Practical Example

SCL, Client/Server, GOOSE and SV

Practical session 1	**Installation of 61850 Test Suite**
Practical session 2	**Configure SCL file in SCL forge**
Practical session 3	**Connecting to Server from SCL Forge**
Practical session 4	**Connecting to Client from SCL Forge**
Practical session 5	**Simulation of Data on Server and Polling on Client side**
Practical session 6	**Sending GOOSE messages between Anvil and Hammer on a local machine**
Practical session 7	**Sending Sample Values (SV) between Anvil and Hammer on a local machine**

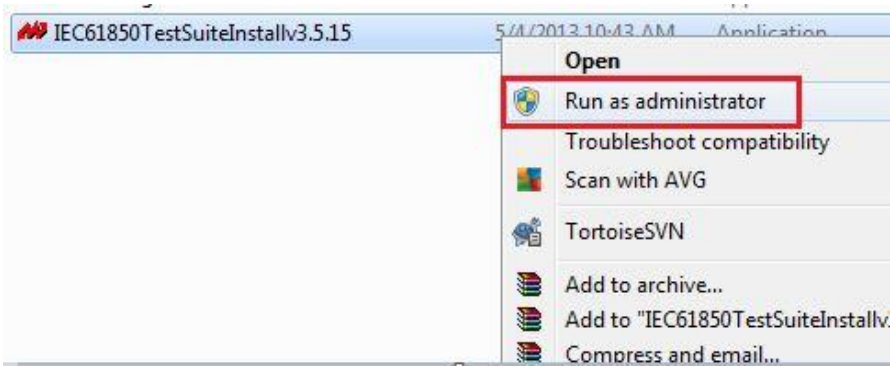
Practical 1

Installation of 61850 Test Suite

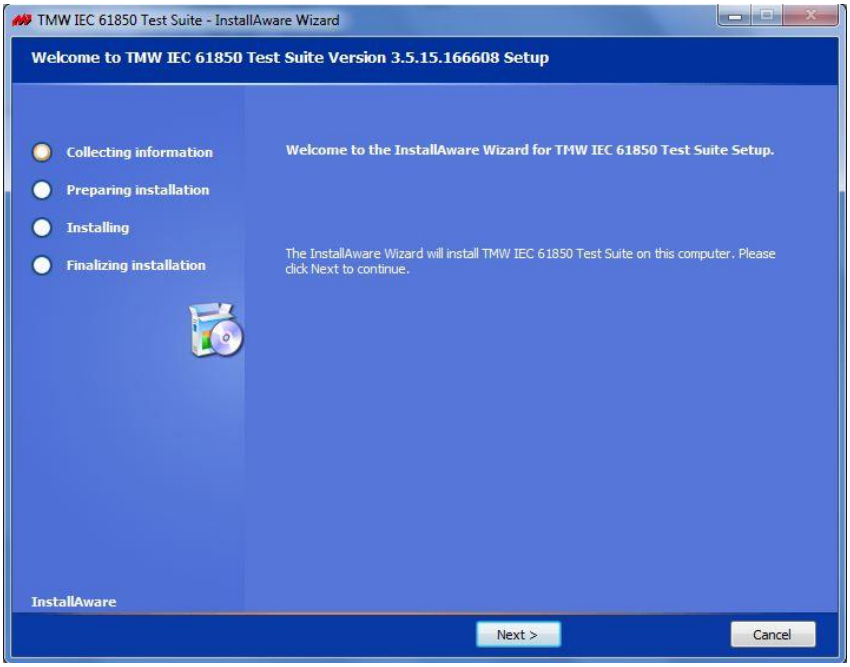
Objective:
To install 61850 Test suite software.
This software is provided by Triangle MicroWorks (TMW)

IGNORE THIS SECTION IF YOU WILL BE USING THE REMOTE LABS! The software will have been installed on the remote lab PC already. Simply skip ahead to Practical 2.

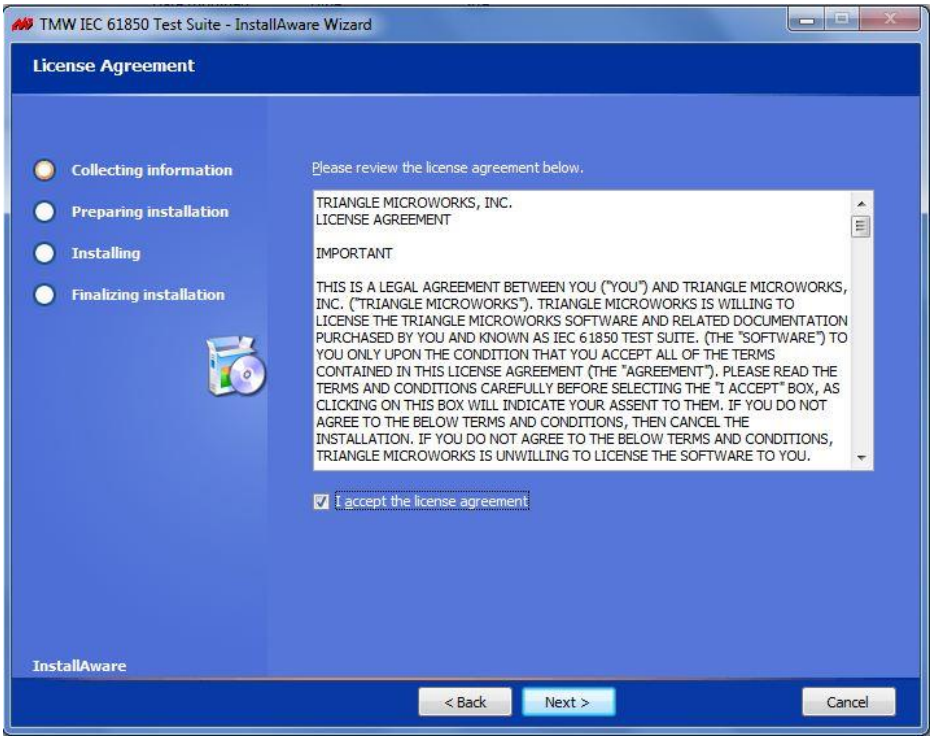
Requirements:
PC running Windows 7, XP SP2, or Server 2008
Download the software from http://www.trianglemicroworks.com/
It is a trial version and expires in 21 days.
Procedure:
Step 1: Right click on the setup file and click on "Run as administrator".



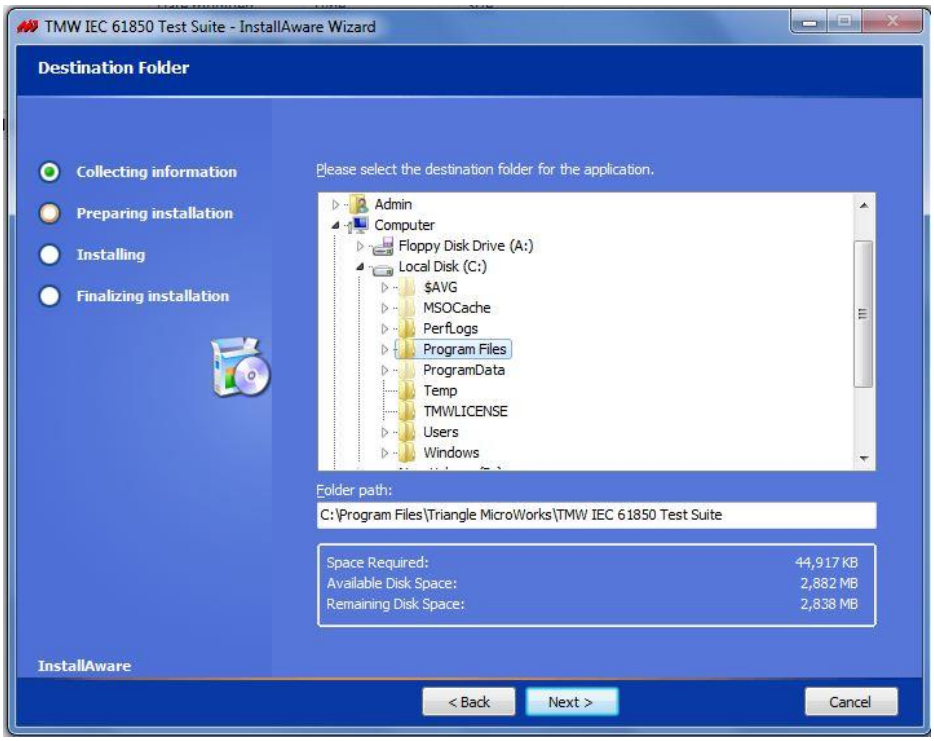
Step 2: Click on "Next" to continue.



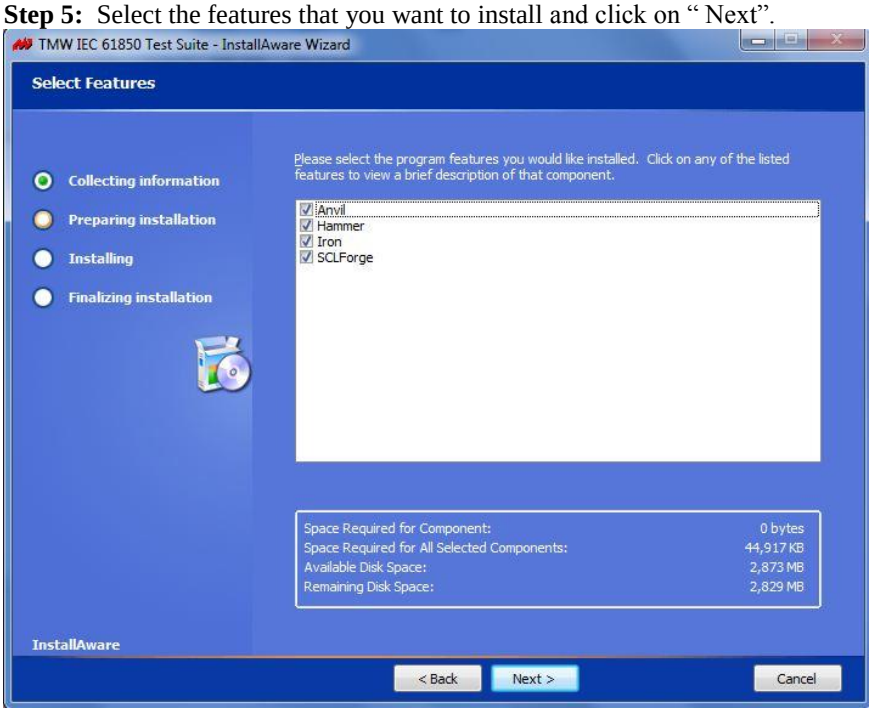
Step 3: Accept the license agreement and click on “Next”.



Step 4: Select the destination folder for the program to install and click on “Next”.
By default the software will be installed in C:\Program Files\...
You can change the destination folder path if you wish to.



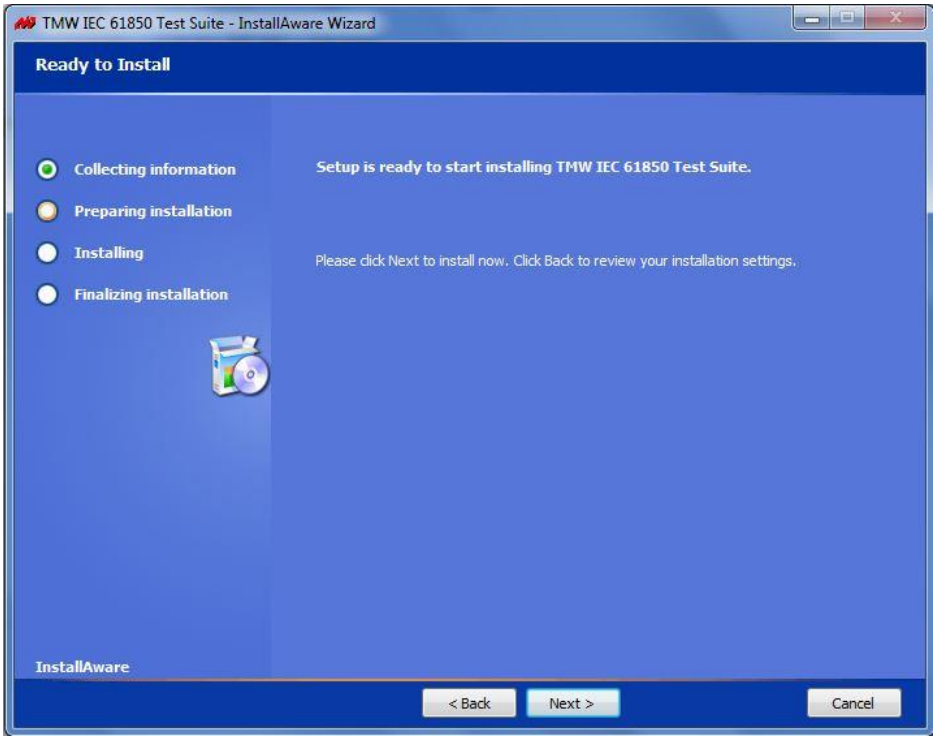
Step 5: Select the features that you want to install and click on " Next".

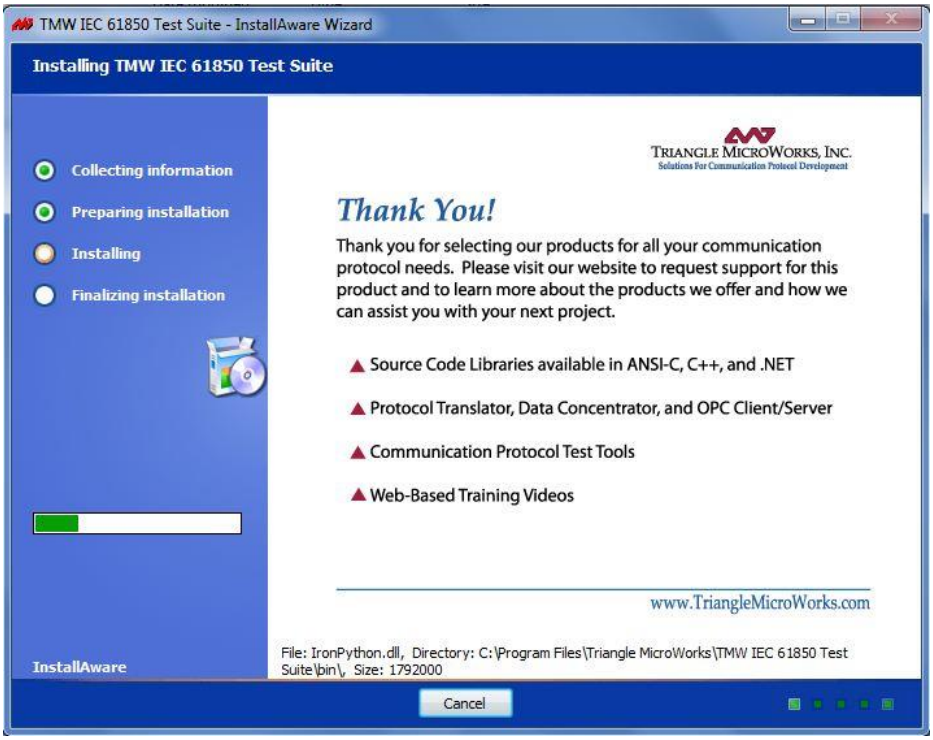


Make sure that Anvil, Hammer and SCL forge are checked.

