ProSoft TECHNOLOGY

Where Automation Connects.

PLX8x-MNET-61850

Communication Gateway

Modbus TCP/IP to IEC 61850

May 14, 2014

USER MANUAL

Your Feedback Please

We always want you to feel that you made the right decision to use our products. If you have suggestions, comments, compliments or complaints about our products, documentation, or support, please write or call us.

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PLX81-MNET-61850
PLX82-MNET-61850

May 14, 2014

ProSoft Technology® Product Documentation

In an effort to conserve paper, ProSoft Technology no longer includes printed manuals with our product shipments. User Manuals, Datasheets, Sample Ladder Files, and Configuration Files are provided on the enclosed DVD, and are available for digital download from our web site, http://www.prosoft-technology.com at no charge.

Important Installation Instructions

Power, Input, and Output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b) of the National Electrical Code, NFPA 70 for installation in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations in Canada, and in accordance with the authority having jurisdiction. The following warnings must be heeded:

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIV. 2;
WARNING - EXPLOSION HAZARD - WHEN IN HAZARDOUS LOCATIONS, TURN OFF POWER BEFORE REPLACING OR WIRING MODULES
WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
THIS DEVICE SHALL BE POWERED BY CLASS 2 OUTPUTS ONLY.

Product Warnings

WARNING – EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.
AVERTISSEMENT – RISQUE D'EXPLOSION – AVANT DE DÉCONNECTER L'EQUIPMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

Battery Life Advisory

The Prosoft Gateway uses a non-rechargeable lithium (lithium carbon monofluoride chemistry) battery to back up the real-time clock and CMOS. The battery should last for at least 10 years when stored. The battery is not used nor being recharged during its operation.

Note: The battery is not user replaceable.

Agency Approvals & Certifications

ATEX	<Ex> II 3 G Ex nA II T5 0 °C <= Ta <= +60 °C
cULus	0°C to +60°C Temperature Code – T5
CB Safety	
CE	

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Guide to the PLX8x-MNET-61850 User Manual

Function		Section to Read	Details
Introduction (Must Do)		Start Here (page 11)	This section introduces the customer to the gateway. Included are: package contents, system requirements, hardware installation, and basic configuration.
Diagnostic and Troubleshooting		Diagnostics and Troubleshooting	This section describes Diagnostic and Troubleshooting procedures.
Reference Product Specifications		Reference (page 136) Product Specifications	These sections contain general references associated with this product and its Specifications.
Support, Service, and Warranty Index		Support, Service and Warranty (page 185) Index	This section contains Support, Service and Warranty information. Index of chapters.

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1.1 Overview

This User Manual will explain the features of the Modbus TCP/IP to IEC 61850 ProSoft gateway. It will guide the user through configuring the ProSoft gateway, showing how to map IEC 61850 Data Attributes between an Intelligent Electronic Device (IED), through the ProSoft gateway, and a Schneider Electric® Modicon® Quantum® (PLC). The configuration software creates files to import into Unity™ Pro programming software, integrating the ProSoft gateway into your system.

This User Manual provides examples of how to move IEC 61850 Data Attributes using IEC 61850 8.1 MMS messages. The PLC will read and write data to the IED. The ProSoft gateway will automatically *push (write)* data from the IEDs to the Quantum, so the Quantum does not have to be programmed to read the IEDs data. You need to have an Intelligent Electronic Device (IED) and be familiar with it. IEDs generally come with their own configuration software, and a template IED Capability Description (ICD) file. The template file represents a device that is not configured. Once configured, the device will make a Configured IED Description (CID) file. A System Configuration Description (SCD) file can also be made. Some IEDs generate an ICD file (rather than a CID file) for their configured file, so be sure to have the right file. Please have these files on hand before beginning this process.

For a complete list of features and supported functions of the PLX8x-MNET-61850, refer to the IEC 61850 PICS Statement, which is available as a separate download at http://www.prosoft-technology.com.

1.2 System Requirements

The ProSoft 61850 Configuration Manager configuration software for the PLX8X-MNET-61850 gateway requires the following minimum hardware and software components:

- Pentium® II 450 MHz minimum. Pentium III 733 MHz (or better) recommended
- 128 Mbytes of RAM minimum, 256 Mbytes of RAM recommended
- 100 Mbytes of free hard disk space (or more based on application requirements)
- 256-color VGA graphics adapter, 800 x 600 minimum resolution (True Color 1024 x 768 recommended)
- DVD drive

Supported operating systems:

- Microsoft Windows 7(32 bit) (64bit not tested)
- Microsoft Windows Vista (not tested)
- Microsoft Windows XP Professional with Service Pack 1 or 2
- Microsoft Windows 2000 Professional with Service Pack 1, 2, or 3 (not tested)
- Microsoft Windows Server 2003 (not tested)

1.3 Package Contents

The following components are included with your PLX8X-MNET-61850 gateway, and are all required for installation and configuration.

Important: Before beginning the installation, verify that all of the following items are present.

Qty.	Part Name	Part Number	Part Description
1	Modbus TCP/IP to IEC 61850 gateway	PLX8X-MNET-61850	ProSoft communication gateway
1	Ethernet Cable	RL-CBL025	5-foot straight-through Ethernet cable (gray)
1	Screwdriver	HRD250	Small, flat-bladed screwdriver
1	ProSoft Solutions DVD	DVD-001	Contains utilities and documentation for the PLX8X-MNET-61850 gateway.
1	1 GB Industrial SD Card	SDCard-1GB	Industrial SD card for stored gateway configuration
1	Power Connector	J180	3-wire dc power connector

