Resource Efficiency Testing

Step by Step Instructions

*OPC Foundation*

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Executive Summary

All OPC products can be certified (Clients, Servers, or both) for Unified Architecture, OPC Classic, or both.

Most products that fail certification testing do so because of resource leaks or crashes found in the 36-hour resource efficiency testing. This document provides step-by-step instructions for you to replicate the resource efficiency testing conducted in the OPC Foundation Certification Test Lab to help you avoid this problem.

This paper covers the following:

- Configuring your OPC Client/Server
- Configuring products to connect to your Client/Server
- Configuring the environment for simulating network communications outages
- Obtaining and analyzing performance metrics

Vendors need to perform this test on their Client/Server products before submitting to the test lab.

Intended Audience

This document contains technical information and is intended for software developers and QA personnel.

OPC Foundation Membership

This document is primarily intended for members of the OPC Foundation.
Introduction

A 36-hour resource-efficiency test will combine stress-testing with robustness and recovery. The goal is to ensure products are reliable, able to automatically recover from communications loss, and are efficient with system resources (no memory-leaks etc.)

The general testing principle is the same for OPC Clients and Servers. However, some subtle differences require us to treat them differently. Please review the applicable sub-section as applicable to your product.

OPC Server Testing

You will need the following:

- Multiple data-sources (PLCs, Modbus Simulators etc. if supported)
- Multiple OPC Clients (5, by minimum)
- Windows Performance Monitor (See section Performance Monitor on page 9)
- Intermittent network connection (simulation)
Multiple data-Sources

*Note: you can skip this section if your server does not support Device connections*

- The Test lab uses “PeakHMI TCP Slave” / [MODBUS Ethernet PLC simulator](#).
- Multiple data-sources are needed (at least 2 remote data sources) as shown here:
Multiple OPC Clients

- A minimum of 5 OPC clients’ are needed:

![Diagram of OPC Clients and Server]

- Each client must consume a minimum of 1000 items/nodes from each Server covering all devices.
- If the server does not support device connections, configure the client with all the available items (internal/simulation tags) in the server.
- A list of typical Classic/UA Clients used in the test lab is shown here:

<table>
<thead>
<tr>
<th>Classic</th>
<th>Iconics Genesis64 V 10.81+FH2</th>
<th>Indusoft-WebStudio V 7.1</th>
<th>Softing Demo Client V 4.30.1 Build 2692</th>
<th>OPCF DA Sample Client V 334</th>
<th>Kepware-OPC Quick Client V 5.11.250.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA</td>
<td>Iconics Genesis64 V 10.81+FH2</td>
<td>Indusoft-WebStudio V 7.1</td>
<td>HB-Soft Comet UA Browser V 1.0.3</td>
<td>OPCF UA Sample Client V 1.1.334.0</td>
<td>Unified Automation-UA Expert V 1.2.2</td>
</tr>
</tbody>
</table>

Please contact the vendors directly to obtain the demo version of their software.
Intermittent Connection Simulation

- Configure the performance monitor tool to record the data as mentioned in Performance Monitor section on page 9.
- Let the system run for an hour without any interruption to get a base-line of resource consumption.
- Run the batch file (see section Batch File on page 13) to start simulating intermittent network connectivity.
- There are two different sets of configuration for the intermittent connection. Please use the configuration applicable for your application:
  - **Configuration 1**: When the server supports device connections:
    - Data Source A
      - PLC/Modbus
      - Intermittent connection to Data Source A
    - OPC Client 1
    - OPC Client 2
    - OPC Client 3
    - OPC Client 4
    - OPC Client 5
  
  - **Configuration 2**: When the server is not connected to an external data source:
    - OPC Client 1
    - OPC Client 2
    - OPC Client 3
    - OPC Client 4
    - OPC Client 5
    - Intermittent Connection to Client 4
OPC Client Testing

You need to have the following in order to perform the resource efficiency test on a Client.

- Multiple OPC Servers (5, by minimum)
- Windows Performance Monitor (See section Performance Monitor on page 9)
- Intermittent connection (simulation)

Multiple OPC Servers

- A minimum of 5 Servers need to be used for the efficiency test:

  ![Diagram of OPC Client and Servers](image)

  - Connect the client to each server as shown and configure 1000 items per OPC server connection.
  - A list of typical Classic/ UA servers used in the test lab are shown in the below table.

<table>
<thead>
<tr>
<th>Classic</th>
<th>Kepware KepServerEX V 5.11</th>
<th>Matrikon UCS V 2.1.0.1602</th>
<th>Softing-OPC Toolbox Demo Server V 4.30.1 Build 2692</th>
<th>OPCF Sample Server V 1.0.01</th>
<th>Cyberlogics- MBX OPC Server V 7.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA</td>
<td>Kepware KepServerEX V 5.11</td>
<td>Matrikon UCS V 2.1.0.1602</td>
<td>Softing – OPC UA C++ Test Server V 5.20.0.8536</td>
<td>OPCF UA Reference Server V 1.1.334.0</td>
<td>Unified/Automation- UA Demo Server V 1.3.2.200</td>
</tr>
</tbody>
</table>
Intermittent connection simulation

- Configure the Client to connect to multiple Servers, as shown here:

![Diagram showing OPC servers and client with intermittent connection to Server 5]

- Configure the performance monitor tool to record the data as mentioned in Performance Monitor section on page 9.
- Let the system run for an hour without any interruption to get a baseline of resource consumption.
- Run the batch file (See section Batch File on page 13) to enable the intermittent connection simulation.
Performance Monitoring

Windows Performance Monitor

Windows performance monitor is used to record performance data and is then converted to charts for reporting.