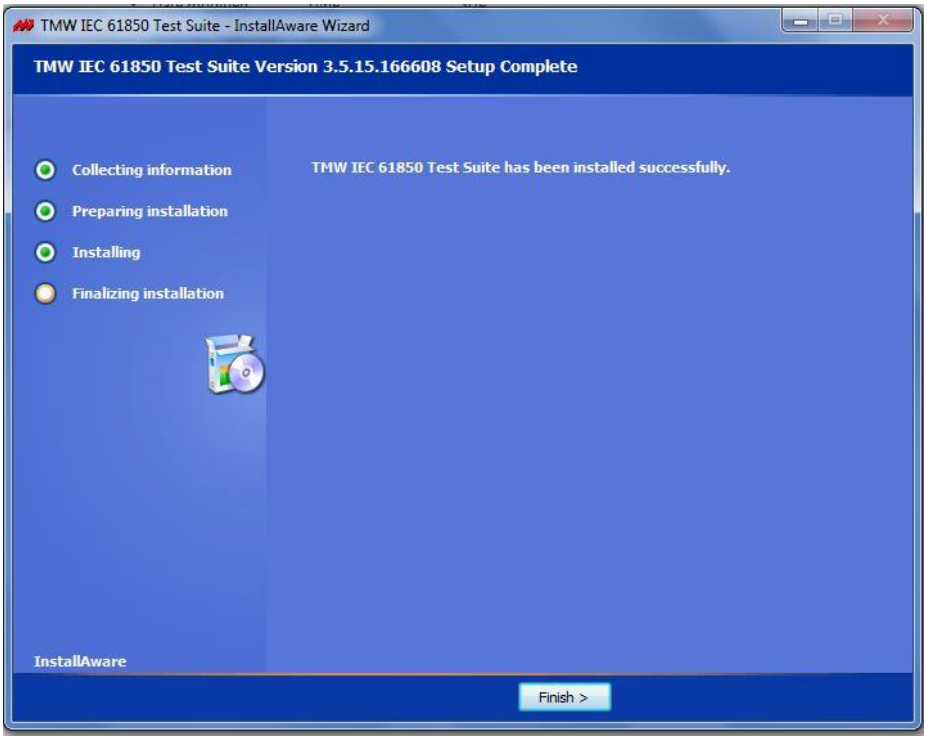
Iron is not required, as we don't use it in the practicals.

Step 6: Click on "Next" to start the installation process.





Step 7: Click on “Finish”.



The software has successfully installed on your PC. You will see the Anvil, Hammer, SCL forge and Iron (if installed) icons on the desktop.

Practical 2

Configure SCL file in SCL forge

Objective:
To configure a device using ICD files. SCL helps in doing this.

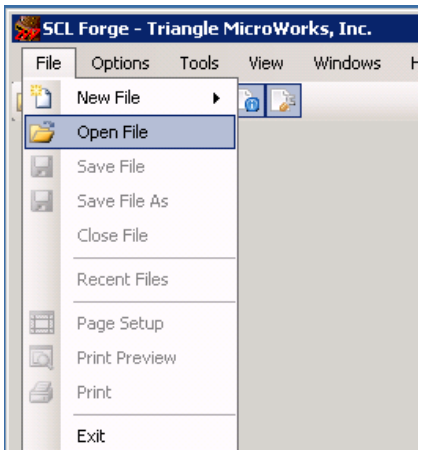
Description:
The purpose of the XML based Substation Configuration description language (SCL) as defined in IEC 61850 is the interoperable exchange of engineering data for distributed substation automation (SA) system. The data exchange will be between engineering tools of different manufacturers at well-defined stages in a general engineering process.

The SCL Forge facilitates editing and creating Substation Configuration Language (SCL) files.

Procedure: **(Connect to Remote Lab 8 or 9 using your student portal to access the tools)**

Step 1: Click on the SCL forge icon to open SCL forge.

Step 2: To open an SCL file, click on Open icon or go to File → Open.

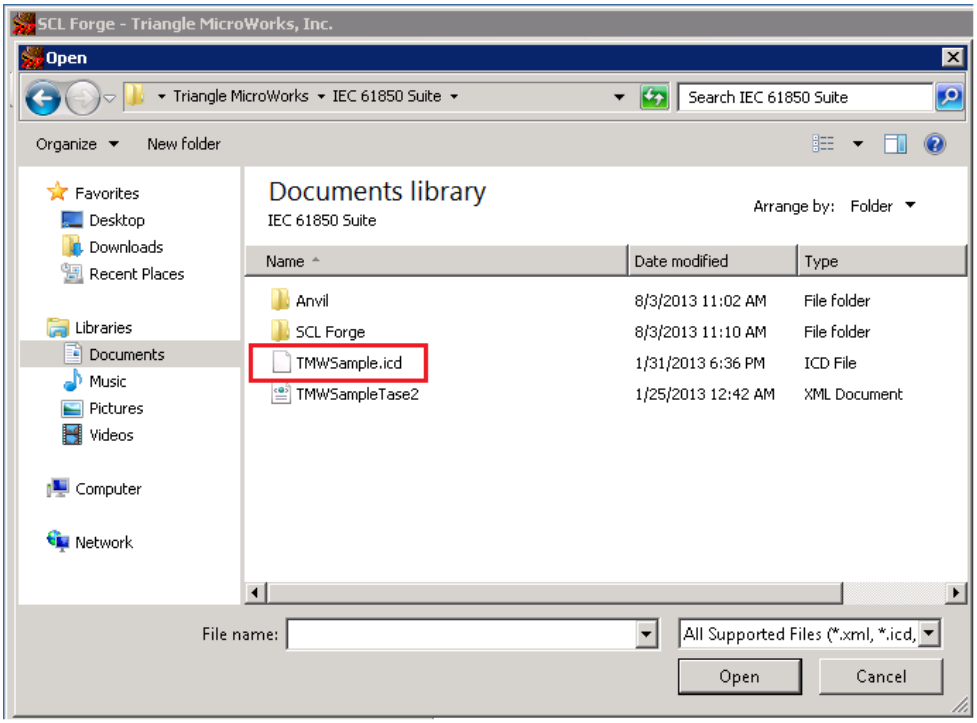


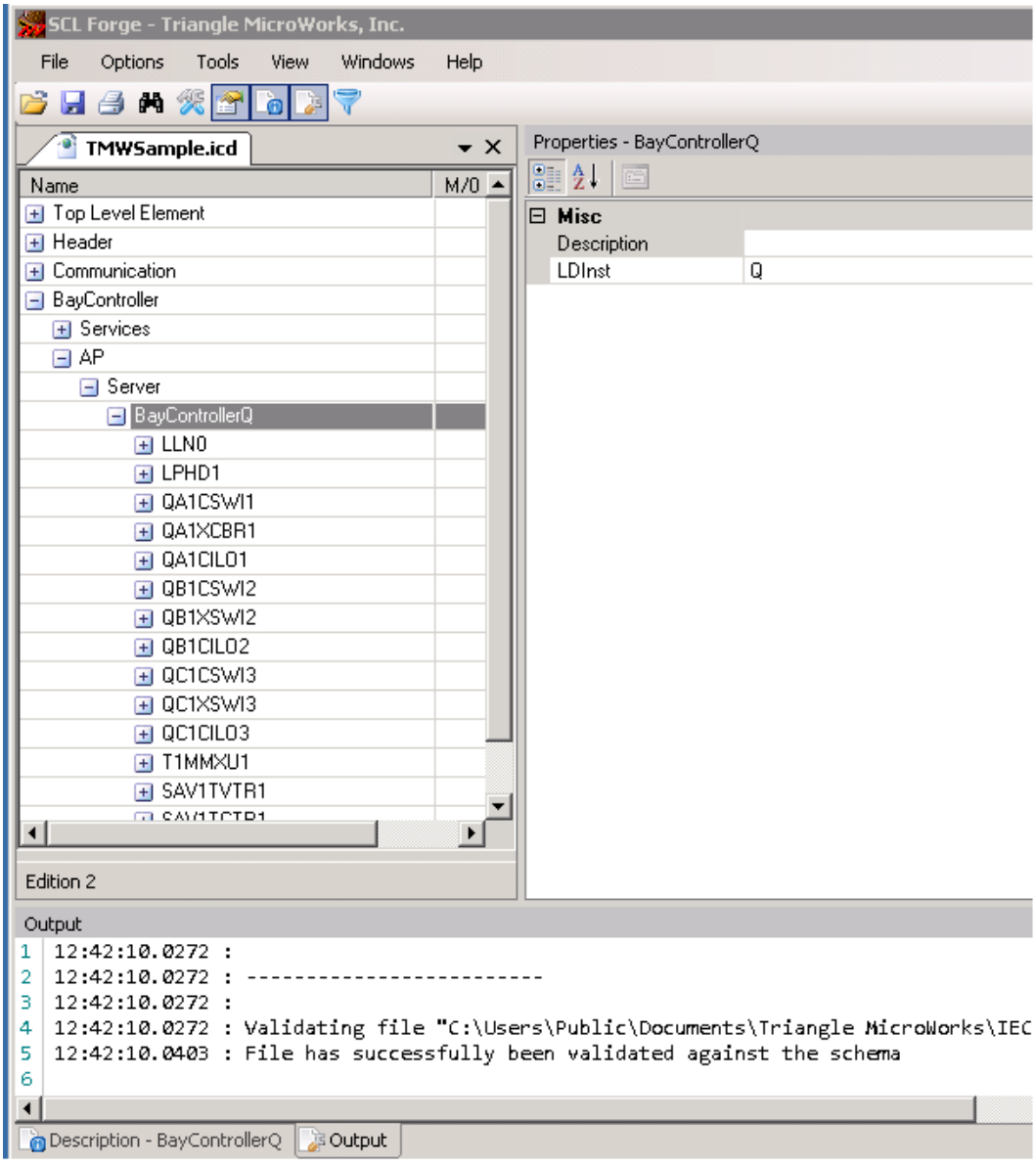
SCL files are in .icd, .iid, .cid, .scl and .scd format.

Where ICD stands for IED Capability Description, SSD - System Specification Description, SCD - System Configuration Description, CID - Configured IED Description

Note:
Usually, the Sample SCL files will be in the following paths, in your PC, if the software is installed in default destination path:

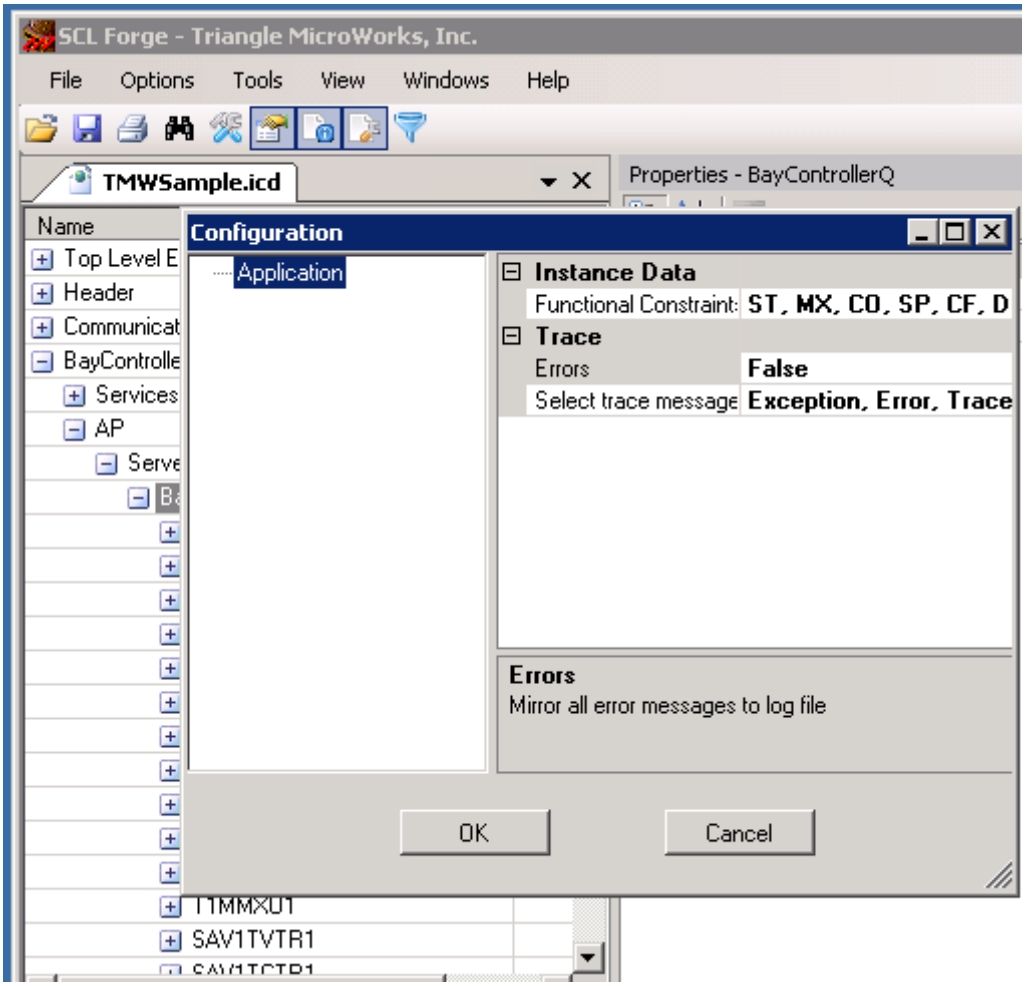
- C:\Program Files\Triangle MicroWorks\TMW IEC 61850 Test Suite\resources
- C:\Documents and Settings\All Users\Documents\Triangle MicroWorks\IEC 61850 Suite


SCL Forge - Triangle MicroWorks, Inc.
Open
Triangle MicroWorks ▸ IEC 61850 Suite ▸
Search IEC 61850 Suite
Organize
New folder
Favorites
Desktop
Downloads
Recent Places
Libraries
Documents
Music
Pictures
Videos
Computer
Network
Documents library
IEC 61850 Suite
Arrange by: Folder
Name
Date modified
Type
Anvil
8/3/2013 11:02 AM
File folder
SCL Forge
8/3/2013 11:10 AM
File folder
TMWSample.icd
1/31/2013 6:36 PM
ICD File
TMWSampleTase2
1/25/2013 12:42 AM
XML Document
File name:
All Supported Files (*.xml, *.icd,
Open
Cancel


SCL Forge - Triangle MicroWorks, Inc.
File
Options
Tools
View
Windows
Help
TMWSample.icd
Name
M/O
Top Level Element
Header
Communication
BayController
Services
AP
Server
BayControllerQ
LLN0
LPHD1
QA1CSWI1
QA1XCBR1
QA1CILO1
QB1CSWI2
QB1XSWI2
QB1CILO2
QC1CSWI3
QC1XSWI3
QC1CILO3
T1MMXU1
SAV1TVTR1
Edition 2
Properties - BayControllerQ
Misc
Description
LDInst
Q
Output
12:42:10.0272 :
12:42:10.0272 : -------------------------
12:42:10.0272 :
12:42:10.0272 : Validating file "C:\Users\Public\Documents\Triangle MicroWorks\IEC
12:42:10.0403 : File has successfully been validated against the schema
Description - BayControllerQ
Output

Step 3:
Click on the configuration icon to configure the SCL file.

