PLX82-MNET-61850

Performance Measurement
Document Code: TN-004-11-PLX82-MNET-61850
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Document Information

<table>
<thead>
<tr>
<th>Author</th>
<th>Kentaro Seki, Neven Gras</th>
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<td>Description</td>
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<td>9/07/2017</td>
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Contents

Document Information ................................................................. 2
OVERVIEW ...................................................................................... 4
   Introduction ............................................................................... 4
   Hardware Requirements ............................................................. 4
   Software Requirements .............................................................. 4
OVERVIEW ..................................................................................... 5
TEST RESULTS ................................................................................ 7
Overview

Introduction
The purpose of this document is to report the PLX82-MNET-61850 performance measurement results. The test evaluates how the module performance is affected by number of data attributes and number of IEDs.

Hardware Requirements
The following table indicates the equipment required for the tests:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Quantity</th>
<th>Short Description</th>
<th>Vendor</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLX82-MNET-61850</td>
<td>3</td>
<td>EUT</td>
<td>Prosoft Technology</td>
<td>Equipment Under Test</td>
</tr>
<tr>
<td>S80 SEPAM</td>
<td>2</td>
<td>IED</td>
<td>Schneider Electric</td>
<td>IED for report performance measurement</td>
</tr>
<tr>
<td>SEL-751A</td>
<td>1</td>
<td>IED</td>
<td>Schweitzer Engineering Laboratories</td>
<td>IED for MMS performance measurement</td>
</tr>
<tr>
<td>F650 By Controller</td>
<td>1</td>
<td>IED</td>
<td>GE</td>
<td>IED for GOOSE performance measurement</td>
</tr>
<tr>
<td>CPU65160</td>
<td>1</td>
<td>Modbus TCP/IP server</td>
<td>Schneider Electric</td>
<td>Modbus TCP/IP server</td>
</tr>
</tbody>
</table>

Software Requirements
The following table indicates the software required for the tests:

<table>
<thead>
<tr>
<th>Software</th>
<th>Vendor</th>
<th>Version</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosoft 61850 Configuration Manager</td>
<td>Prosoft Technology</td>
<td>1.0.0.96</td>
<td>Module configurator</td>
</tr>
<tr>
<td>Anvil</td>
<td>Triangle Microworks</td>
<td>3.00.0022</td>
<td>IED Simulator</td>
</tr>
<tr>
<td>Ethereal</td>
<td>Ethereal</td>
<td>1.1.0</td>
<td>Data capture</td>
</tr>
<tr>
<td>SFT850</td>
<td>Schneider Electric</td>
<td>2.0.28</td>
<td>Schneider IED configuration</td>
</tr>
<tr>
<td>AcSelerator Architect</td>
<td>SEL</td>
<td>1.1.98</td>
<td>SEL IED configuration</td>
</tr>
</tbody>
</table>
Overview

Performance Measurement

In monitoring direction: it was measured the time interval between receiving a 61850 message from the IED (MMS read, report and GOOSE) and sending the Modbus TCP/IP write message to the server:

![Diagram of monitoring direction performance measurement]

**Note:** Performance results on the EtherNet/IP products (PLX81-EIP-61850 and PLX82-EIP-61850) have no relationship with MBTCP performance results.

In controlling direction: it was measured the time interval between the module receiving a Modbus TCP/IP write request and sending MMS write operation to a controllable data attribute in the IED:

![Diagram of controlling direction performance measurement]
The time interval is measured through data capture analysis. The tests are measured for two scenarios:

**Performance according to number of data attributes**

It was measured the performance while increasing the number of data attributes for the same IED.

**Performance according to number of IEDs**

Measures the performance while increasing the number of IEDs. The performance is measured for a real IED while the IED count is increased by adding simulated IEDs to the network.

The following IEDs were used according to the IEC-61850 message type:

<table>
<thead>
<tr>
<th>Message Type</th>
<th>IED</th>
<th>Number of test repetitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOSE</td>
<td>SEPAM S80</td>
<td>20</td>
</tr>
<tr>
<td>Report</td>
<td>SEPAM S80</td>
<td>20</td>
</tr>
<tr>
<td>MMS Read</td>
<td>SEL-751A</td>
<td>20</td>
</tr>
<tr>
<td>MMS Write</td>
<td>SEPAM S80</td>
<td>10</td>
</tr>
</tbody>
</table>

**Test Setup**

The performance is measured using a real IED according to the previous section. For the tests that requires more than one IED it was used simulated IEDs. The Unity processor (Schneider Electric) was used as a Modbus TCP/IP server:
Test Results

