measurements.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test case** | **# Samples** | **Average** | **Median** | **90% Line** | **Throughput** | **KB/sec** |
| **instruments-gainerslosers** | 11 | 1109 | 1094 | 1135 | 0,19570516 | 2,7979 |
| **instruments-list** | 11 | 414 | 405 | 477 | 0,19824106 | 0,6497 |
| **instrument-details?id=4966&stockListId=35207** | 11 | 546 | 525 | 666 | 0,19769594 | 0,1626 |
| **instrument-details?id=125334&type=1907** | 11 | 505 | 453 | 631 | 0,19941625 | 0,3071 |
| **instruments?stockListId=35207** | 11 | 235 | 236 | 267 | 0,20056157 | 10,047 |
| **instruments?type=1901** | 11 | 152 | 115 | 263 | 0,20102339 | 0,8651 |
| **instruments?type=1902** | 11 | 118 | 110 | 130 | 0,20122565 | 1,51 |
| **instruments?type=1903** | 11 | 130 | 115 | 133 | 0,20117045 | 2,2734 |
| **instruments?type=1904** | 11 | 115 | 112 | 122 | 0,20113734 | 2,5209 |
| **instruments?type=1905** | 11 | 130 | 125 | 162 | 0,20113734 | 4,0096 |
| **instruments?type=1906** | 10 | 129 | 113 | 176 | 0,20089196 | 1,0003 |
| **instruments?type=1907** | 10 | 226 | 178 | 239 | 0,20067829 | 10,017 |
| **instruments?type=1908** | 10 | 193 | 179 | 239 | 0,20065413 | 10,016 |
| **instruments?type=1909** | 10 | 177 | 170 | 199 | 0,20073469 | 10,02 |
| **instruments?type=1910** | 10 | 192 | 185 | 252 | 0,20082741 | 10,025 |
| **instruments-light** | 10 | 288 | 83 | 483 | 0,20152352 | 32,797 |
| **instruments-multi?type=1911** | 10 | 602 | 535 | 724 | 0,20714656 | 26,522 |
| **market-news** | 10 | 164 | 142 | 194 | 0,20871598 | 3,9778 |
| **market-about** | 10 | 19 | 12 | 40 | 0,20930573 | 0,0531 |
| **TOTAL** | 200 | 289 | 176 | 631 | 3,41833595 | 111,59 |

### Response times

As can be seen, some pages have a considerably higher response time than other pages, which can be explained by the number of requests that is made to the Millistream Web Service API (MWS) for each page request. For example, the instruments-gainerslosers makes 6 consecutive requests to the MWS, while the market-about does not make any such requests.

## Webapp requests

This section contains the page test results where the client emulated a webapp user.

### Key metrics

The table below shows the result of the key metric measurements.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Test case** | **# Samples** | **Average** | **Median** | **90% Line** | **Throughput** | **KB/sec** |
| **market** | 12 | 32 | 13 | 61 | 0,20374898 | 0,6789 |
| **instruments-gainerslosers** | 12 | 1335 | 1084 | 1253 | 0,20075282 | 7,4124 |
| **instruments-list** | 11 | 452 | 421 | 560 | 0,21024465 | 1,1531 |
| **instrument-details?id=4966&stockListId=35207** | 11 | 686 | 538 | 1105 | 0,21103118 | 1,7583 |
| **instrument-details?id=125334&type=1907** | 11 | 672 | 624 | 839 | 0,21406609 | 2,1359 |
| **instruments?stockListId=35207** | 11 | 248 | 247 | 278 | 0,21956088 | 2,9248 |
| **instruments?type=1901** | 11 | 135 | 114 | 185 | 0,22044972 | 1,8687 |
| **instruments?type=1902** | 11 | 121 | 119 | 146 | 0,22084362 | 2,8516 |
| **instruments?type=1903** | 11 | 143 | 127 | 165 | 0,22104332 | 2,6454 |
| **instruments?type=1904** | 11 | 148 | 147 | 186 | 0,22125229 | 3,1735 |
| **instruments?type=1905** | 11 | 150 | 147 | 160 | 0,22133687 | 3,1512 |
| **instruments?type=1906** | 11 | 133 | 118 | 178 | 0,22151962 | 2,5429 |
| **instruments?type=1907** | 11 | 182 | 179 | 204 | 0,22139033 | 3,1831 |
| **instruments?type=1908** | 11 | 179 | 167 | 228 | 0,22165354 | 3,1869 |
| **instruments?type=1909** | 11 | 182 | 176 | 234 | 0,22247841 | 3,1988 |
| **instruments?type=1910** | 11 | 276 | 196 | 341 | 0,22265404 | 3,2013 |
| **market-news** | 11 | 188 | 187 | 202 | 0,22299256 | 2,5211 |
| **market-about** | 11 | 14 | 12 | 22 | 0,22387756 | 0,512 |
| **TOTAL** | 200 | 293 | 171,5 |  | 3,92089648 | 48,1 |

### Response times

Just like in the app case, the difference in response times between pages depends on the fact that some pages issue multiple requests to the MWS, which increases the response times.