A pop up window opens with the configuration details. Set the details and click on “Ok”.



Note:
Additional nodes, data objects and data attributes can be added to the SCL file but the file cannot be saved as the trial version limits the feature of saving SCL files.

Practical 3

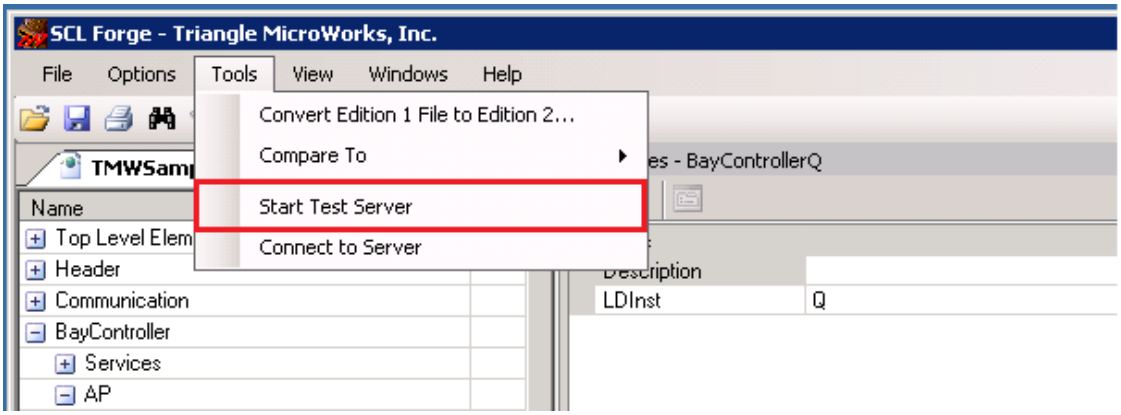
Connecting to Server from SCL Forge

Objective:
To connect to the Server (Anvil) through SCL forge.

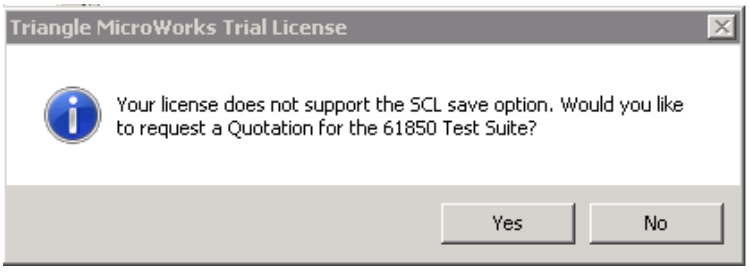
Description:
The Anvil provides a Test Server in order to exercise Client implementations.

Procedure:

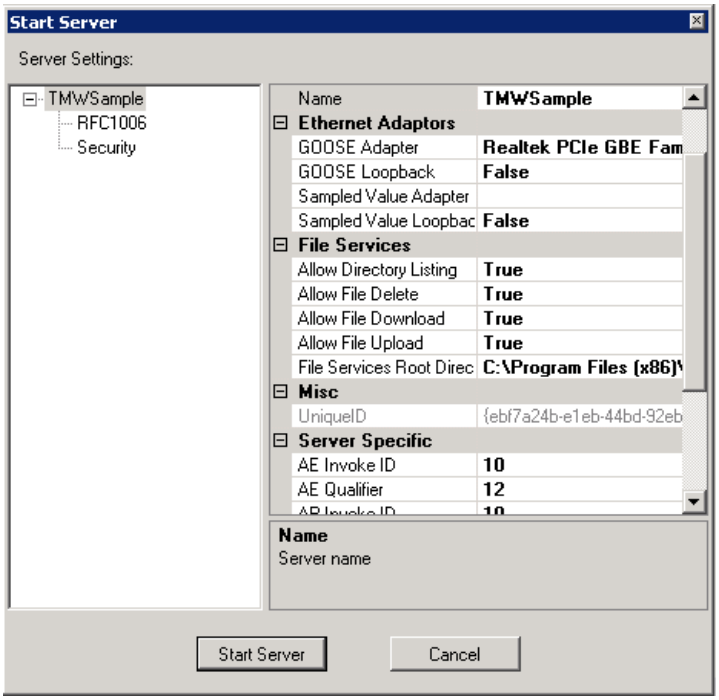
Step 1:
In SCL forge window, click on Tools →Start Test Server. This opens Client (Anvil).



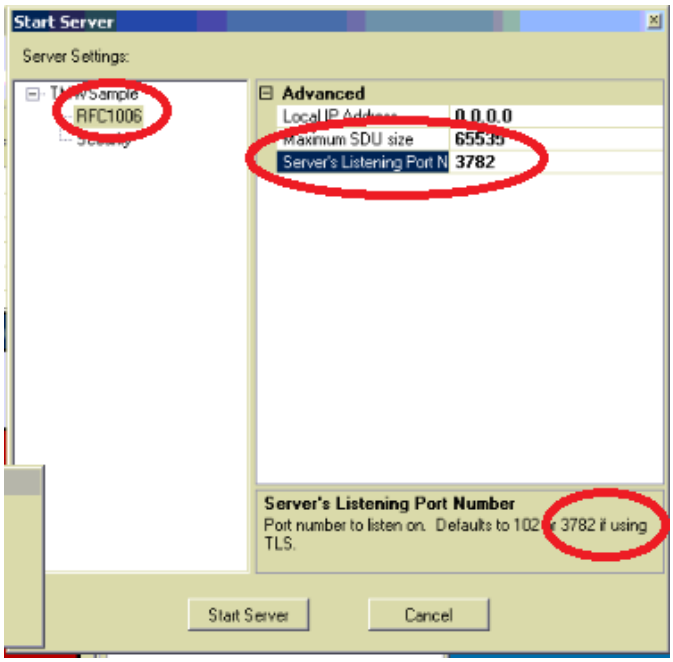
Step 2:
(If using the trial version) A pop up window opens asking for a "…request a Quotation for the 61850 Test Suite." Click on "No". Otherwise simply click OK on the licence notice. Or move the window to the side, to continue the exercise.



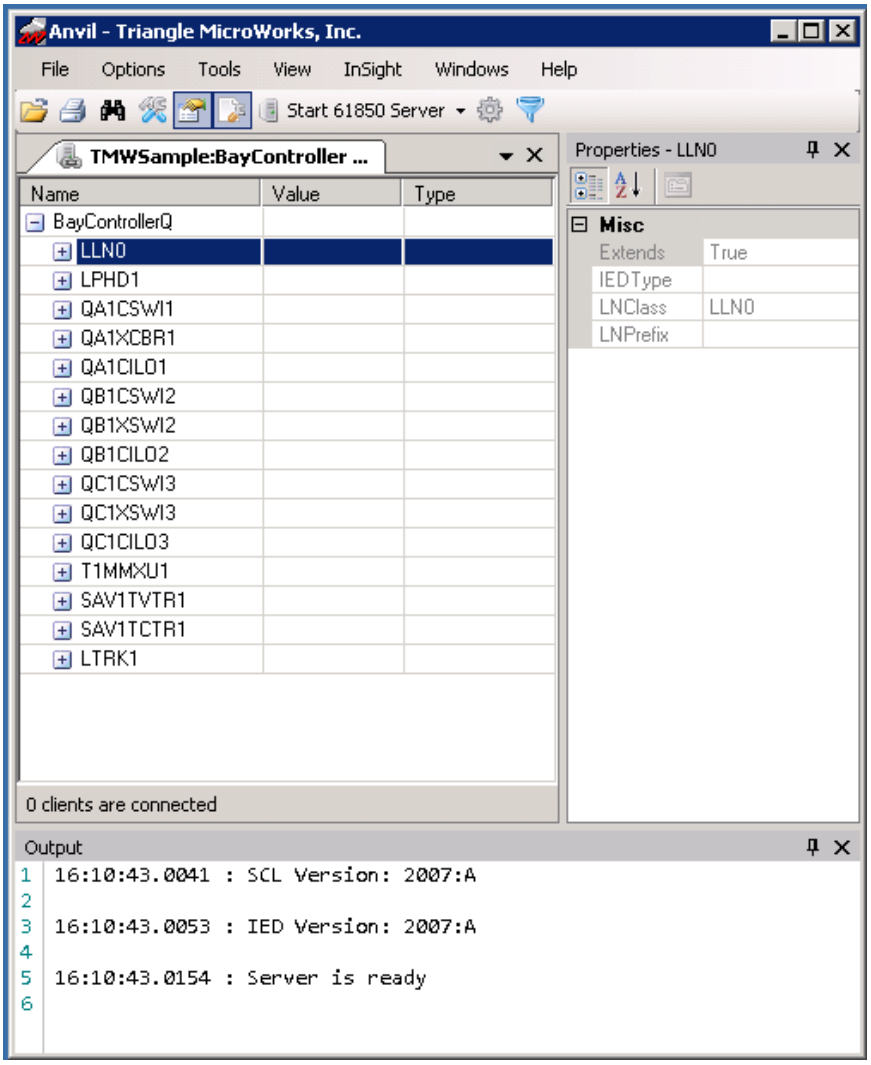
(If windows asks for network or firewall permission, allow and retry the previous step.)
Then a Start Server window, containing server settings, opens. Click on “Start Server”.



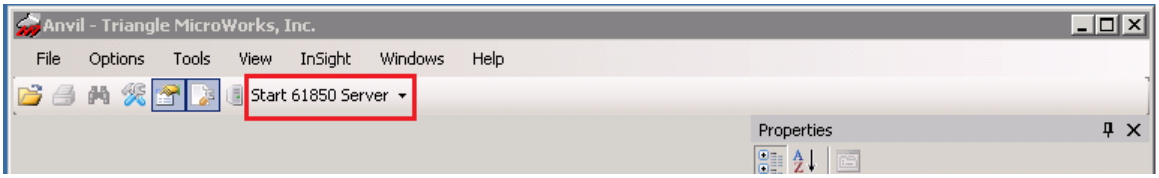
If the server does not start, and gives an error saying the port is in use, simply close the new “Anvil” window, and follow the steps from step 1 again, but **before** clicking “Start Server”, change the **Port** in the following window, and then click Start Server:



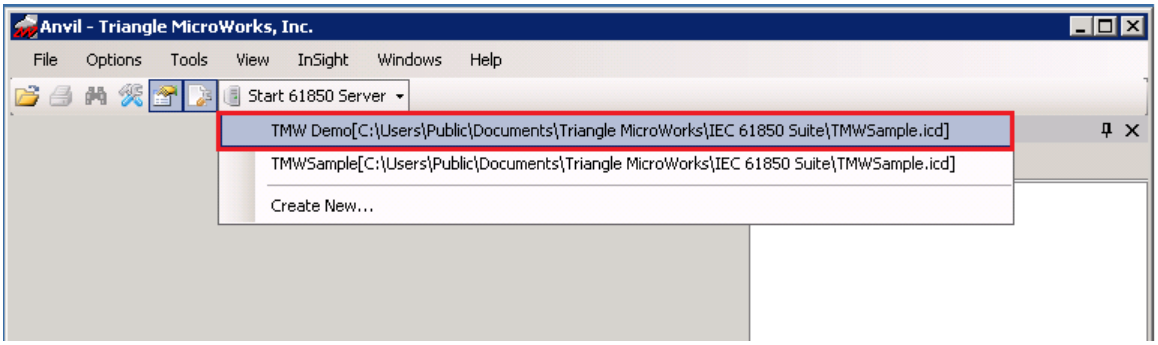
Set the required settings like Ethernet Adapter, Name of the server etc.