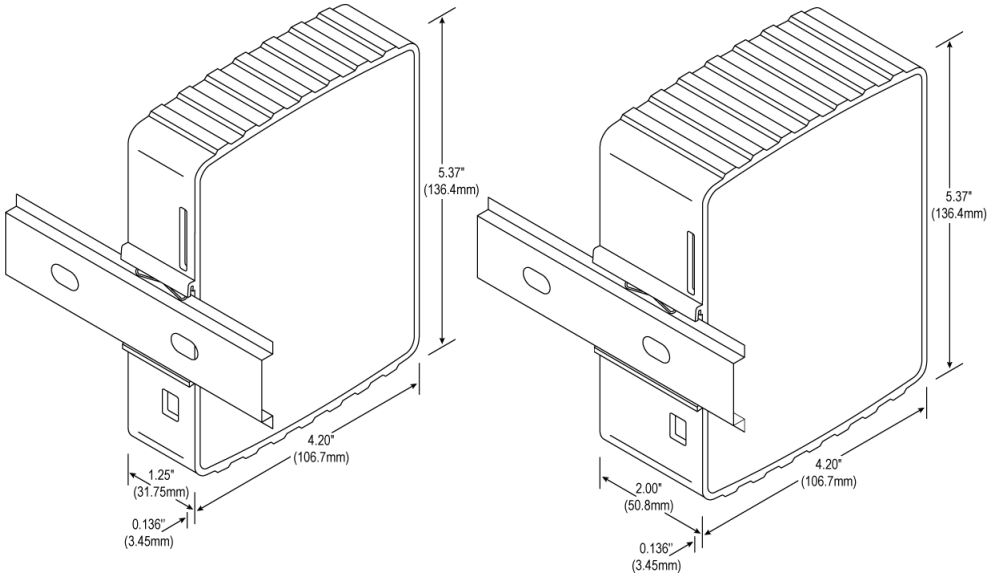
If any of these components are missing, please contact ProSoft Technology Support for replacement parts.

1.4 Jumper States

There are three sets of jumper settings located on the back of the module.

- **MODE 3 - Development Mode Jumper**: (Top Jumper) Used for firmware updates only. The two pins should NOT be jumpered during normal operation.
- **MODE 2 – Default IP Jumper:** (Middle Jumper) The default IP address of the ProSoft gateway is 192.168.0.250. Set this jumper to put the gateway's IP address back to the default. The two pins should NOT be jumpered during normal operation.
- **MODE 1 –** (Bottom Jumper) Reserved

1.5 Mounting the Gateway on a DIN-rail



ProSoft IEC 61850 Series gateway mounting schematic

1.6 Connecting Power to the Unit

WARNING: Be sure not to reverse polarity when applying power to the gateway. This will cause permanent damage to the gateway's internal power distribution circuits.

1.7 Configuration Ethernet Port

The included Ethernet cable(s) can be used to connect from the PC to the ProSoft gateway's Ethernet port(s). Later, the gateway can be connected to a switch, through a patch cable, allowing the IEDs, ProSoft gateway, and Quantum PLC, Premium PLC, or M340 PAC to all operate on the same network.

1.8 ProSoft Discovery Service

ProSoft Discovery Service (PDS) is Windows-based software that connects to the gateway through the Ethernet port for the following purposes:

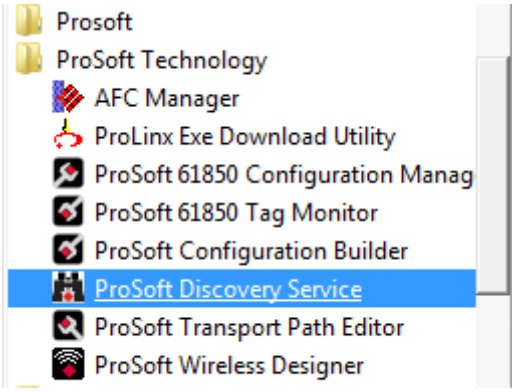
- Automatic discovery of the gateway on the Ethernet network
- Set a temporary IP address for the gateway for commissioning
- Allow PDS to select the gateway for monitoring and IP address reconfiguration

The ProSoft Discovery Service software is supplied as a stand-alone utility, available on the DVD.

1.8.1 Setting Up a Temporary IP Address

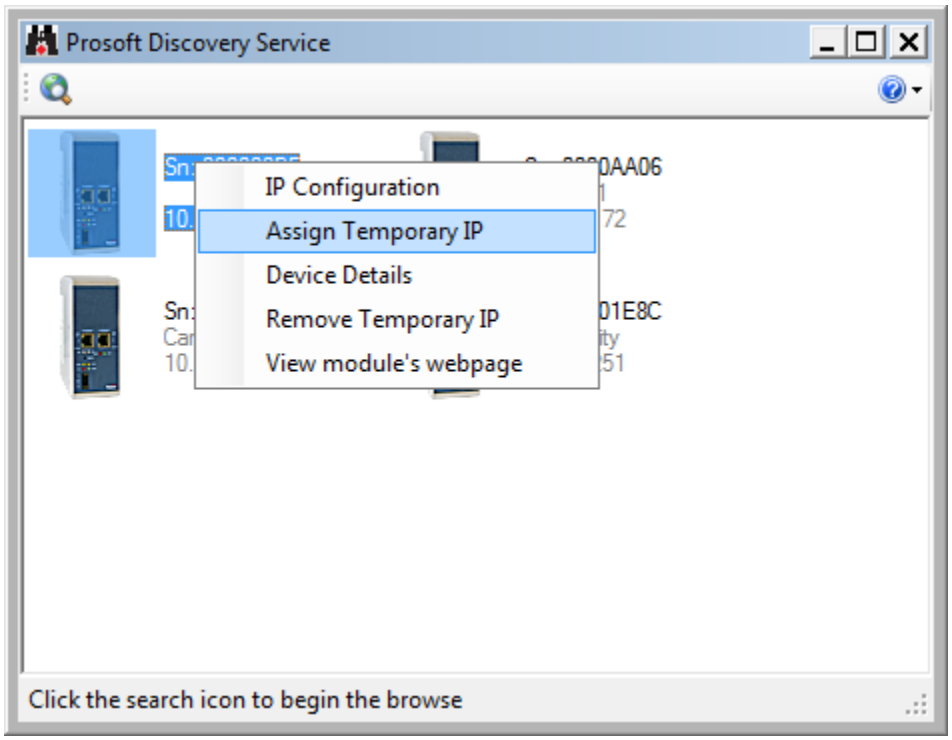
Important: ProSoft Discovery Service locates PLX8x gateways through UDP broadcast messages. These messages may be blocked by routers or layer 3 switches. In that case, ProSoft Discovery Service will be unable to locate the gateways.
To use ProSoft Discovery Service, arrange the Ethernet connection so that there is no router/layer 3 switch between the computer and the gateway OR reconfigure the router/layer 3 switch to allow the routing of the UDP broadcast messages.