*MMS Read Tests*

**According to number of IEDs**

<table>
<thead>
<tr>
<th>Number of IEDs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.960</td>
<td>21.880</td>
<td>13.199</td>
</tr>
<tr>
<td>2</td>
<td>4.568</td>
<td>22.776</td>
<td>15.358</td>
</tr>
<tr>
<td>5</td>
<td>5.602</td>
<td>22.559</td>
<td>11.612</td>
</tr>
<tr>
<td>20</td>
<td>6.678</td>
<td>54.861</td>
<td>20.220</td>
</tr>
<tr>
<td>45</td>
<td>18.989</td>
<td>1105.8</td>
<td>37.655</td>
</tr>
</tbody>
</table>

**According to number of Data Attributes**

<table>
<thead>
<tr>
<th>Number of DAs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.900</td>
<td>31.483</td>
<td>15.975</td>
</tr>
<tr>
<td>2</td>
<td>7.085</td>
<td>25.220</td>
<td>14.704</td>
</tr>
<tr>
<td>5</td>
<td>7.115</td>
<td>32.642</td>
<td>16.758</td>
</tr>
<tr>
<td>50</td>
<td>6.988</td>
<td>24.234</td>
<td>16.597</td>
</tr>
<tr>
<td>100</td>
<td>6.166</td>
<td>30.010</td>
<td>18.714</td>
</tr>
</tbody>
</table>

*Report Tests*

**According to number of IEDs**

<table>
<thead>
<tr>
<th>Number of IEDs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.336</td>
<td>4.356</td>
<td>3.553</td>
</tr>
<tr>
<td>2</td>
<td>3.385</td>
<td>4.604</td>
<td>3.729</td>
</tr>
<tr>
<td>5</td>
<td>3.676</td>
<td>5.692</td>
<td>4.682</td>
</tr>
<tr>
<td>20</td>
<td>4.295</td>
<td>204.69</td>
<td>48.601</td>
</tr>
<tr>
<td>45</td>
<td>13.892</td>
<td>764.504</td>
<td>213.895</td>
</tr>
</tbody>
</table>

**According to number of Data Attributes**

<table>
<thead>
<tr>
<th>Number of DAs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.293</td>
<td>5.115</td>
<td>3.678</td>
</tr>
<tr>
<td>2</td>
<td>3.569</td>
<td>11.006</td>
<td>6.362</td>
</tr>
<tr>
<td>5</td>
<td>4.313</td>
<td>24.390</td>
<td>12.762</td>
</tr>
<tr>
<td>50</td>
<td>16.151</td>
<td>54.868</td>
<td>22.210</td>
</tr>
<tr>
<td>100</td>
<td>10.262</td>
<td>84.906</td>
<td>50.645</td>
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</table>
**GOOSE Tests**

*According to number of IEDs*

<table>
<thead>
<tr>
<th>Number of IEDs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.155</td>
<td>3.747</td>
<td>2.643</td>
</tr>
<tr>
<td>2</td>
<td>2.176</td>
<td>63.050</td>
<td>14.903</td>
</tr>
<tr>
<td>5</td>
<td>2.181</td>
<td>226.238</td>
<td>36.529</td>
</tr>
<tr>
<td>20</td>
<td>648.320</td>
<td>3440.307</td>
<td>1755.598</td>
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<tr>
<td>45</td>
<td>2254.365</td>
<td>4575.712</td>
<td>3525.888</td>
</tr>
</tbody>
</table>

*According to number of Data Attributes*

<table>
<thead>
<tr>
<th>Number of DAs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2.180</td>
<td>63.050</td>
<td>14.900</td>
</tr>
<tr>
<td>50</td>
<td>15.908</td>
<td>1251.192</td>
<td>1051.487</td>
</tr>
<tr>
<td>100</td>
<td>33.784</td>
<td>1204.699</td>
<td>798.204</td>
</tr>
</tbody>
</table>

**MMS Write Tests**

*According to number of IEDs*

<table>
<thead>
<tr>
<th>Number of IEDs</th>
<th>Minimum (ms)</th>
<th>Maximum (ms)</th>
<th>Average (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.0</td>
<td>11.0</td>
<td>7.0</td>
</tr>
<tr>
<td>20</td>
<td>4.0</td>
<td>14.0</td>
<td>8.0</td>
</tr>
<tr>
<td>45</td>
<td>13.0</td>
<td>262.0</td>
<td>17.0</td>
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