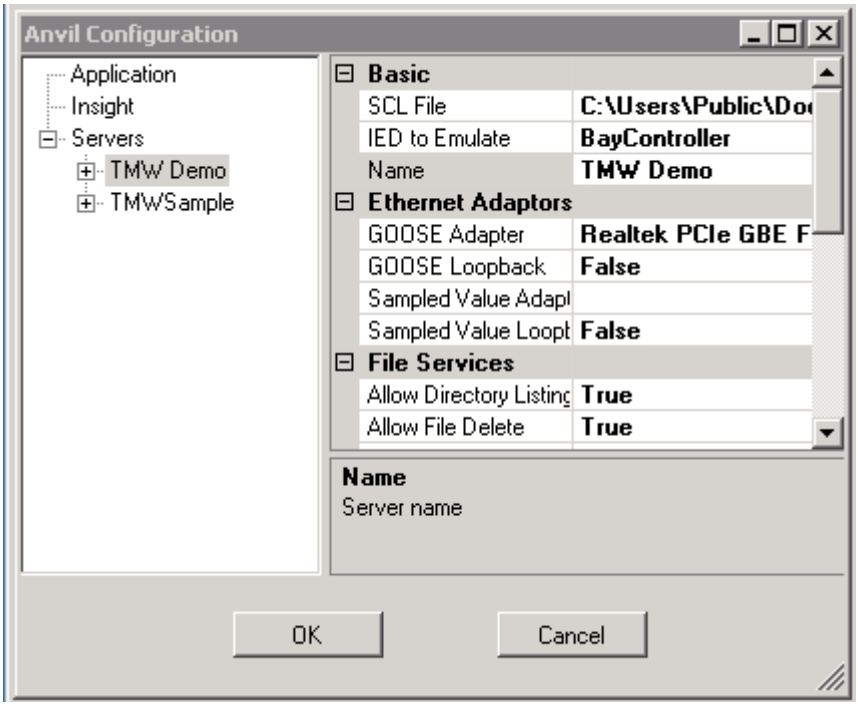
If "Start Server" window doesn't pop up, in the Anvil window click on "Start 61850 Server" drop down.



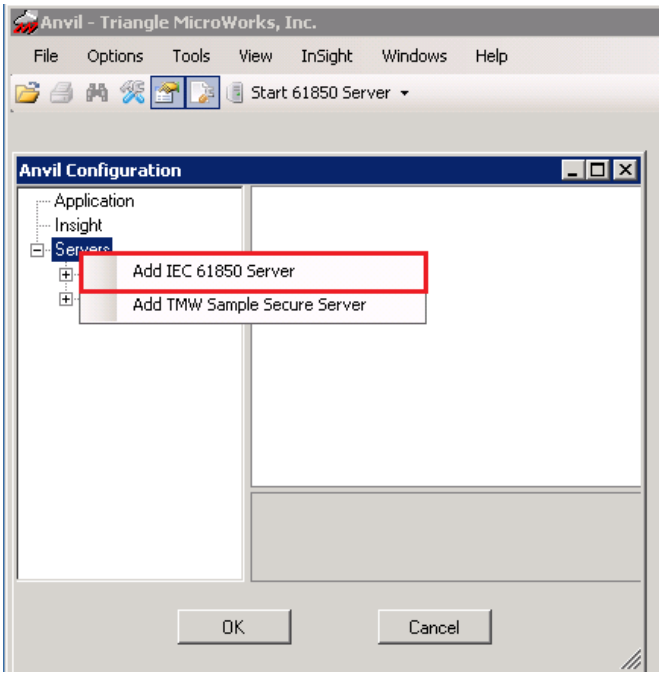
It displays the available SCL configured files. Click on the one which you used to configure SCL.



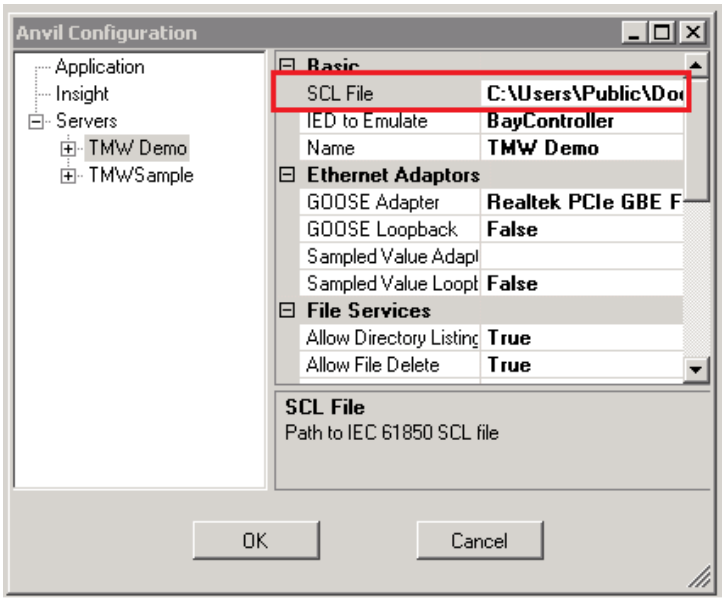
Alternate method:
In Anvil Window, click on “Configuration” icon. This opens the Anvil configuration pop-up window and it shows the already available Servers and their details.



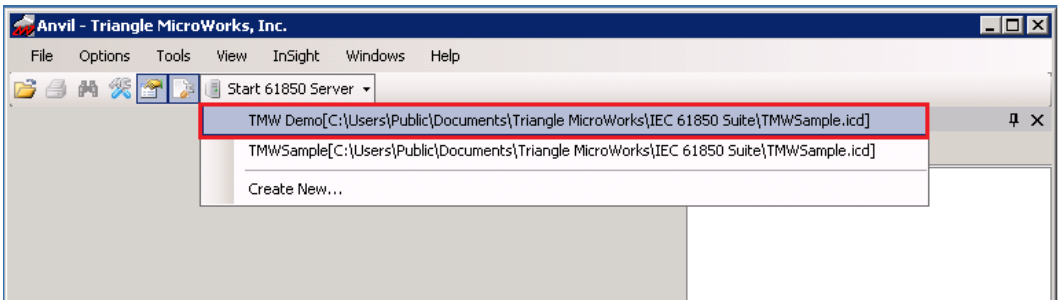
Configure a new server, by right clicking on “Server” and then on “Add IEC 61850 Server”.



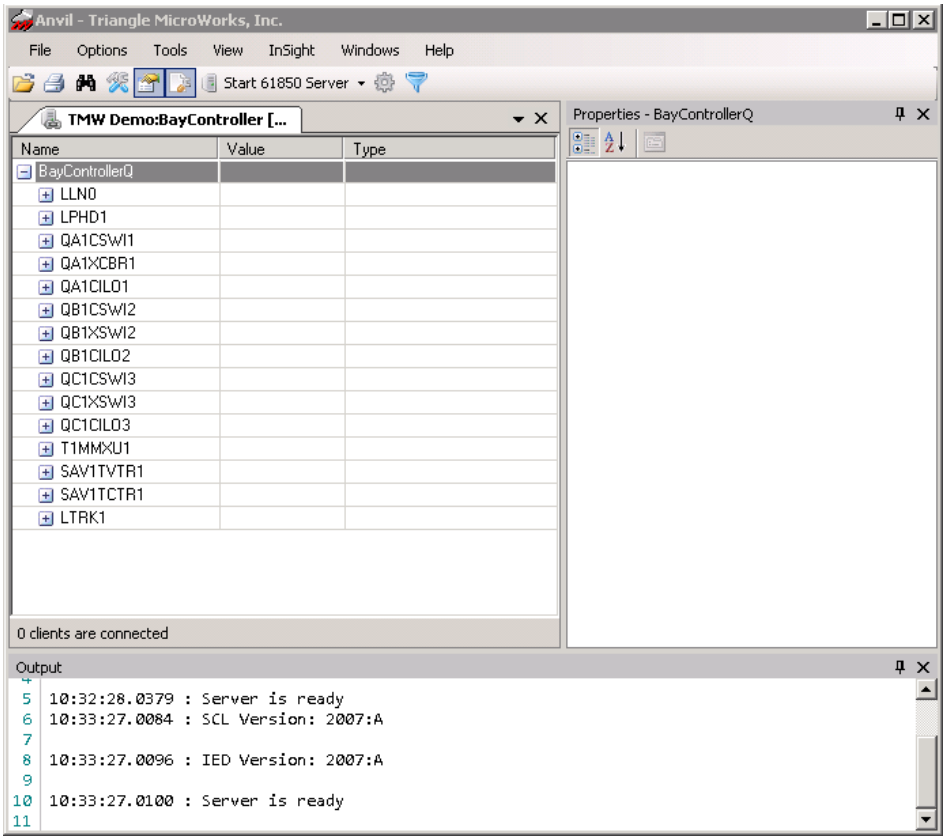
After adding the Server, on the right side pane, select the SCL file (Same SCL file, opened in SCL forge). Then, click OK.



Now we started the Server, by clicking on “Start 61850 Server”. Select the server you want to start from the list.



The started server will be shown in the Anvil window:



Practical 4

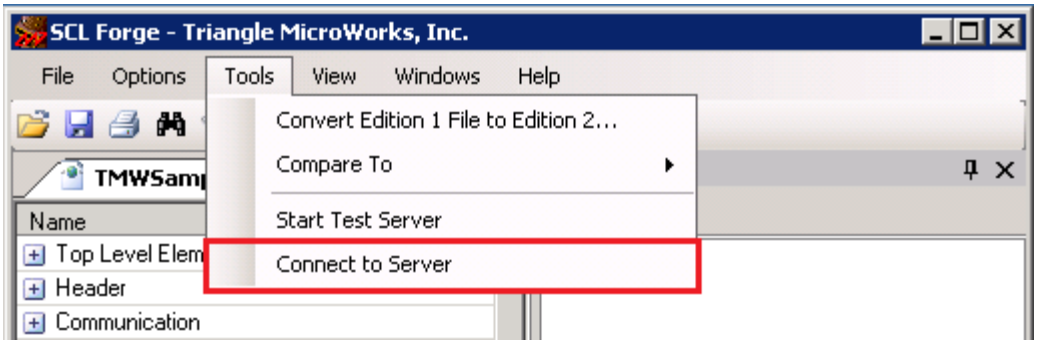
Connecting to Client from SCL Forge

Objective:
To connect to the client (Hammer)

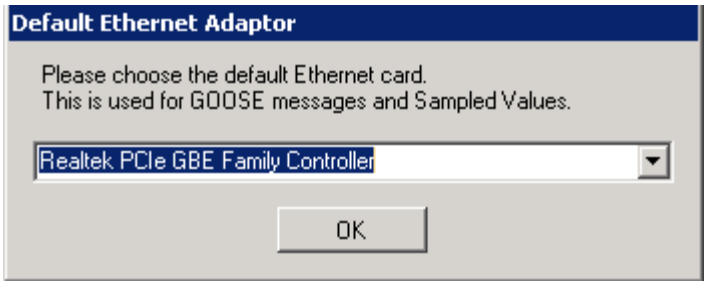
Description:
The Hammer provides a Test Client in order to validate Server implementations

Procedure:

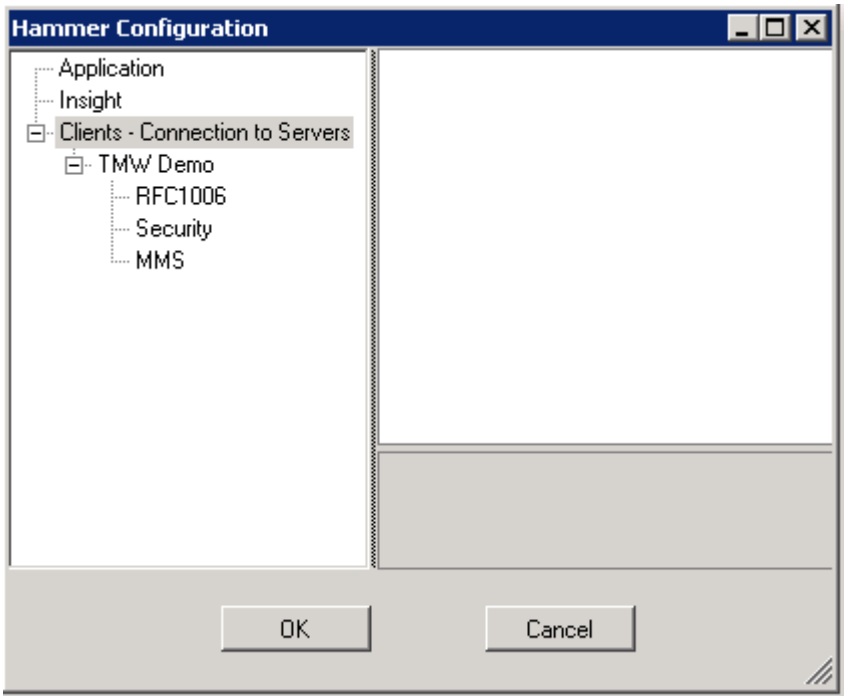
Step 1:
Open SCL forge window. Click on Tools → Connect to Server, to connect to a Client. The client (Hammer) window opens.