1 Click the **START** button, and then navigate to **PROGRAMS / PROSOFT TECHNOLOGY**.

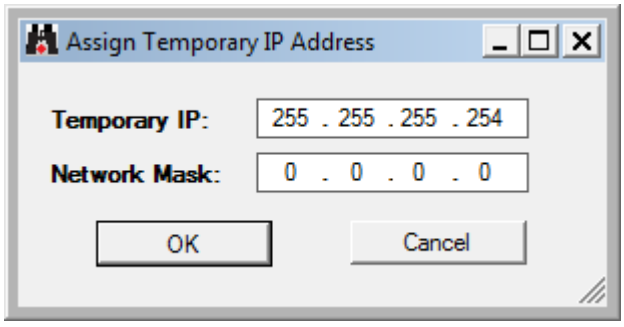


2 Click to start *ProSoft Discovery Service*.

3 Select the module, then right-click and choose **ASSIGN TEMPORARY IP**.



4 The module's default IP address is 192.168.0.250.



5 Choose an unused IP within your subnet, and then click **OK.**

1.9 Installing Prosoft 61850 Configuration Manager

ProSoft 61850 Configuration Manager must be installed in order to configure the gateway. ProSoft 61850 Configuration Manager is on the DVD included with the gateway.

- Insert the provided DVD into the DVD drive of the PC.
- Choose “Install ProSoft 61850 Configuration Manager” from the startup screen, or navigate to the *Prosoft 61850 Configuration Manager* folder on the DVD, and double-click setup.exe to install it.

Note: System requirements in this document are subject to change and do not represent a commitment to support any particular software or hardware.

1.9.1 ProSoft 61850 Configuration Manager Systems Requirements

- Windows 7 Professional (32-bit version), 1 GB RAM Intel® Pentium 4™ (2.66 GHz)
- Windows XP Professional Ver.2002 Service Pack 2, 2 GB RAM Pentium 4 (2.8 Gz)

NOTE: To use ProSoft 61850 Configuration Manager under the Windows 7 OS, you must be sure to install ProSoft 61850 Configuration Manager using the Run as Administrator option. To find this option, right-click on the Setup.exe installer program icon. In the context menu, you will see the Run as Administrator option. Click to use this installation option. Be aware, you must install using this option even if you are already logged in as an Administrator on your network or personal computer (PC). Using the Run as Administrator option will allow the ProSoft 61850 Configuration Manager installer to create folders and files on your PC with proper permissions and security. If you do not use the Run as Administrator option, ProSoft 61850 Configuration Manager may appear to install correctly; but you will receive numerous, repeating file access errors whenever ProSoft 61850 Configuration Manager is running, especially when changing configuration screens. If this happens, to eliminate the errors, you will have to completely uninstall ProSoft 61850 Configuration Manager and then re-install using the Run as Administrator option.

1.10 ProSoft 61850 Tag Monitor

ProSoft 61850 Tag Monitor is a way to monitor the data tag values through the ProSoft gateway. It is automatically installed when you install ProSoft 61850 Configuration Manager.

2 ProSoft 61850 Configuration Manager

In This Chapter

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- ProSoft Gateway Configuration 31
- IEC 61850 37
- Modbus TCP/IP Configuration 46

To configure the ProSoft gateway, these steps will need to be followed in this order:

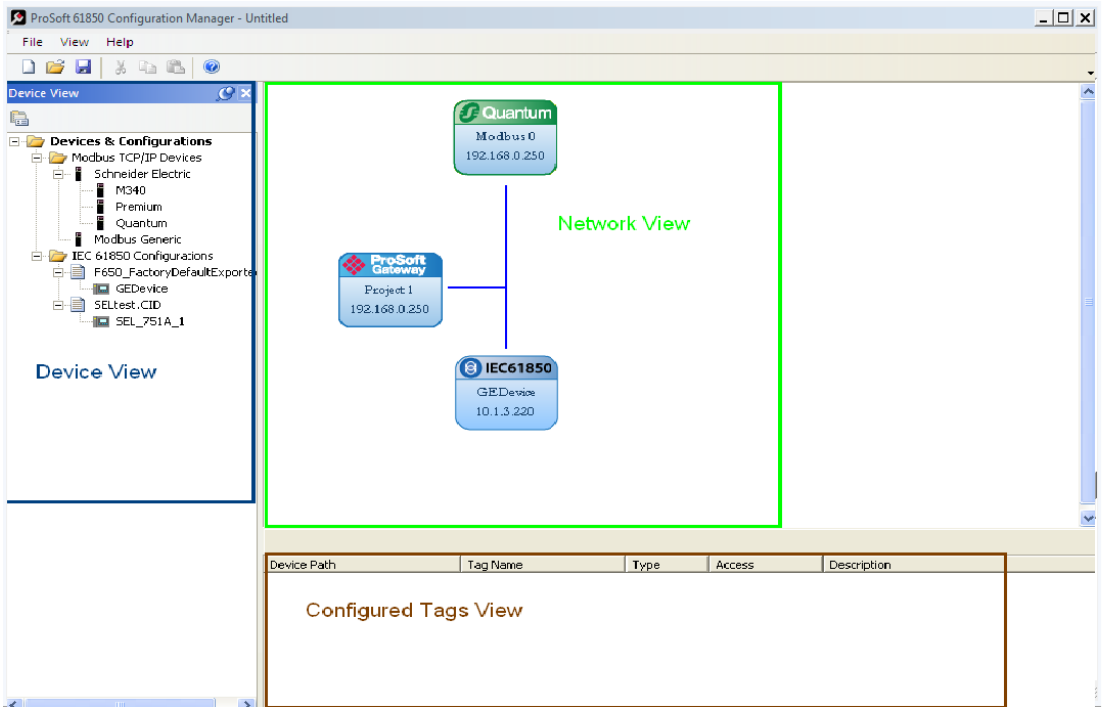
1. Configure the gateway by setting the properties for the ProSoft Gateway icon.
2. Configure the IEDs that will communicate with the gateway.
3. Configure the Modbus devices that will communicate with the gateway.

The reason the IEDs are configured before the Modbus devices is because ProSoft 61850 Configuration Manager takes steps to assist with the Modbus configuration after the IEDs are setup.