# Load test results

This section contains a summary of the performed tests and analysis of the test results. Results are mainly presented as graphs followed by some comments on the figures.

## App requests

This section contains the load test results where the client emulated an app user (such as Android/iPhone).

### Key metrics

The table below shows the result of the key metric measurements.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test case** | **# Samples** | **Average** | **Median** | **90% Line** | **Min** | **Max** | **Error %** | **Throughput** | **KB/sec** |
| **1 user** | 100 | **273** | 170 | 514 | 5 | 1849 | **0,00%** | 3,64577637 | **120,62** |
| **10 users** | 1000 | **788** | 552 | 1612 | 8 | 6990 | **0,00%** | 10,4222035 | **353,94** |
| **50 users** | 5000 | **4435** | 3189 | 9123 | 5 | 35341 | **0,00%** | 10,2863091 | **357,84** |
| **100 users** | 10000 | **9192** | 8097 | 14351 | 14 | 38837 | **0,00%** | 10,3450167 | **375,62** |
| **150 users** | 15000 | **14115** | 12491 | 21098 | 6 | 121611 | **0,07%** | 10,2031168 | **394,77** |
| **200 users** | 20000 | **18261** | 13151 | 30600 | 17 | 169746 | **1,38%** | 10,2751637 | **428,24** |
| **TOTAL** | 51100 | 13539 | 11661 | 22082 | 5 | 169746 | 0,56% | 10,2302978 | 398,04 |

### Response times

The response times graph is consistent to the expectations of a typical server system under high load. Any system will have response times that increase (exponentially) during overload. The point of overload depends on the server configuration and performance. A more powerful server would allow lower response times under higher loads.

### Throughput

The reason to why errors are introduced when the load is increased is because the server system has too many open connections open in some component. No further investigation has been made at this point to analyze which component is responsible for the errors, due to the low frequency of errors.

### Errors

As can be seen, when the server gets overloaded, the throughput remains (fairly) constant.

## Webapp requests

### Key metrics

The table below shows the result of the key metric measurements.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test case** | **# Samples** | **Average** | **Median** | **90% Line** | **Min** | **Max** | **Error %** | **Throughput** | **KB/sec** |
| **1 user** | 100 | **252** | 173 | 457 | 12 | 1205 | **0,00%** | 3,9300452 | **48,919** |
| **10 users** | 1000 | **723** | 508 | 1339 | 8 | 5721 | **0,00%** | 10,6967888 | **132,95** |
| **50 users** | 5000 | **3926** | 2731 | 7223 | 7 | 35030 | **0,00%** | 11,6600399 | **144,92** |
| **100 users** | 10000 | **8235** | 7226 | 12154 | 15 | 39334 | **0,00%** | 11,552787 | **143,56** |
| **150 users** | 15000 | **12463** | 11103 | 17841 | 12 | 120045 | **0,04%** | 11,54898 | **143,44** |
| **200 users** | 20000 | **15992** | 11488 | 26991 | 7 | 213058 | **1,33%** | 11,661488 | **143,02** |
| **TOTAL** | 51100 | 11928 | 10198 | 19317 | 7 | 213058 | 0,53% | 11,533916 | 142,58 |

### Response times

The response times graph is consistent to the expectations of a typical server system under high load. Any system will have response times that increase (exponentially) during overload. The point of overload depends on the server configuration and performance. A more powerful server would allow lower response times under higher loads.

### Throughput

The reason to why errors are introduced when the load is increased is because the server system has too many open connections open in some component. No further investigation has been made at this point to analyze which component is responsible for the errors, due to the low frequency of errors.

### Errors

As can be seen, when the server gets overloaded, the throughput remains (fairly) constant.

# Summary

This report has shown the results from a performance evaluation made on the Marknadsinfo pages of the Handelsbanken app.

The performance graphs are typical for a server system under high load, and no critical performance issues have been identified. It is important that a similar series of test cases are run in a production like environment for comparison, because the target environment in this evaluation was a virtual server with relatively low performance.

Note: The concept of user in this report should not be considered an actual end user of the system. An actual user would probably behave differently, whereas the “users” in this evaluation used no think time between requests thus maximizing their utilization of the server system. This means that 200 actual end users would probably experience better performance than that recorded for 200 users in this evaluation.