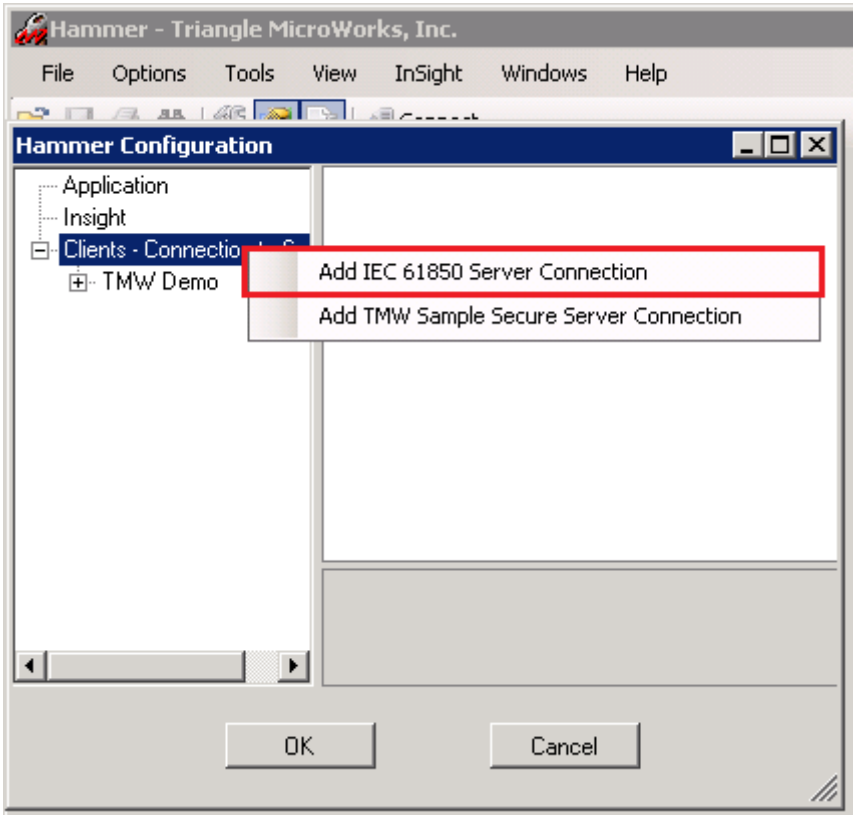
A "Default Ethernet Adaptor" pop window **might** open. Select the Ethernet card to be used from the drop down and click on OK. **(INTEL Gigabit connection)**



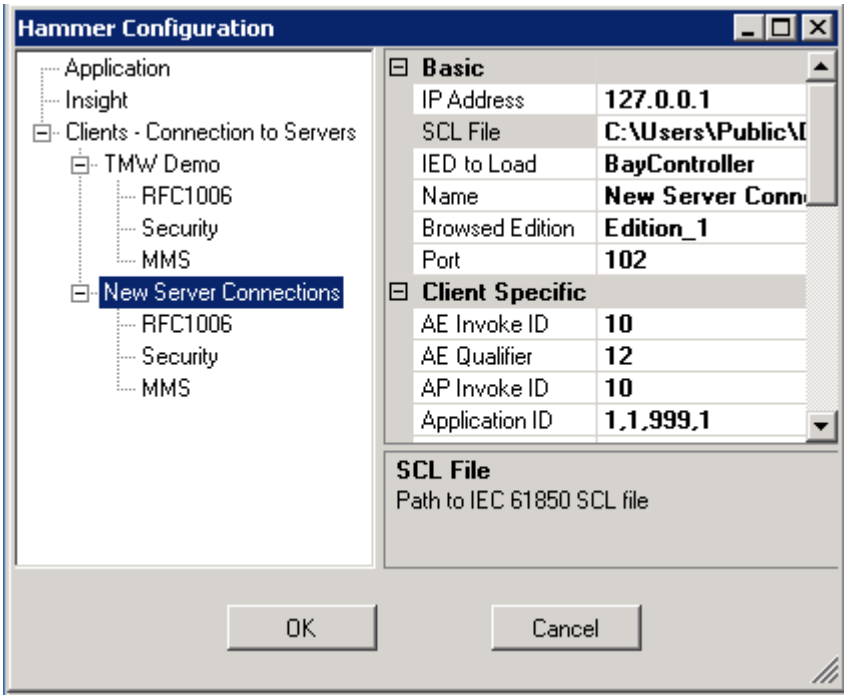
Step 2:
In Hammer window, click on “configuration” icon. A Hammer configuration pop-up window opens.



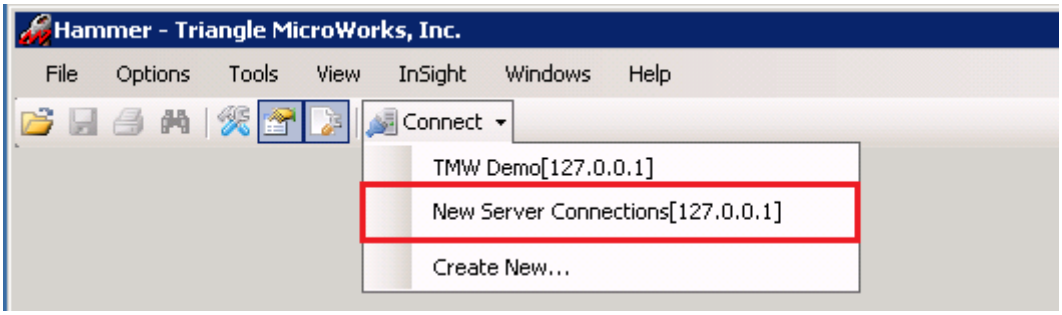
Step 3:
Right click on “Client- Connections to Servers” and then on “Add IEC 61850 connection”.

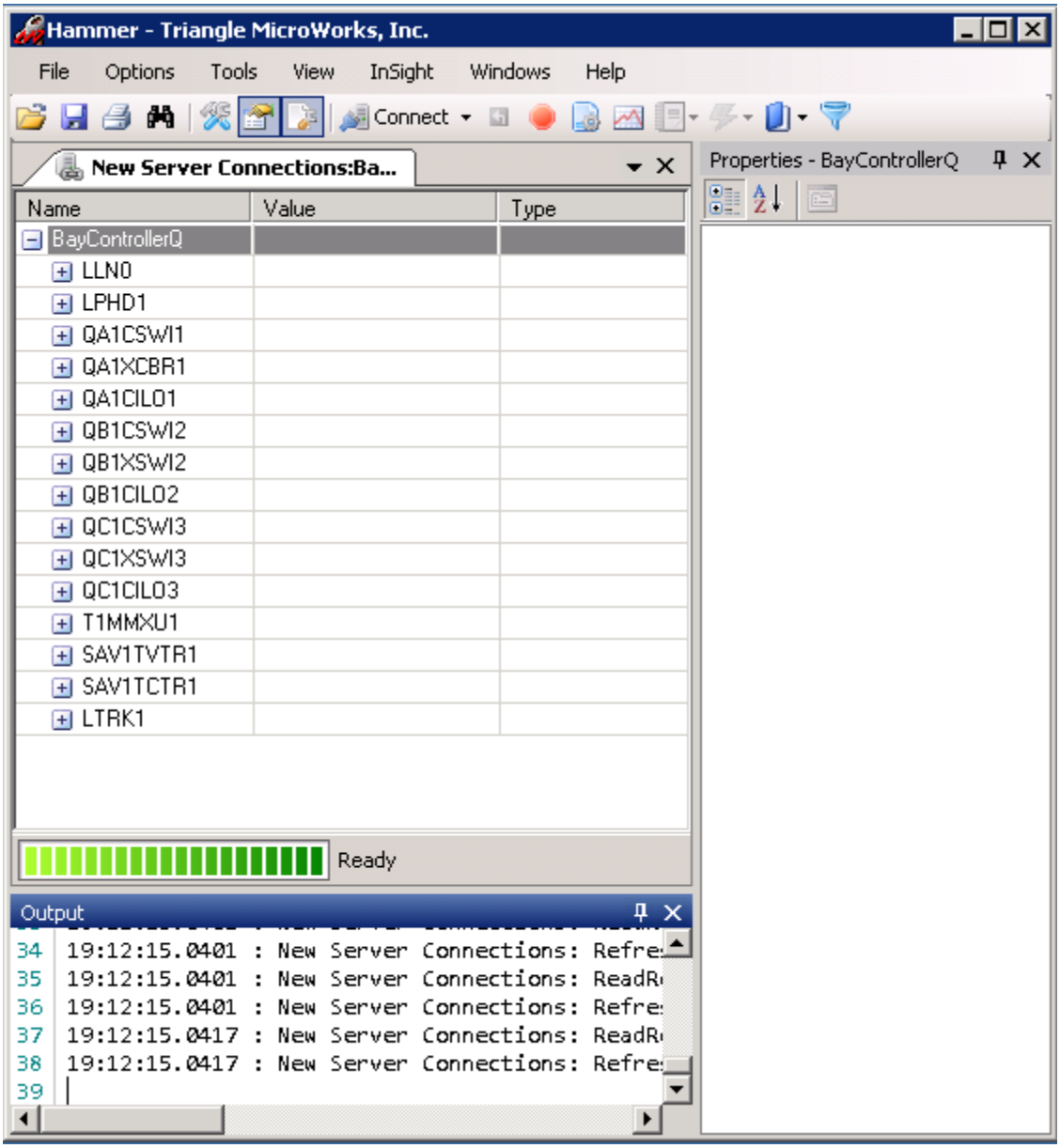


Step 4:
You can change the Server connection details like IP address, SCL file etc. Be sure to check the PORT is the same as the one you specified in the Server in the previous Practical (102 OR 3782)!
After you are done, click on OK.



Step 5:
Click on “Connect” icon in tool bar, to connect to Server. Connect to the IP on which the Server is running.




Hammer - Triangle MicroWorks, Inc.
File
Options
Tools
View
InSight
Windows
Help
Connect
New Server Connections:Ba...
Properties - BayControllerQ
Name
Value
Type
BayControllerQ
LLN0
LPHD1
QA1CSWI1
QA1XCBR1
QA1CILO1
QB1CSWI2
QB1XSWI2
QB1CILO2
QC1CSWI3
QC1XSWI3
QC1CILO3
T1MMXU1
SAV1TVTR1
SAV1TCTR1
LTRK1
Ready
Output
34 19:12:15.0401 : New Server Connections: Refre
35 19:12:15.0401 : New Server Connections: ReadR
36 19:12:15.0401 : New Server Connections: Refre
37 19:12:15.0417 : New Server Connections: ReadR
38 19:12:15.0417 : New Server Connections: Refre
39

Practical 5

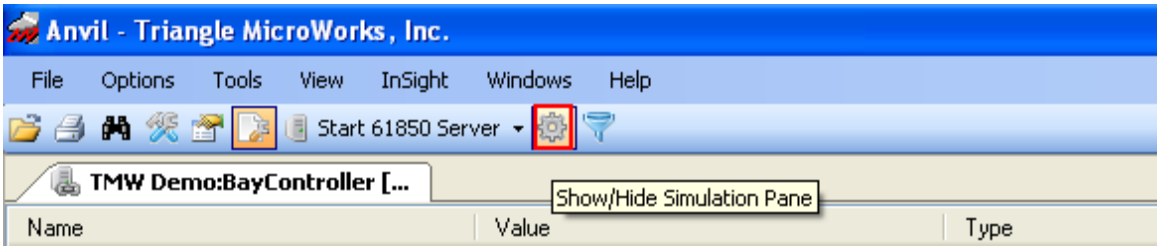
Simulation of Data on Server and Polling on Client side

Objective:
To simulate the data on the Server (Anvil).

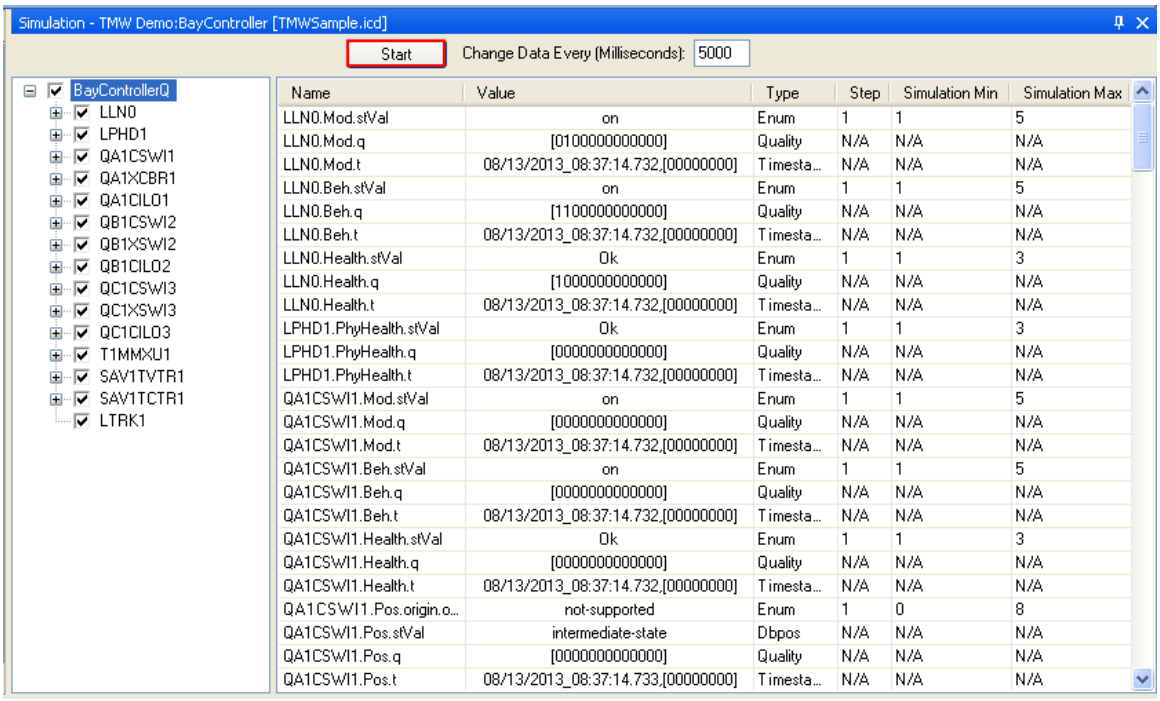
Description:
Simulation:
The Simulation Pane allows a Server to randomly change data which causes data change events which in turn may activate Reports, Logging, and/or GOOSE messages.

Procedure:

Step 1:
In Anvil window, click on "Show/Hide Simulation Pane"



Step 2:
To Start/Stop the simulation, press the Start button. Once the simulation is running the text on the button will change to "Stop". The data change interval is controlled by the "Change Data Every (Milliseconds)" field.