2.1 ProSoft 61850 Configuration Manager Main Screen

Here is an example of ProSoft 61850 Configuration Manager with a configuration. The left panel of the window is the *Device View* section. In this picture, the *Device View* section has a dark blue outline around it. The *Device View* section shows the selection options such as selecting the Modbus TCP/IP Devices, and a list of available IEC 61850 configurations. The *IEC 61850 Configurations* section will show the list of CID or SCD files added to this configuration.

The *Network View* section is the large space on the right side of the window, and is shown with a green outline. When ProSoft 61850 Configuration Manager is opened, only the ProSoft Gateway icon will be shown. As devices are added to the configured network, they will show in the *Network View* section. The *Configured Tags View* section will list the tags associated with the icon that is currently selected and is shown below with a brown outline around this section.



Note: The colored outline is only for demonstration purposes in this manual. The colored outline will not actually be seen in the program.

2.1.1 ProSoft 61850 Configuration Manager Project File

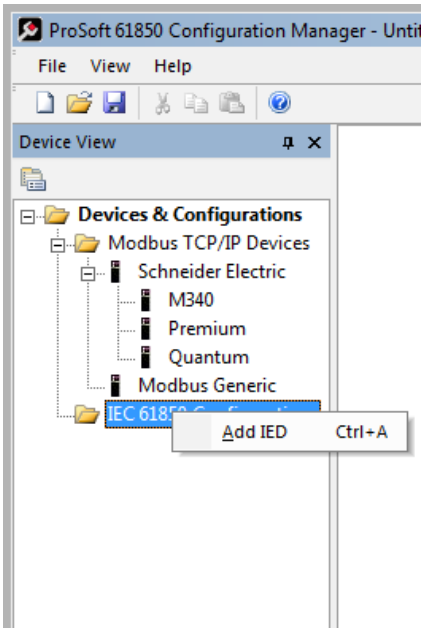
A project in ProSoft 61850 Configuration Manager is intended to be one configuration setup for one ProSoft Gateway. If there is more than one ProSoft Gateway, then a different project file will be needed for each one. Multiple instances of ProSoft 61850 Configuration Manager can be active at the same time if there is a need to review or compare projects.

- **FILE / NEW:** Create a new ProSoft 61850 Configuration Manager project file.
- **FILE / OPEN PROJECT**: Open an existing ProSoft 61850 Configuration Manager project file.
- **FILE / ADD IED**: This is the same action as choosing **ADD IED** after right-clicking on **IEC 61850 CONFIGURATION**s, described later in this section.
- **FILE / SAVE**: Save your configuration work into a ProSoft 61850 Configuration Manager project file.
- **FILE / SAVE AS**: Save your configuration in a ProSoft 61850 Configuration Manager project file with another name and/or in another location.
- **IMPORT CONFIGURATION**: Use this feature to open a configuration file that was received from someone else. Do not open a project file created on another PC, because it will not contain all the CID files that were used with it. Instead, use **IMPORT CONFIGURATION**, and this will include the CID/SCD/ICD files used to create that configuration.
- **EXPORT CONFIGURATION**: Use this feature to save a configuration with all associated IED files, so that the entire configuration may be imported into a new project. For additional details, See Exporting Configuration (page 83)

2.1.2 Device View Section

The *Device View* section shows the Modbus TCP/IP devices and IEC 61850 configurations. The Modbus TCP/IP Devices list is a static list of the Modicon processors that can be chosen.

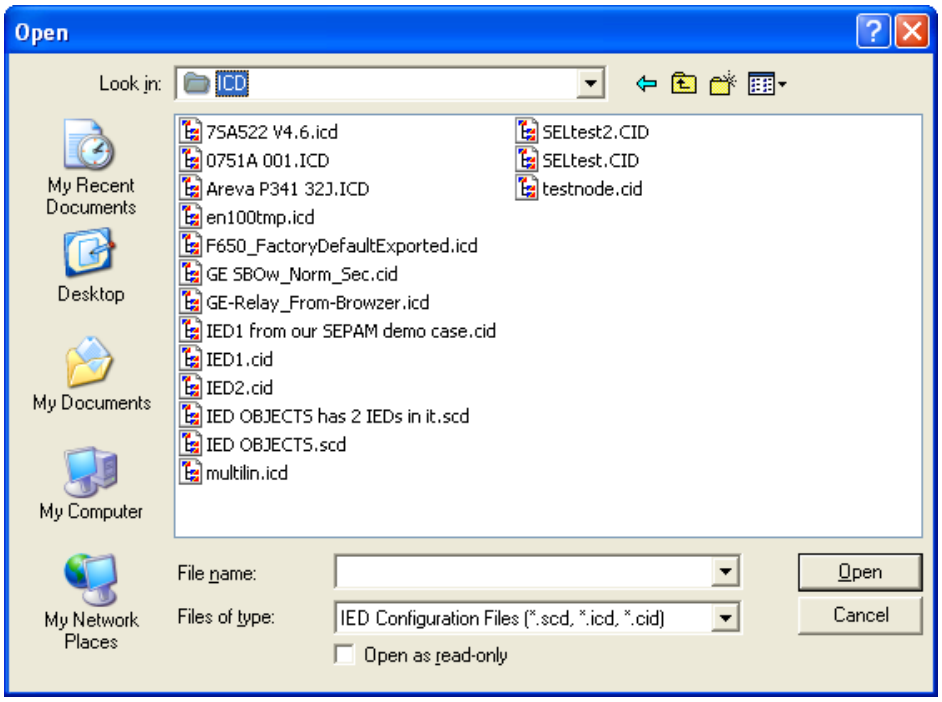
To use one of them, click to highlight one (Quantum, Premium, or M340), drag it to the right, and drop it into the *Network View* section. If you are using an NOE card between the PLC and the gateway, choose Quantum. If you are using some other Modbus device to communicate with the gateway, then drag and drop Modbus Generic.



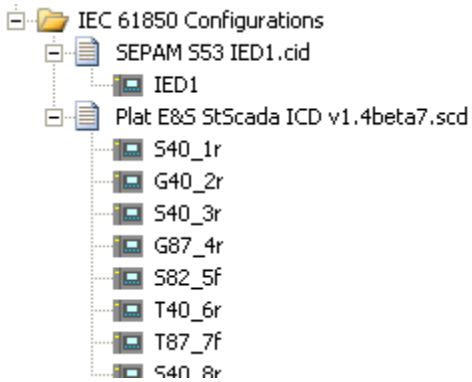
The *IEC 61850 Configuration*s folder, is a list of IEDs' configuration files. This folder will be empty until you import IED files into the software. To import them, right-click on the *IEC 61850 Configurations* folder and choose **ADD IED**. Once an IED's configuration is in the list, you can drag and drop its attributes into the Network View section to add them to the system configuration.

