

Appendix H

Test Report for 100 Test Runs for the End-to-End Prototype

Appendix for Master Thesis:
Different Paths to High Availability
by Introducing Redundancy
in a Distributed SCADA System

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1 Comments to the Graphs

This appendix contains the detailed test graphs for all 100 test runs for the end-to-end based prototype. The unprocessed data that these graphs are created from, are included in the source archive for the thesis in the `test-runs/end2end-timings` folder.

Figure 1 below is a summary of all 100 tests in one graph, showing the *maximum* observed client data age for each of the 100 test runs as the solid line, and the *mean value over the max values* as the dashed line. It is seen that test run number 27 is a single outlier that just reaches the 5 second deadline (QAS1). For all other tests the maximum age is in the range 3.5 to 4.0 seconds. With respect to the mean values, these are slightly below the 1 second deadline (QAS3).

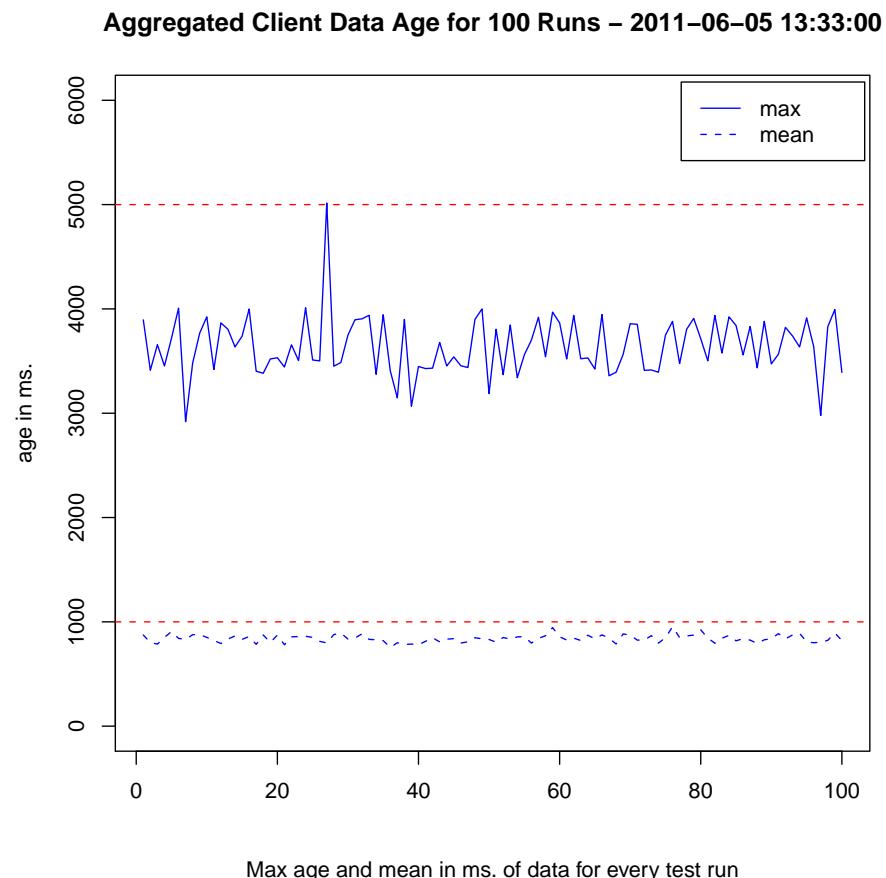


Figure 1: Aggregated max and mean of the max values for all 100 test runs.

2 Network Measurements

The two figures on the following page shows the network measurements of the nodes in the test system before and after the 100 test runs.

It is seen that the network layout as reported by the hop length between the nodes are stable during the test. This verifies that no live migration of running systems happens in the Amazon EC2 data center.

With respect to the network round trip times (rtt) 6 notable outliers are seen in the test before the tests was performed. These are the 6 white spots in figure 2, with rtt crossing 100 ms. This is somewhat surprising and shows that one must expect a certain degree of variation in network latency in the test system. This would have been a problem if the deadlines in the wind farm SCADA system has been in the millisecond range, instead of in the seconds range.