Name	Value	Type	Step	Simulation Min	Simulation Max
LLN0.Mod.stVal	on	Enum	1	1	5
LLN0.Mod.q	[0100000000000]	Quality	N/A	N/A	N/A
LLN0.Mod.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
LLN0.Beh.stVal	on	Enum	1	1	5
LLN0.Beh.q	[1100000000000]	Quality	N/A	N/A	N/A
LLN0.Beh.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
LLN0.Health.stVal	Ok	Enum	1	1	3
LLN0.Health.q	[1000000000000]	Quality	N/A	N/A	N/A
LLN0.Health.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
LPHD1.PhyHealth.stVal	Ok	Enum	1	1	3
LPHD1.PhyHealth.q	[0000000000000]	Quality	N/A	N/A	N/A
LPHD1.PhyHealth.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
QA1CSWI1.Mod.stVal	on	Enum	1	1	5
QA1CSWI1.Mod.q	[0000000000000]	Quality	N/A	N/A	N/A
QA1CSWI1.Mod.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
QA1CSWI1.Beh.stVal	on	Enum	1	1	5
QA1CSWI1.Beh.q	[0000000000000]	Quality	N/A	N/A	N/A
QA1CSWI1.Beh.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
QA1CSWI1.Health.stVal	Ok	Enum	1	1	3
QA1CSWI1.Health.q	[0000000000000]	Quality	N/A	N/A	N/A
QA1CSWI1.Health.t	08/13/2013_08:37:14.732,[00000000]	Timesta...	N/A	N/A	N/A
QA1CSWI1.Pos.origin.o...	not-supported	Enum	1	0	8
QA1CSWI1.Pos.stVal	intermediate-state	Dbpos	N/A	N/A	N/A
QA1CSWI1.Pos.q	[0000000000000]	Quality	N/A	N/A	N/A
QA1CSWI1.Pos.t	08/13/2013_08:37:14.733,[00000000]	Timesta...	N/A	N/A	N/A

The columns shown in the right panel are as follows:

Name – Shows the name of the Data Attribute proceeded by the Functional Constraint
Value – Current value
Type – Type of the value

Step – Upon each data change this is the value that is added to the current value. Current value is stepped until Simulation Max or Simulation Min is reached it is then seeded with a random value between Simulation Max and Simulation Min and restarted.
Simulation Min – Minimum value
Simulation Max – Maximum value

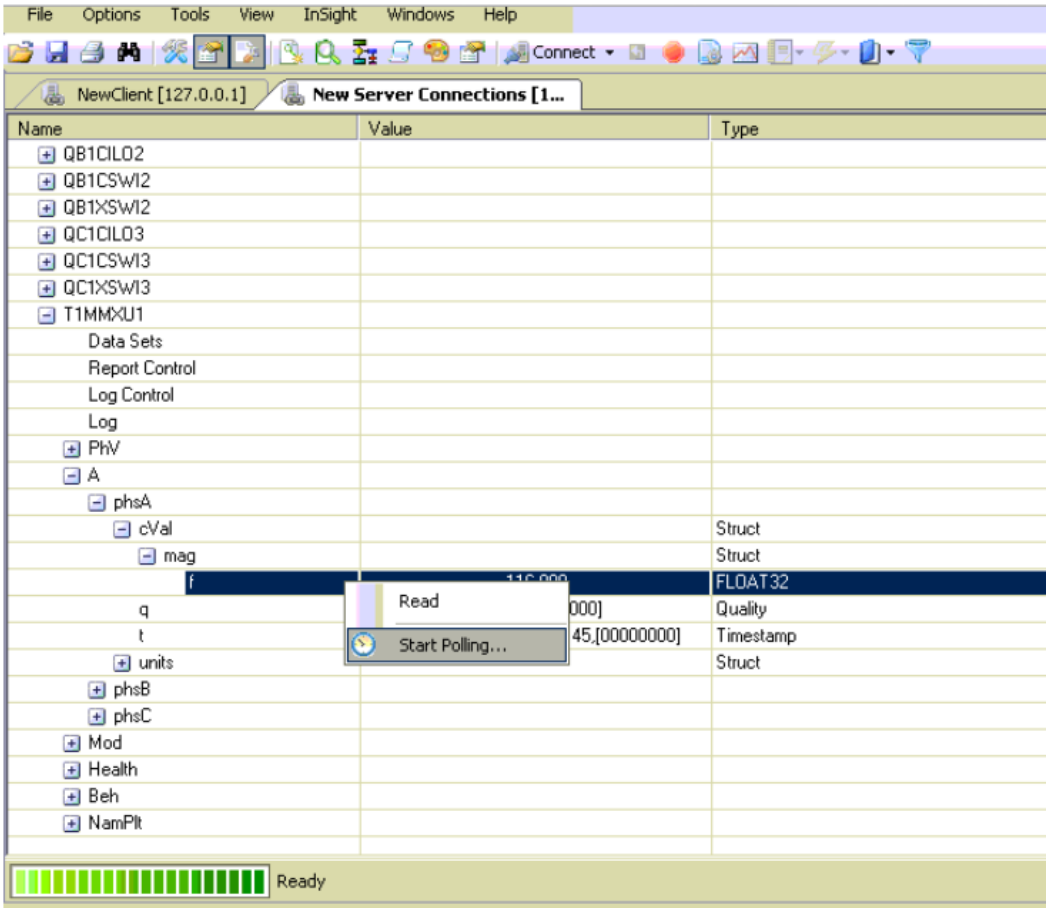
Step, Simulation Min and Simulation Max can be changed by double clicking on the value.

Description:

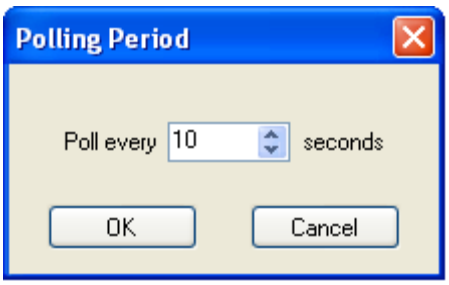
Polling:
Any Data Object or its children can be read on a polled basis.

Procedure:

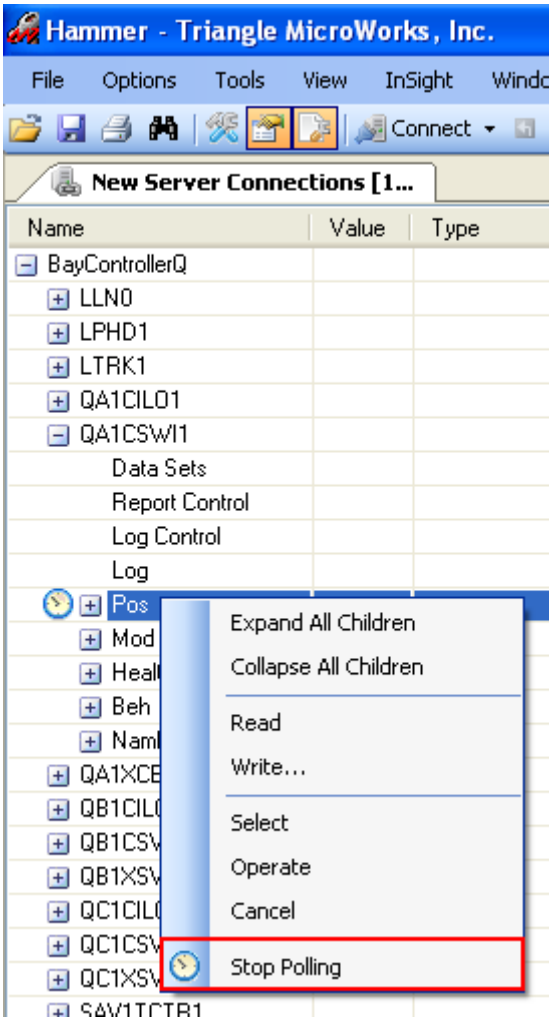
Step 1:
In Hammer, right click on any data object and select "Start Polling"



Step 2:
Enter polling period and click Ok.

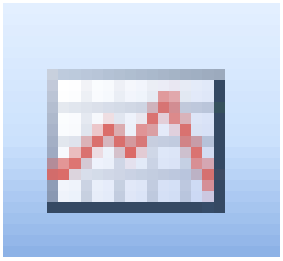


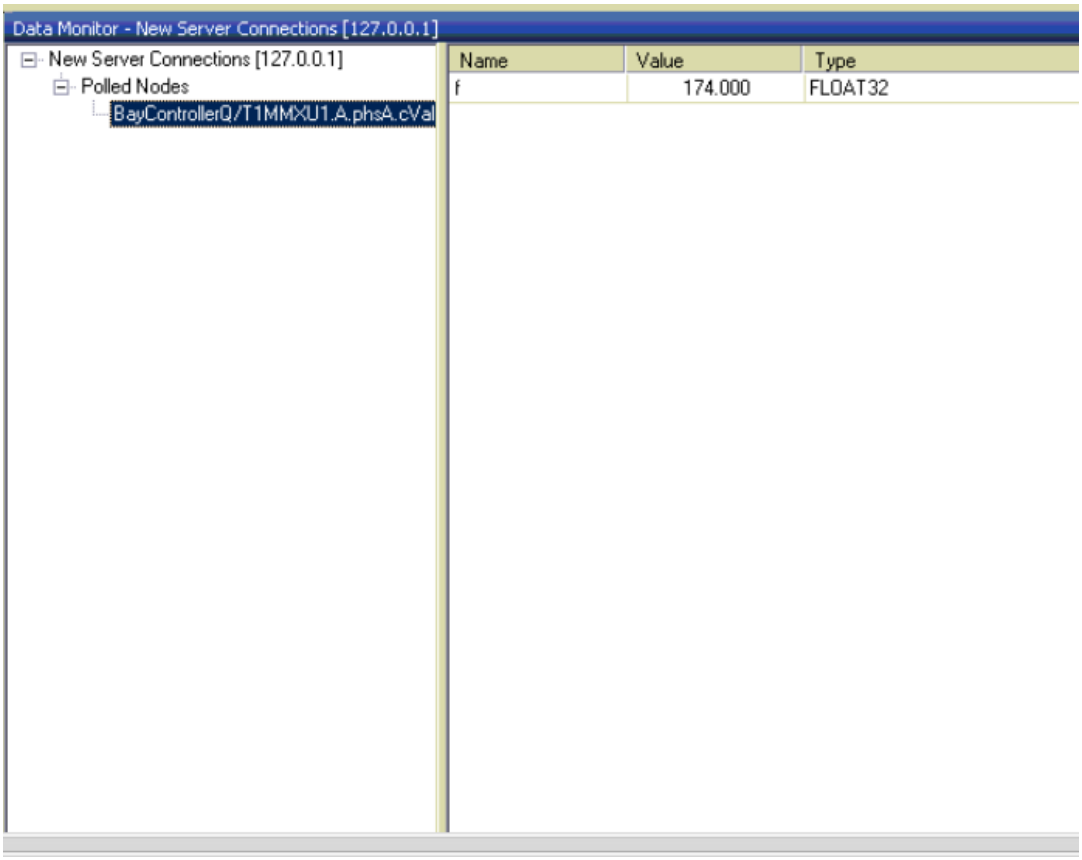
To stop polling right click on the item being polled and select Stop Polling.



Step 3:
Click on Data Monitor icon to see the polled nodes.

The Data Monitor Pane is used by the IEC 61850 Client to view the currently active Control Blocks and any Polled Data. It is possible to miss a data change because by default the user interface redraws every second. The model does not store a history rather it is real time data that could be updated from many different source.





When polling starts, the client receives data from the server for the polled node.

Practical 6

Sending GOOSE messages between Anvil and Hammer on a local machine

Objective:
To send GOOSE messages between the Server and Client.

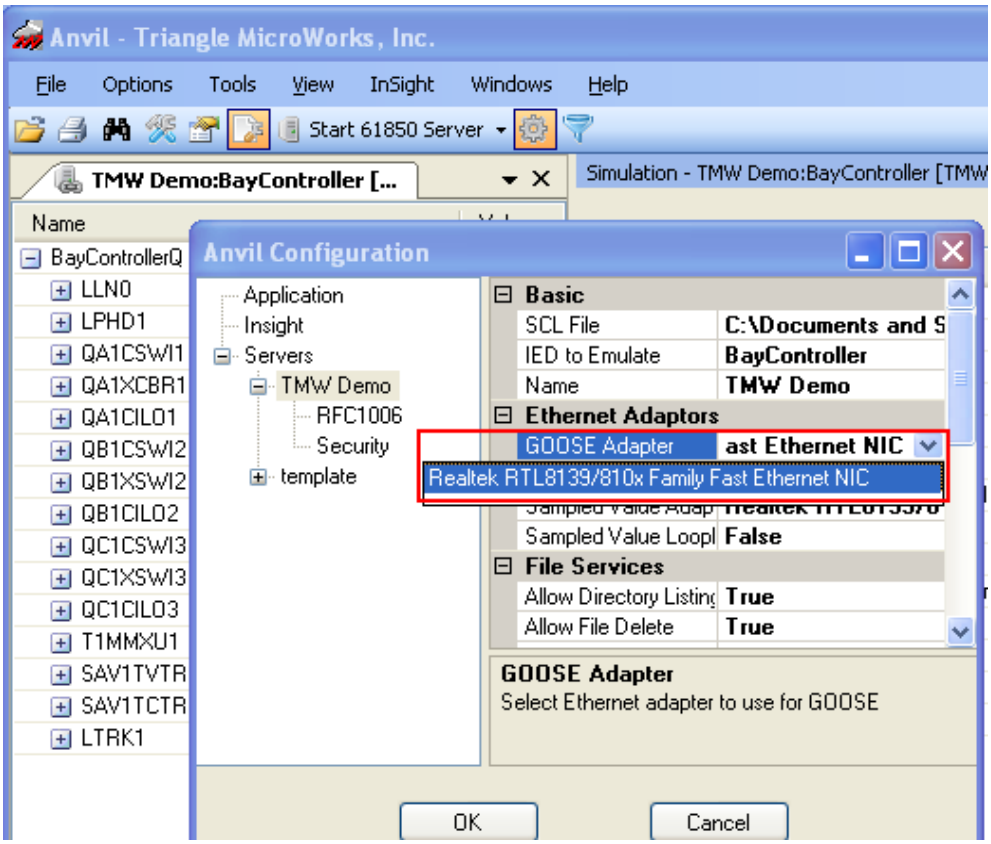
Description:
GOOSE (Generic Object Oriented Substation Event) service included in the IEC 61850 protocol set enables fast inter-device communication with time critical real time communication over wide-band communication links.