IEDs come with a template ICD file, but an ICD file generally indicates possible configuration options but usually does not contain specific configuration information. For instance, ICD files usually do not have an IP Address or other configured elements in them. Once an IED has been configured (using third-party configuration software provided by the IED manufacturer), the manufacturer's software will usually create a specific CID configuration file. Some third-party software may also create a SCD system configuration file.

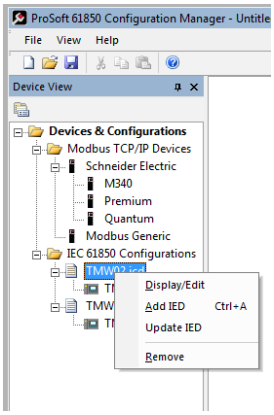
ProSoft 61850 Configuration Manager can import CID, SCD, or ICD files. Use the following window to browse for your IEDs' configuration files. The **OPEN AS READ-ONLY** field shown on the window should not be used, and does not appear in Windows 7.

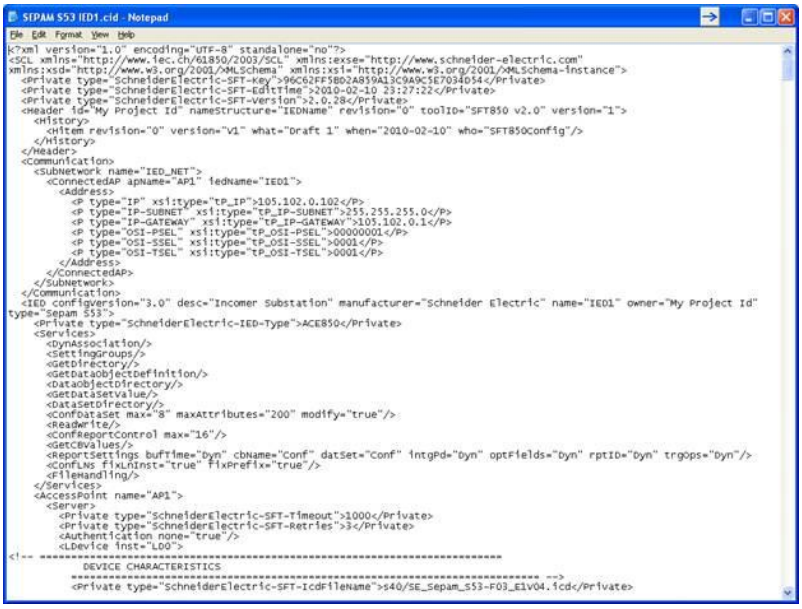


After adding the IED configuration file to the IEC 61850 Configuration folder, click on the **+** sign to the left of it, to expand it and see the IEDs inside it. A CID file generally has one IED (but can have more) and a SCD file generally has multiple IEDs in it, like this:



Drag and drop the IEDs (not the CID or SCD file name, but the IED inside it) over to the *Network View* section to configure them to communicate with the ProSoft gateway. If you are familiar with looking at the contents of CID, SCD, and ICD files, it may be useful to use the **DISPLAY/EDIT** option, shown here.





Normally this feature will not be used to alter configured files. It is a handy reference tool if you are familiar with these files, and want to look up something in it. The IED has its own configuration software, and that software should be used to configure the IED.

The other two menu options on the context menu with Display/Edit are:

ADD IED: This is the same action as choosing **ADD IED** from right-mouse-clicking on **IEC 61850 CONFIGURATIONS**.

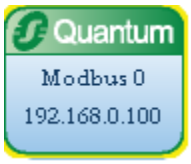
UPDATE IED: This is used to import newer versions of previously loaded IEC configuration files. For additional details see Updating a CID File.

2.1.3 Network View Section

This is where a graphic representation of the devices to be connected to the gateway can be seen. There will be one *ProSoft Gateway* icon on this window.

When you drag and drop an IED, it creates an *IEC 61850* icon, like this:

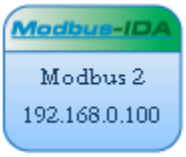
When you drag and drop a Quantum device from the *Device View* section to the *Network View* section, it creates a *Quantum* icon, like this one:



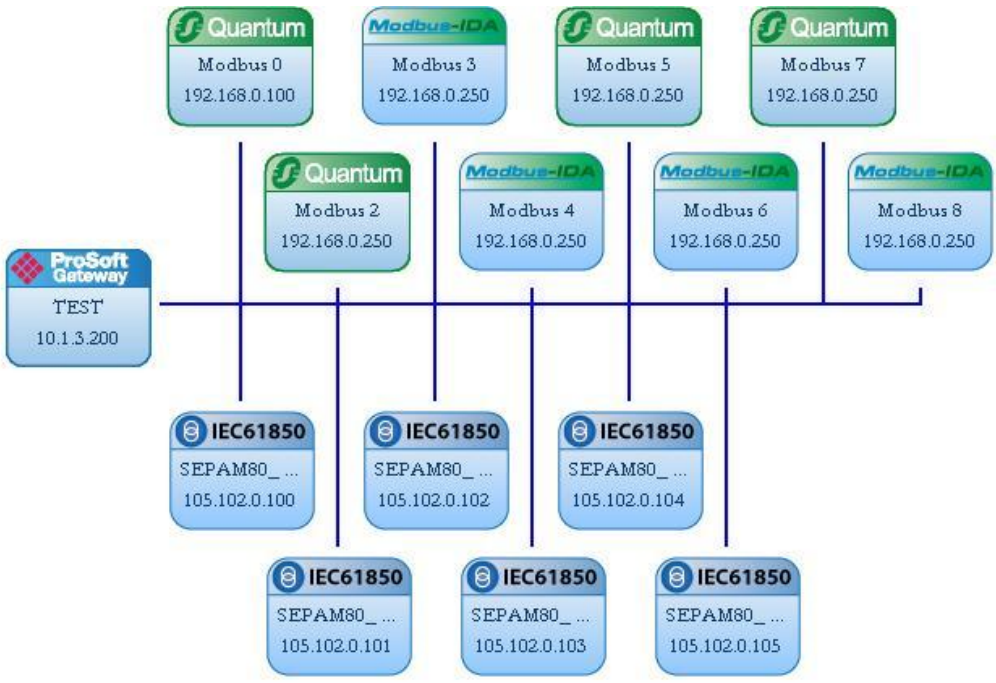
When you drag and drop a Premium device, it creates a *Premium* icon, like this one:

When you drag and drop a M340 device, it creates a *M340* icon, like this one:

When you drag and drop a Modbus Generic device, it creates a *Modbus-IDA* icon, like this one:



As you drag and drop more devices, notice that the *Network View* section will fill up, like this:



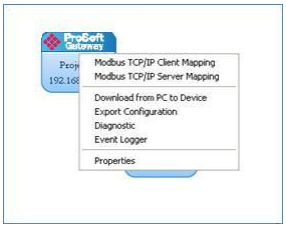
The gateway can be configured to communicate with multiple IEDs and multiple Modbus TCP/IP devices.

2.2 ProSoft Gateway Configuration

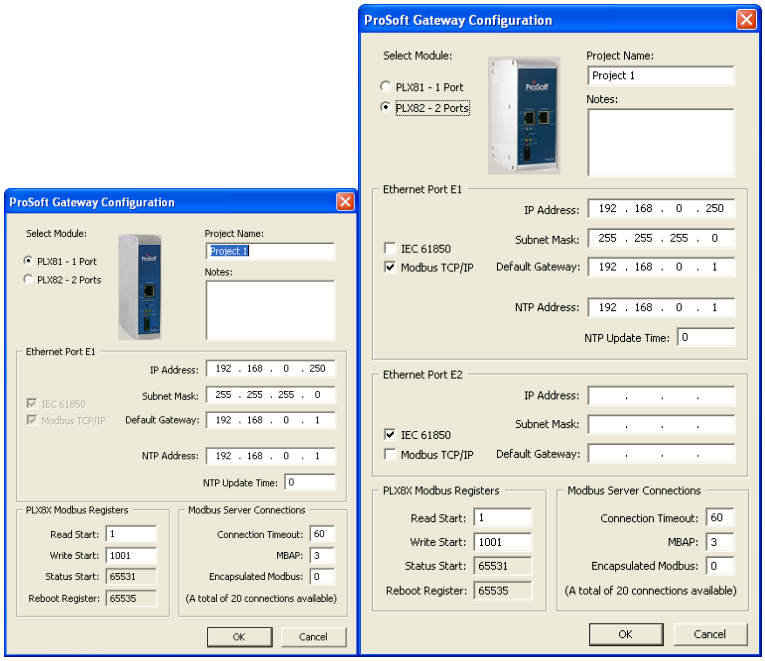
The following options are available by right-clicking on the *ProSoft Gateway* icon.

- Modbus TCP/IP Client Mapping
- Modbus TCP/IP Server Mapping
- Download from PC to Device
- Upload from Device to PC
- Diagnostic:
- Event Logger
- Properties

To configure the ProSoft gateway, right-click on the *ProSoft Gateway* icon and choose **PROPERTIES**.



This displays the *Prosoft Gateway Configuration* windows, depending on which gateway you select from the PLX8X or PLX 82.



SELECT MODULE: CHOOSE EITHER "PLX81 – 1 PORT" OR "PLX82 – 2 PORTS" TO MATCH THE MODULE YOU HAVE. IF YOU CHOOSE THE 2 PORT MODULE, YOU WILL NEED TO SELECT THE APPROPRIATE CHECKBOX TO INDICATE WHICH NETWORK (MODBUS TCP/IP OR IEC 61850) YOU WILL USE ON EACH PORT. ADDITIONALLY, YOU WILL NEED TO ENTER THE IP ADDRESS, SUBNET MASK, AND DEFAULT GATEWAY FOR THE SECOND PORT.

PROJECT NAME: Enter the name of the ProSoft gateway.

Note: The Notes field is for informational purposes.

Use the next 3 fields to configure the Ethernet settings for the gateway. An IP address, subnet mask and gateway address must be assigned.

1 **IP Address**: The IP address must be a fixed IP address. Determine the network settings for the ProSoft gateway, with the help of your network administrator if necessary.
2 **Subnet Mask**: Enter the ProSoft gateway's subnet mask.
3 **IP Gateway**: The IP Gateway address is optional, and is not required for networks that do not use a default Gateway.

Other fields to configure:

NTP ADDRESS: This is the IP address for the SNTP Server. The gateway has a SNTP Client in it, and the SNTP Server is the IP address which it can poll for the current date and time. For example, in the USA, there are a number of time servers and their IP addresses listed at *http://tf.nist.gov/tf-cgi/servers.cgi.*

NTP UPDATE TIME: This number (in minutes) is the poll frequency at which the gateway's SNTP Client will poll the SNTP Server. A value of 0 (zero) means the SNTP Server will not be polled.

READ START AND WRITE START represent the ProSoft gateway's beginning Modbus registers. This addressing is so that Modbus Clients can access Modbus data on the gateway. All of the tags in the ProSoft tag database are in a numbered array of Modbus registers, addressed as **1** to **65535.**

PLX READ START: Valid values are in the range **1** to **65535**, with a default value of 1. A value of 1 means the first available Modbus read data register can be accessed using a Modbus Holding Register address of 40,001 (or 400,001 if using six-digit addressing). This is the starting Modbus address of the data in the gateway's tag database for read-only IED data. See the Modbus TCP/IP Server Mapping (page 35) window to lookup the tag addressing.

PLX WRITE START: Valid values are in the range **1** to **65535**, with a default value of 1,000. A value of 1,000 means 41,001. This is the starting Modbus address of the data in the gateway's tag database for writable IED data. See the Modbus TCP/IP Server Mapping (page 35) window to lookup the tag addressing.