2 NETWORK MEASUREMENTS

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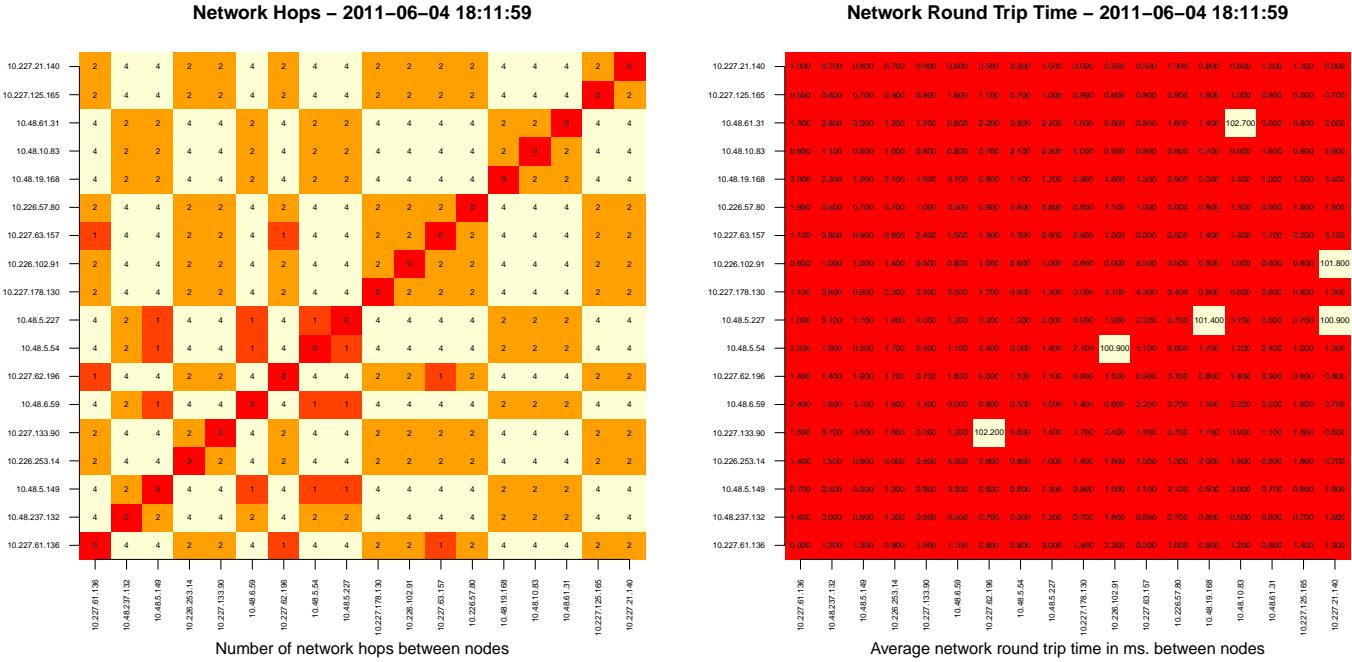
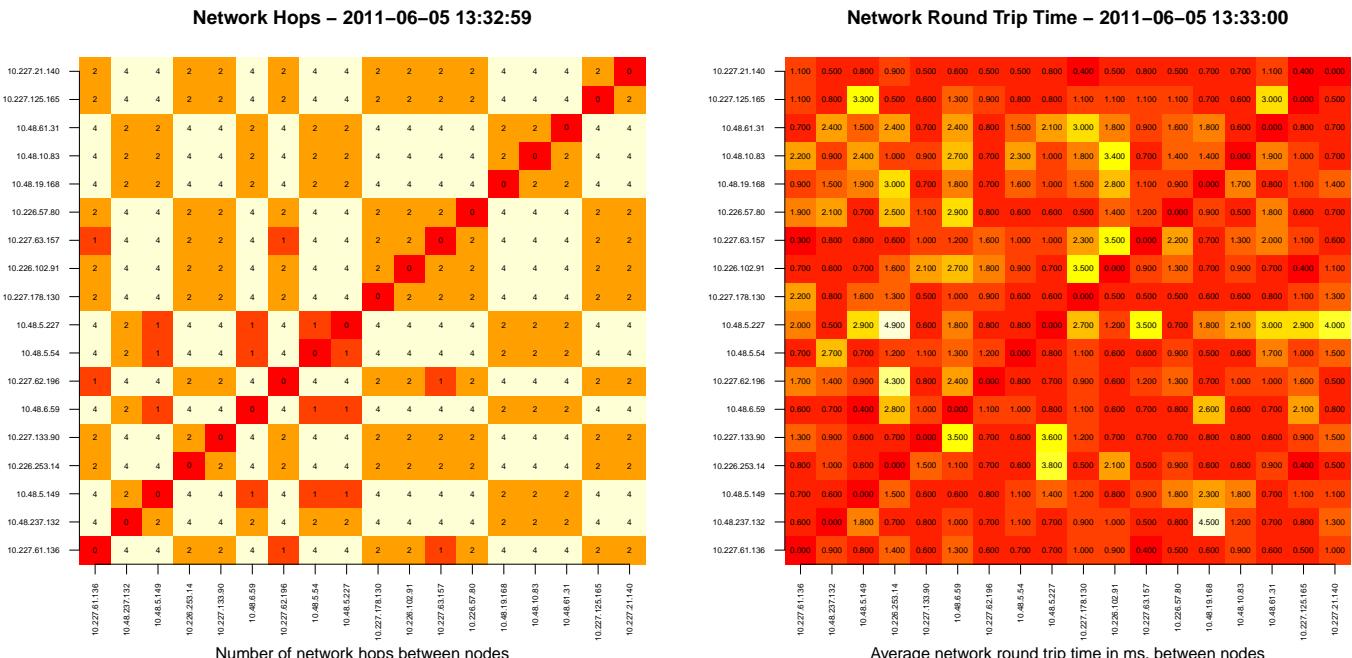


Figure 2: Network measurements *before* the test runs.



3 Measurements for the 100 Prototype Test Runs

The following 100 images each depict the measured timings during *one* prototype test run. Except for test run 27 on page 12 there are no real surprises. When the system is running in normal operation the measured max and mean values are in a narrow band around the 1 second deadline (QAS3), and at failover situations as indicated by the 3 blue server lines depicted at the bottom of each graph, the max values are well below the 5 second deadline (QAS1).