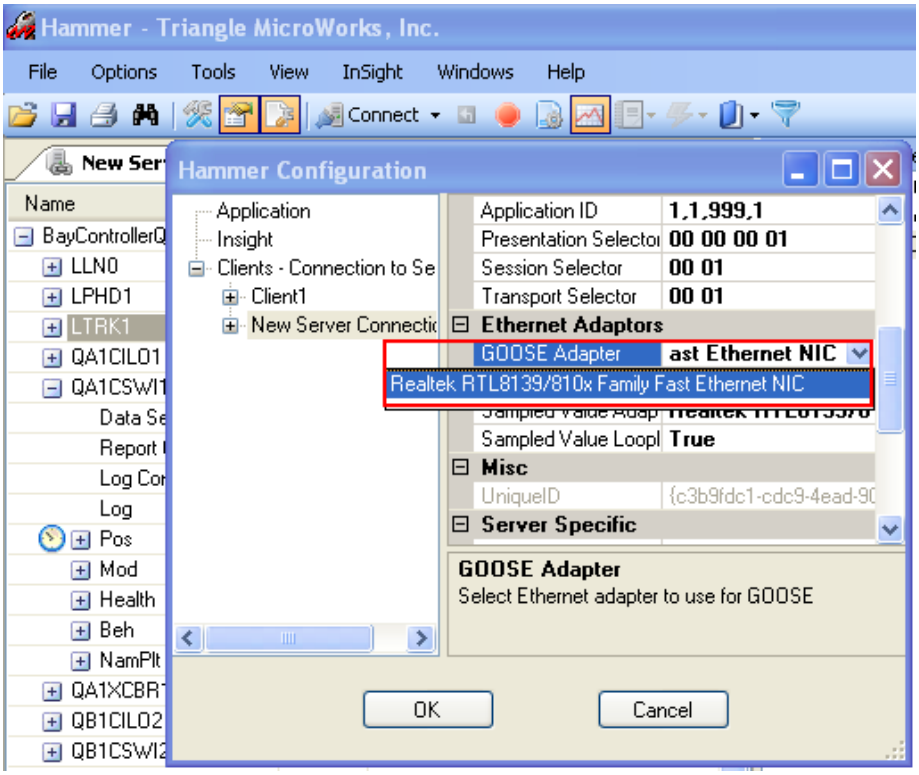
A device is sending information per multicast. Only the IEDs that have subscribed for this information receive the message. A GOOSE message of an IED can therefore be received and processed by several units at the same time

Procedure:

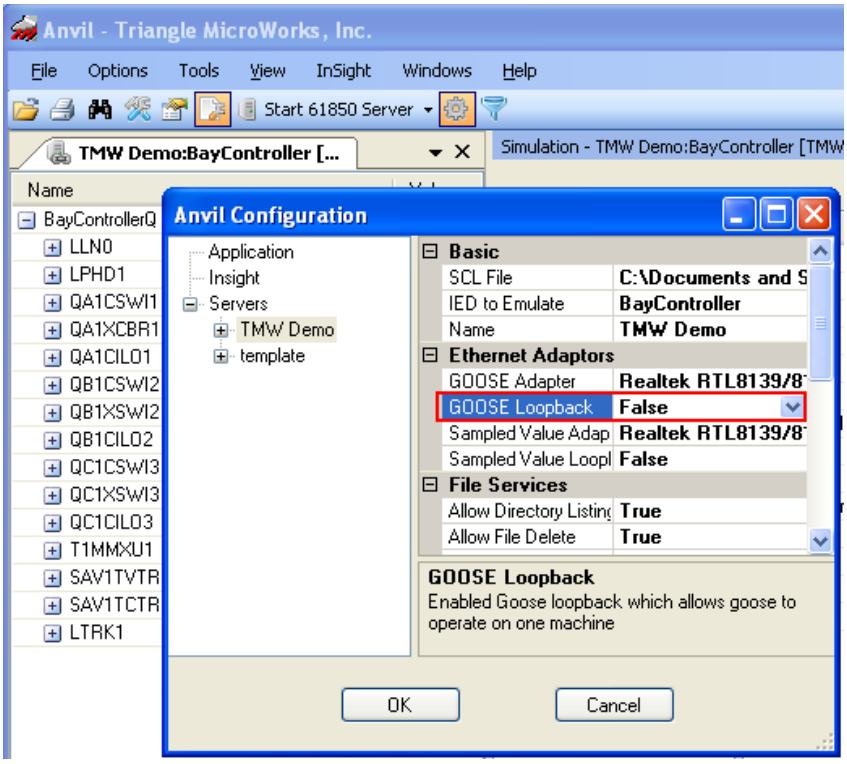
Step 1: Close both the server and the client. In anvil, start **the default TMW Demo** server. In Hammer connect to the default TMW Demo. Ensure the following:

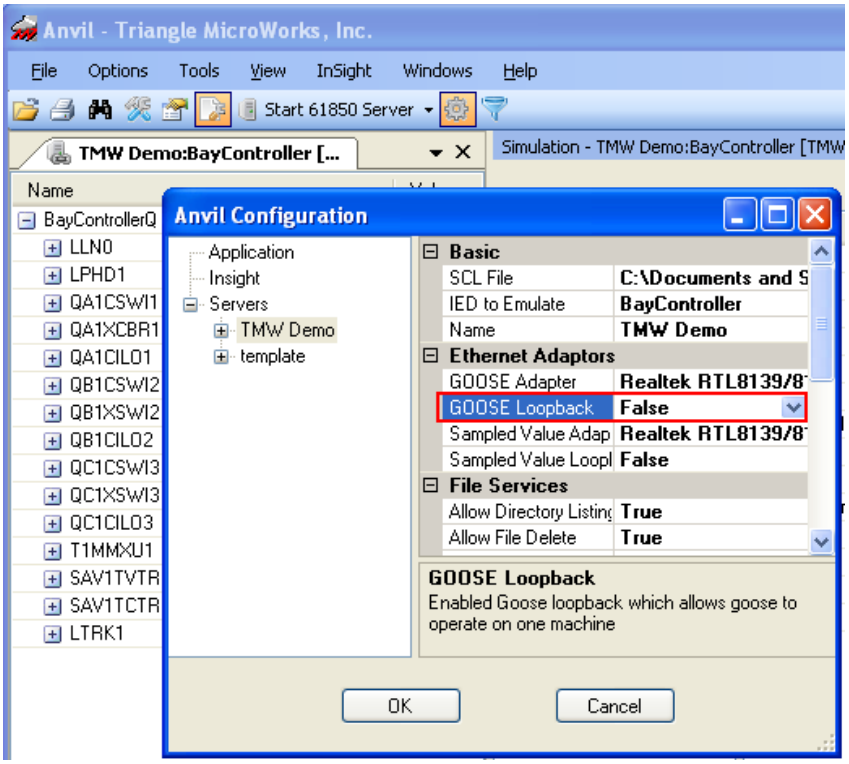
- Hammer and Anvil both have the same adapter set as the GOOSE adapter in the Configuration. **(INTEL Gigabit connection)**





- Anvil's GOOSE Loopback value must be FALSE, while Hammer's must be TRUE.



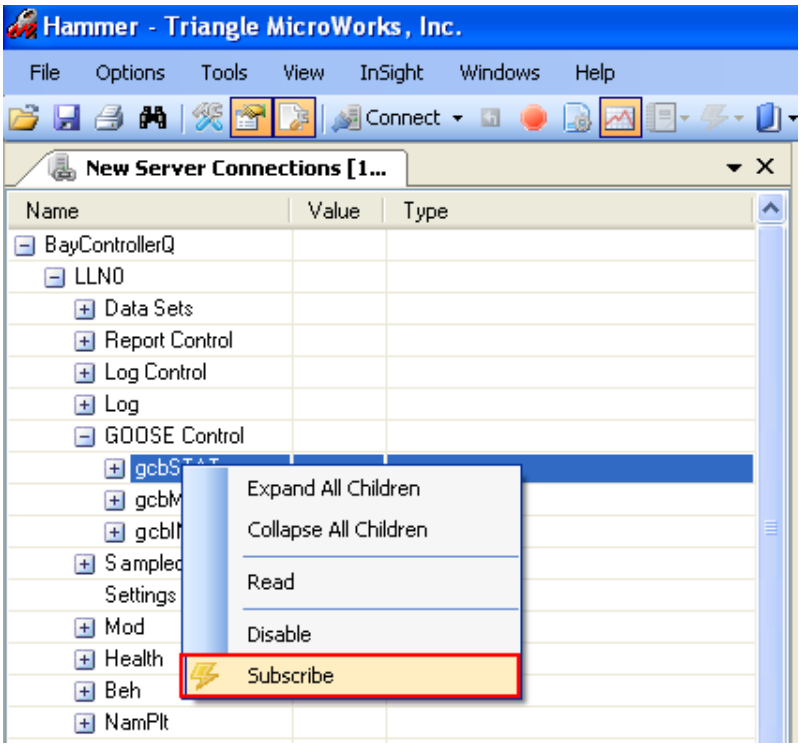


If any settings changes are made, Anvil and Hammer must be closed and re-opened for them to take effect.

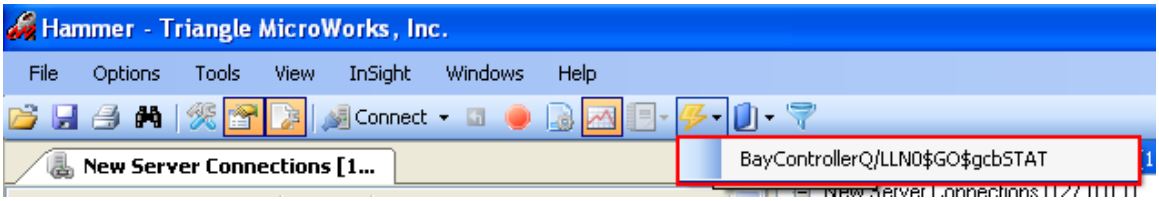
Step 2:
Start the simulation in Anvil.

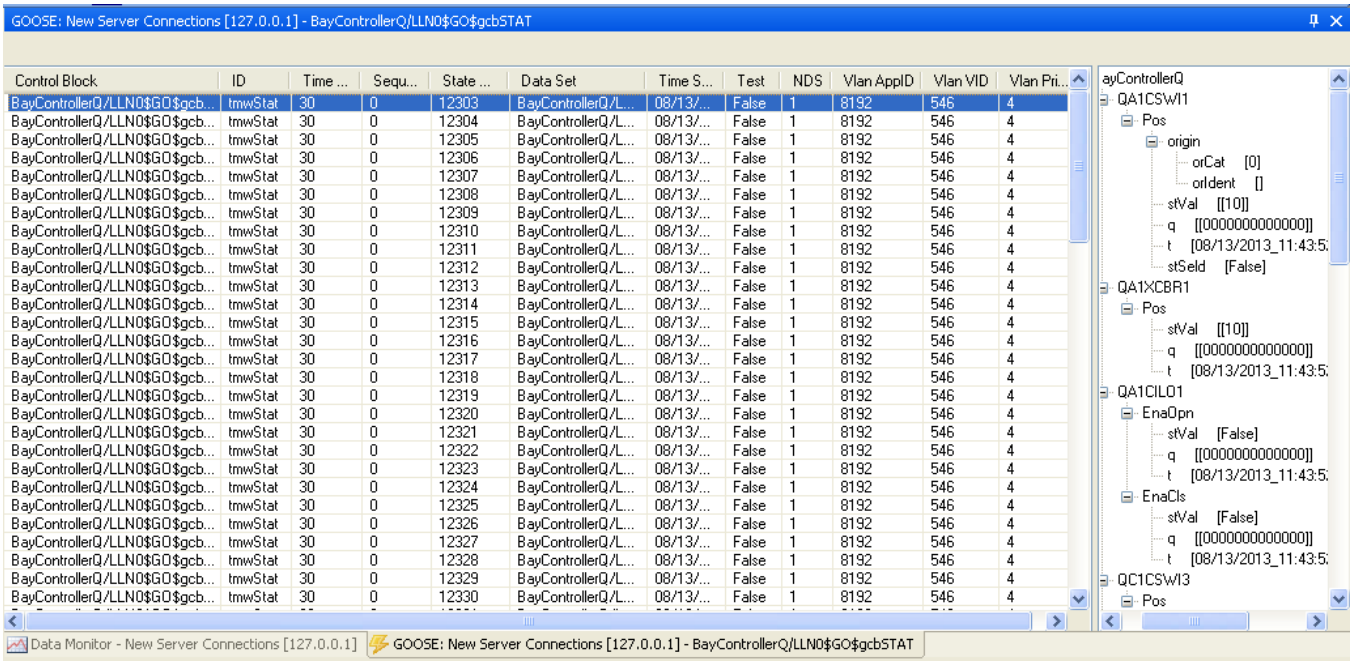
Step 3:
GOOSE Control is included within LLN0 node.

In Hammer, right click on the GOOSE Control blocks and select Subscribe (You might have to right-click and select 'Enable' first). If you experience trouble with connecting GOOSE, try to right-click the control tag, and select "Read" to load some values. If there are still issues, stop the simulation in Anvil, and then in hammer click "disable", wait and click "enable" again. Then subscribe on the tags in Hammer, and go back to Anvil to start the simulation.



Step 4:
To see the Goose messages, in the tool bar, click on GOOSE Messages icon.





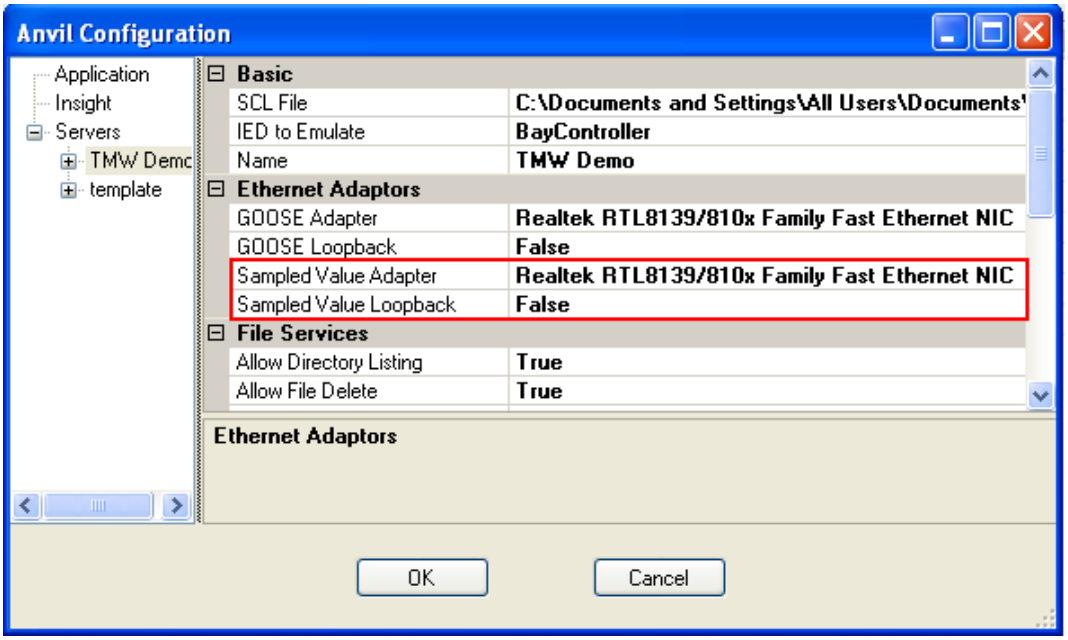
Practical 7

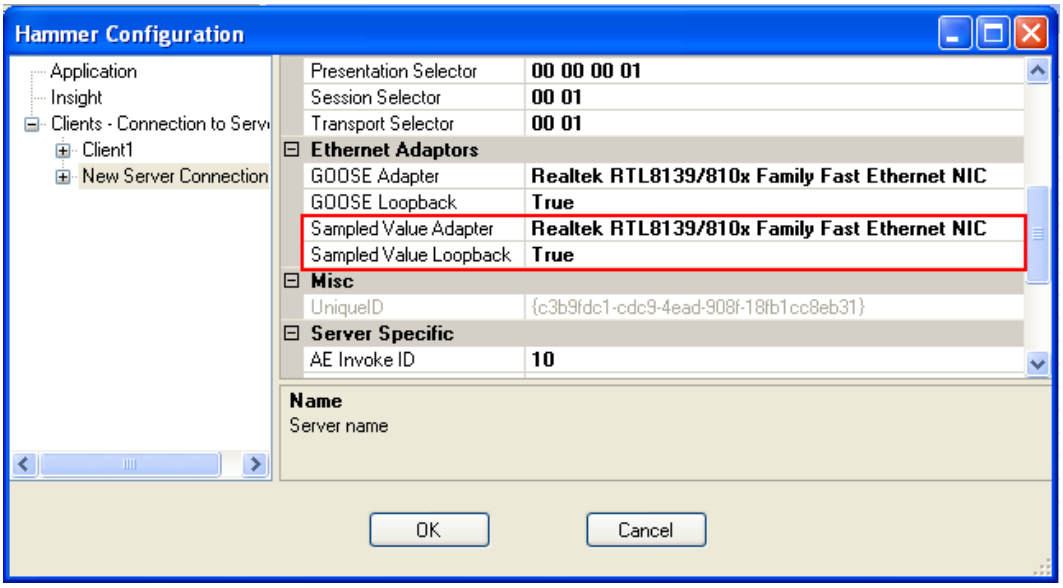
Visual display of Values between Anvil and Hammer on a local machine

Objective:
To send Sampled Values (SV) between Client and Server.