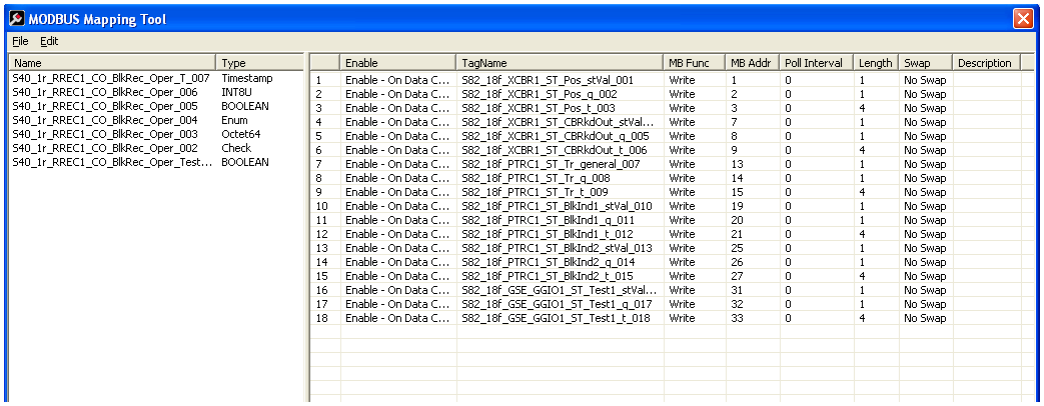
CONNECTION TIMEOUT: **0** to **1200** seconds. This is the number of seconds the Server will wait to receive new data. If the Modbus TCP/IP Server does not receive any new data during this time, it will close the Ethernet socket connection. The default value is 60.

The gateway supports multiple MNET servers and MBAP servers.

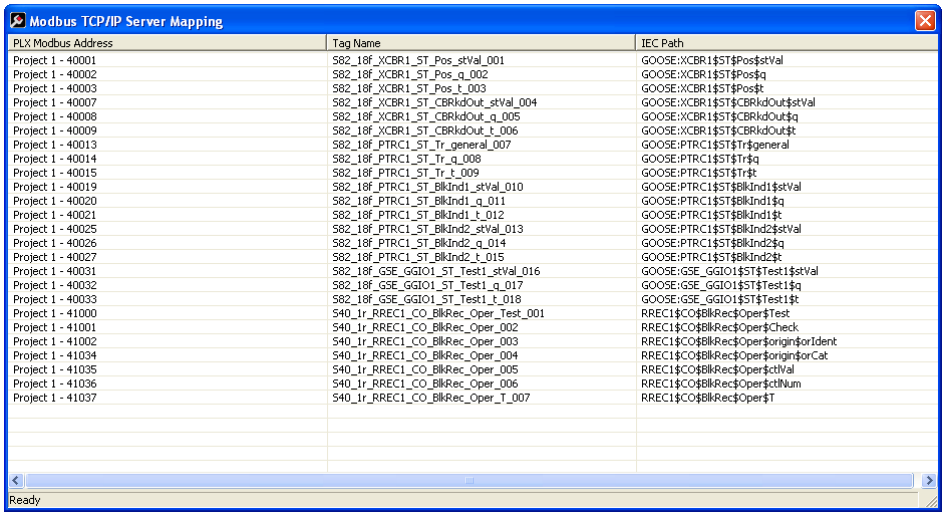
ENCAPSULATED MODBUS: This is the number of Modbus TCP/IP Client devices that will communicate with the gateway using TCP/IP Service Port 2000. These are devices that use Modbus RTU serial-style message structures enclosed in an Ethernet wrapper.

MBAP : This is the number of Modbus TCP/IP Client devices that will communicate with the gateway using Schneider Electric MBAP-style messages on TCP/IP Service Port 502.

2.2.1 Modbus TCP/IP Client and Server - Lookup

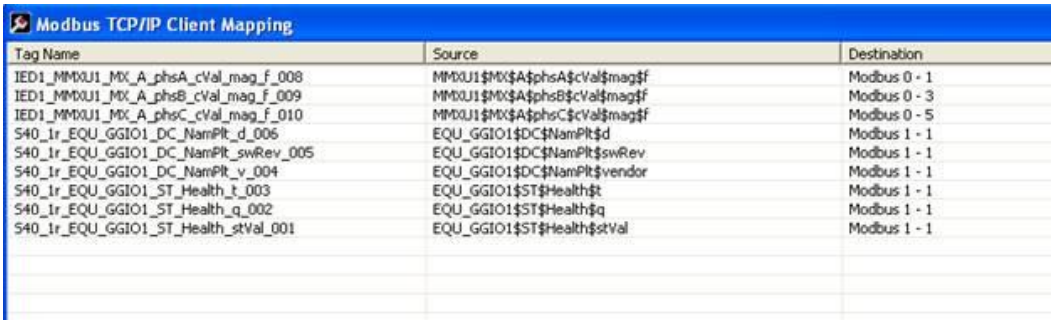


All tags are available to be read from the gateway by a Modbus TCP/IP Client. To lookup the address of the tags in the gateway, right-click on the *ProSoft Gateway* icon, and choose **MODBUS TCP/IP SERVER MAPPING**.



2.2.2 Modbus TCP/IP Client Mapping

When you choose **MODBUS TCP/IP CLIENT MAPPING**, the following window will appear:



This list shows the entire mapping of the Modbus TCP/IP Client gateway. Columns of data shown are:

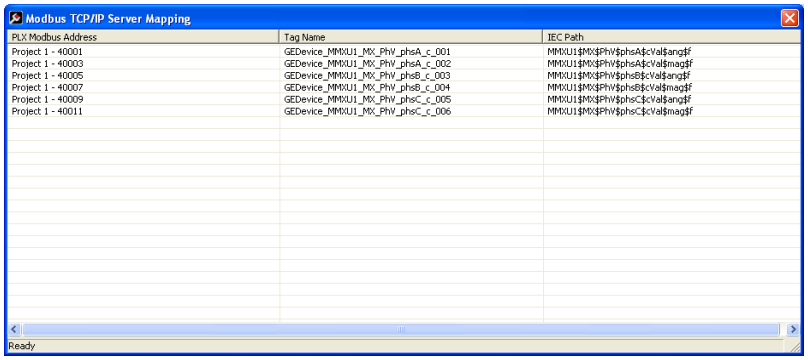
TAG NAME: These are the tag names. By default they are prefixed with the IED name. The Tag Name can be changed on the *IEC 61850 Mapping Tool* window.

SOURCE: This is the IED source path of the data.

DESTINATION: In this example the destinations are on two different Modbus devices, Modbus 0 and Modbus 1. The *PLC Starting Modbus Address* is appended to the end of the Modbus device names.