1. Open Performance monitor by typing “Perfmon.msc” in windows Start menu search.
2. Create a new collector set in the “Data Collector Sets/ User Defined” section of the performance monitor:

   ![Image of Performance Monitor]

   3. Select “Create Manually” option on the screen and select Performance counter under “Create data logs” option on the next screen:

   ![Image of Create new Data Collector Set]
4. Select the performance counters in the next screen. Click “Add” to include the counters that needs to be monitored:

![Image of performance counter selection screen]

5. Here is the list of counters needed for the test:

<table>
<thead>
<tr>
<th>Counters</th>
<th>Instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>_Total</td>
</tr>
<tr>
<td>% Processor Time</td>
<td></td>
</tr>
<tr>
<td>% User Time</td>
<td></td>
</tr>
<tr>
<td>Process</td>
<td>All related Instances of your Opc Server/ OPC Client</td>
</tr>
<tr>
<td>% Processor Time</td>
<td></td>
</tr>
<tr>
<td>% User Time</td>
<td></td>
</tr>
<tr>
<td>Elapsed Time</td>
<td></td>
</tr>
<tr>
<td>Handle Count</td>
<td></td>
</tr>
<tr>
<td>Priority Base</td>
<td></td>
</tr>
<tr>
<td>Thread Count</td>
<td></td>
</tr>
<tr>
<td>Working Set</td>
<td></td>
</tr>
</tbody>
</table>

6. Add the counters listed above, as shown here:

![Image of counters added to the list]
7. Set the Sampling Interval, e.g. 15-seconds, and then follow the steps to create the collector set:

8. Right click on the Data collector set and choose properties to set the Stop Condition:

9. To record the data for 36 hours specify the “Overall duration” as 36 hours in the “Stop Condition” and click “Ok”:
10. Right click on the DataCollector01 to see the DataCollector01 properties.

11. Select the log format and click "ok".

12. Start the collector once the OPC Server/OPC Client is ready to start the 36-hour test.

**Linux Performance monitor**

- Linux provides the **top** command to monitor the performance during the efficiency test.
- Below is the screenshot of how the **top** command looks in the terminal:

```
top - 06:23:58 up 8 min, 2 users, load average: 0.36, 0.55, 0.28
Tasks: 118 total, 3 running, 115 sleeping, 0 stopped, 0 zombie
    Cpu(s):  6.8us,  2.0sy,  0.0ni,  92.0id,  0.0wa,  0.0hi,  0.0si,  0.0%全面提升
Mem: 1826436k total, 476688k used, 547760k free, 15692k buffers
Swap: 1546652k total, 0k used, 1614662k free, 216828k cached
```

- Use the following command in the terminal to view the output:
  ```
  ./top_pname.sh <OPC Server/OPC Client>
  ```
- Use the following command to redirect the output to a csv file:
  ```
  ./top_pname.sh <OPC Server/OPC Client> > <Filename.csv>
  ```
- Use Ctrl+c to terminate the process.
**Linux TOP Shell Script**

The following script will remove unwanted information from the TOP output:

```bash
#!/bin/bash
if [ $# -eq 0 ];
then
    echo "arg error : ?"
    echo "top_pname.sh <exename>"
    exit
else
    echo ""
fi

h1="Time,Mem total,Mem used,Mem free,Mem buffers,PID,USER,PR,NI,VIRT,RES,SHR,S,%CPU,%MEM,TIME+,COMMAND"
pname=$1
echo -e "$h1"
print_vals(){
  l1=`/usr/bin/top -bn1p $(pidof $pname)|sed -n -e 1p|awk '{print $3,"\n="/1}'`
  l2=`/usr/bin/top -bn1p $(pidof $pname)|sed -n -e 4p|awk '{print $2","$4","$6","$8","}'`
  l3=`/usr/bin/top -bn1p $(pidof $pname)|sed -n -e 8p|awk '{print $1","$2","$3","$4","$5","$6","$7","$8","$9","$10","$11","$12}'}
  echo -e "$l1$l2$l3"
}
while true
do
  print_vals
  sleep 4
done
```

**Windows Batch File**

Test lab uses a batch file to enable/disable the “Local Area Connection” network adapter in a windows environment. Copy the below text into a “.bat” file and run it using Administrator/elevated permission to enable the intermittent connection.

```batch
@echo off
SET DTIME = 120
CLS
ECHO Delay time is: %DTIME%
ECHO Network Connection Enabler/Disabler started at: %date% %time% :
:start
ECHO Disabling network adapter at %time%
netsh interface set interface "Local Area Connection" DISABLED
timeout /t %DTIME%
ECHO Enabling network adapter at %date% %time%
netsh interface set interface "Local Area Connection" ENABLED
choice /c:yn /m "Repeat network adapter recycle (y/n)?" /t %DTIME% /d y
ECHO ERRORLEVEL
IF ERRORLEVEL 2 GOTO end
IF ERRORLEVEL 1 GOTO start
:end
ECHO.
ECHO Network adapter recycle complete at %date% %time%
```

You can change the time period of the intermittent connection by varying DTIME in the above code.
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## Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Author</th>
<th>Change</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>May 16, 2014</td>
<td>DT</td>
<td>Initial version.</td>
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