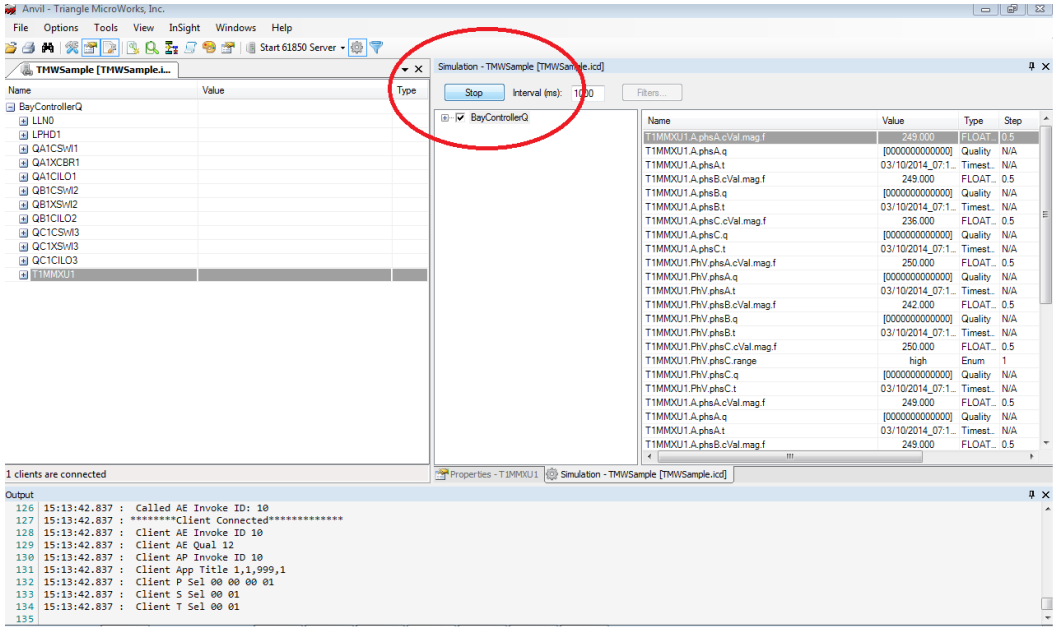
Procedure:

Step 1:
Set the adapter (must use same adapter for SV and GOOSE) for and loopback settings as you did for GOOSE.

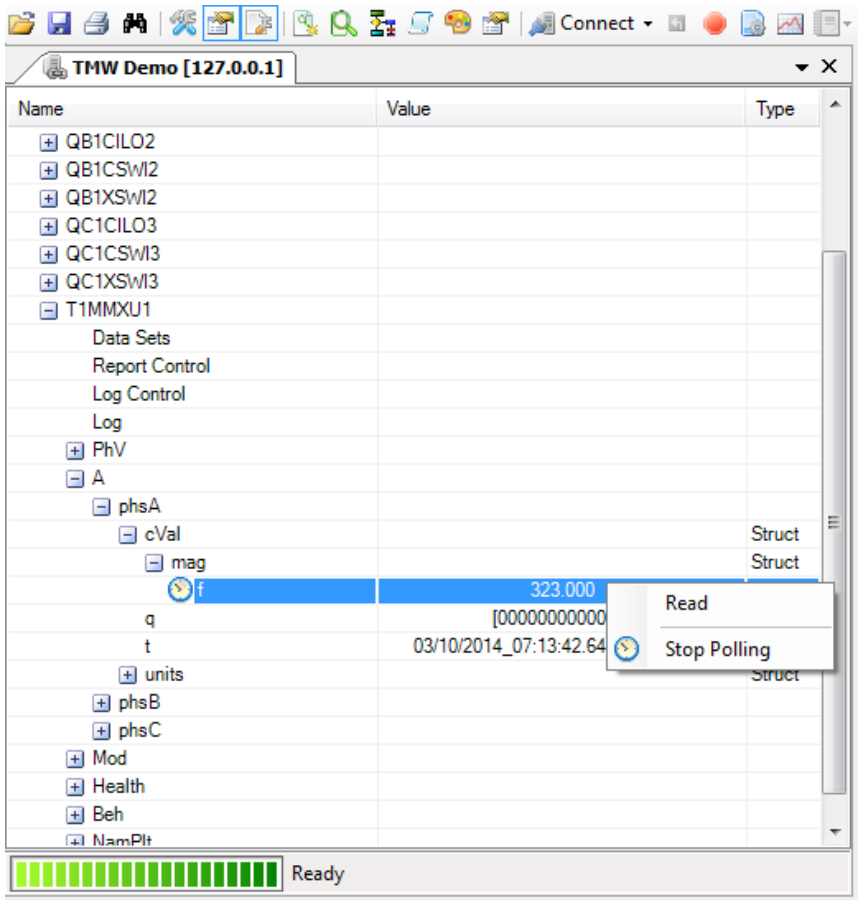




Step 2:
In Anvil, make sure the simulation is running.

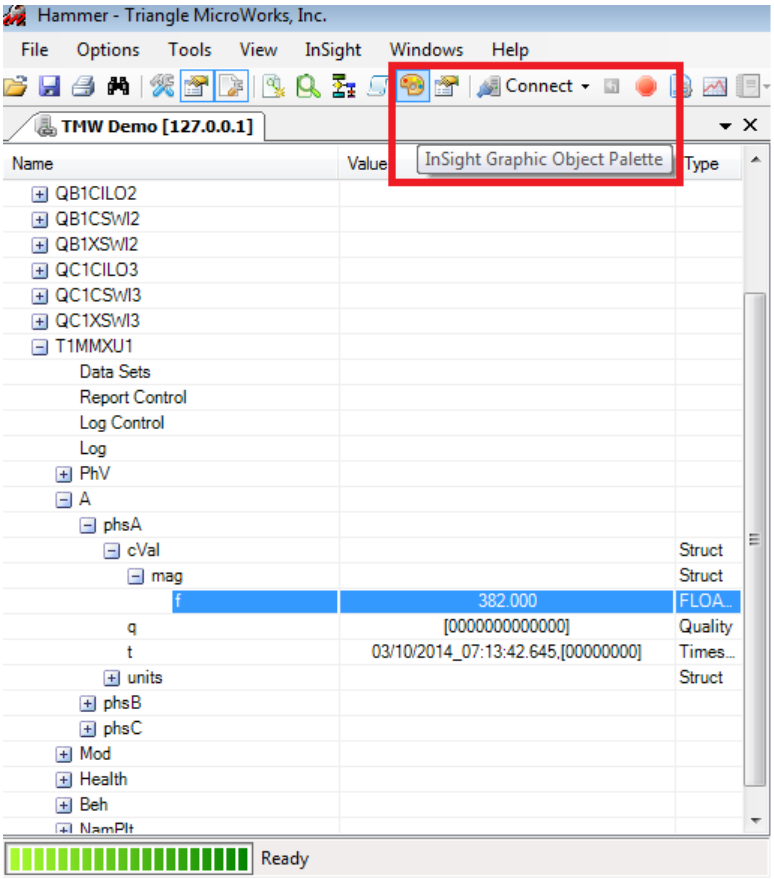


Step 3:
In order to view some of the values graphically: In Hammer, ensure the following value is being polled.

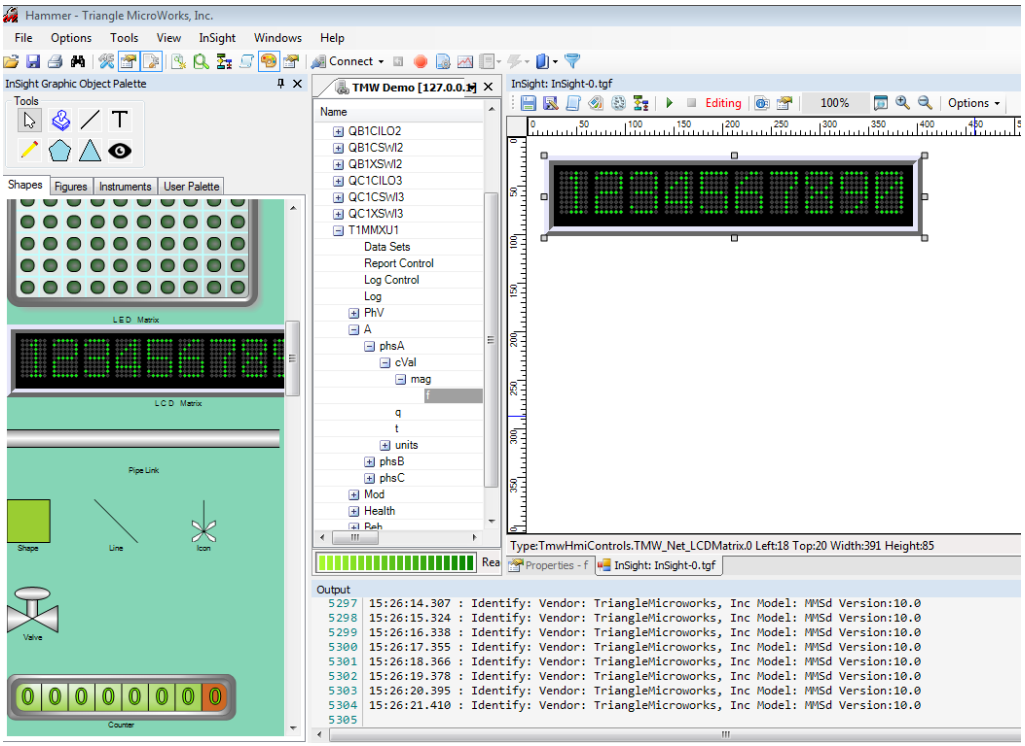


In Hammer, click on InSight → New. A new Insight window will open.

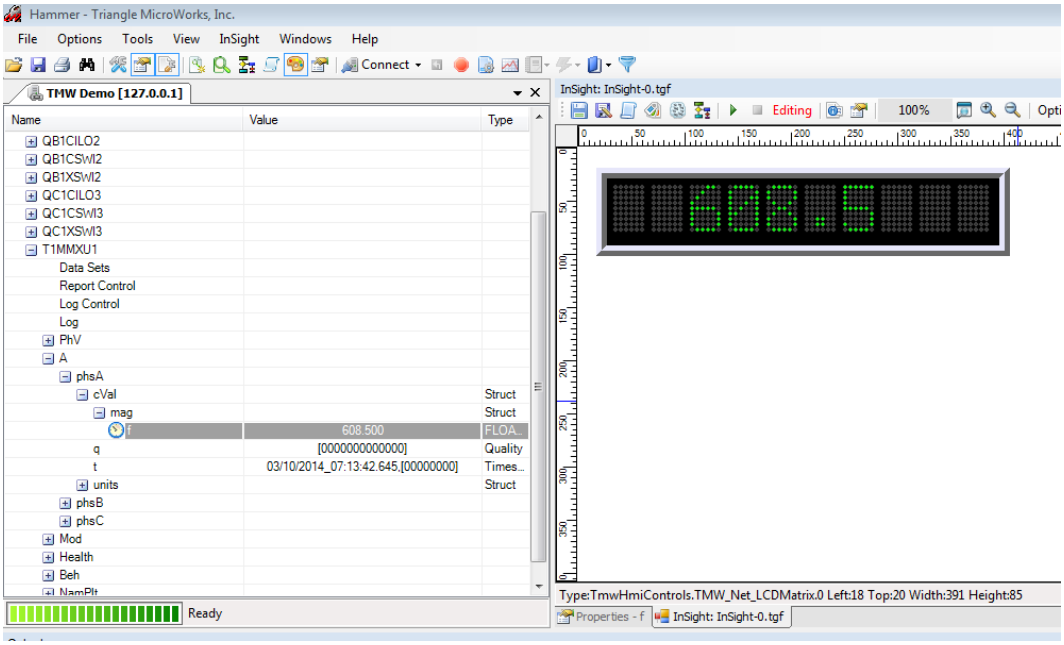
Step 4: Click on the InSight Graphic Object Palette button and "continue".



Scroll down to the LCD Matrix object, and drag it to the InSight window created earlier.



Step 5: Close the Palette window, and drag the SV value being polled earlier (A.phsA.cVal.mag.f) onto the InSight LCD Matrix. (Make sure the value is being polled, or else no values will change.)



The value in the display should change; simulating the values being sent from the server.