2.2.3 Modbus TCP/IP Server Mapping

Right-mouse-click on the *ProSoft Gateway* icon and choose **MODBUS TCP/IP SERVER MAPPING**. This shows the location of all configured tags on the ProSoft gateway.



PLX MODBUS ADDRESS: This starts with the Project Name, hyphen, followed by the Modbus Address of the tag in the gateway. Your Modbus TCP/IP Client can fetch this data from this location in the gateway.

TAG NAME: This is the tag name for the data, as referenced by the ProSoft gateway.

IEC PATH: This is the original source path of the data from the IED.

2.2.4 Download from PC to Device

See *Downloading the Configuration File* (page 79)

2.2.5 Uploading from PC to Device

See *Uploading the Configuration File* (page 86)

2.2.6 Diagnostic

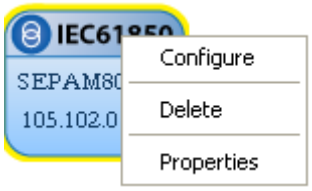
See *Diagnostics and Troubleshooting* (page 101)

2.2.7 Event Logger

See *Diagnostics and Troubleshooting / Event Logger* (page 124)

2.3 IEC 61850

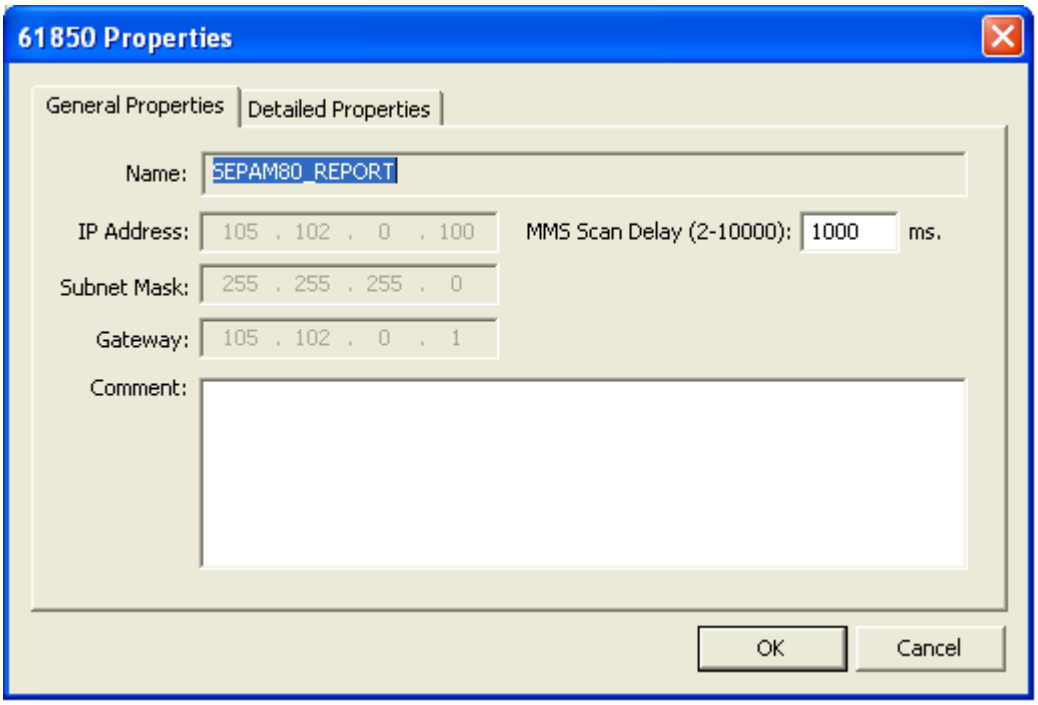
The following options are available for 61850 Configuration:



- Properties
- Delete
- Configure

2.3.1 IEC 61850 Properties

Right-mouse-click on the IEC *61850* icon and choose **PROPERTIES**.



on the *General Properties* tab, **NAME, IP ADDRESS, SUBNET MASK**, and **GATEWAY** will already be filled in, because ProSoft 61850 Configuration Manager reads this from the configured CID, SCD, or ICD file. If these fields are not already filled in, the file used to **ADD THIS IED** to ProSoft 61850 Configuration Manager was not a configured file. If this is the case, you should import a configured IED file and try again.

MMS SCAN DELAY has a default value of 1000 milliseconds. Valid values are **2** ms to **10,000** ms (10 seconds). The MMS Scan Delay parameter is the time between each issuance of a MMS read command.

IEC 61850 Reports and GOOSE messages are generated by the IED. Therefore, the MMS Scan Delay setting has no impact on the timing of those types of messages. The MMS Scan Delay parameter also has no impact on MMS writes.

The lower you put the MMS Scan Delay parameter, the more network capacity there will be with MMS Read network traffic. If you do not configure an IED to read any Data Attributes using MMS messages, then this parameter has no effect.

In the *Detailed Properties* tab there is one parameter, Device File, which is not editable. It is the path on your PC where ProSoft 61850 Configuration Manager stores its own copy of the CID, SCD, or ICD file for this IED.

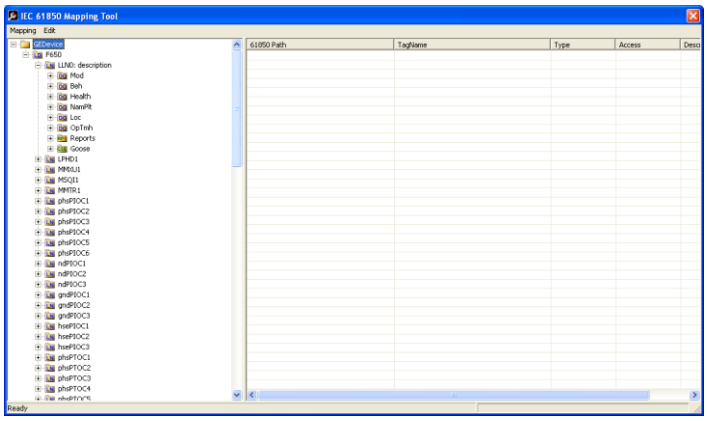
2.3.2 Delete

Right-click on the *IEC-61850* icon and choose **DELETE** to remove this IED from the current configuration.

2.3.3 IEC 61850 Configuration

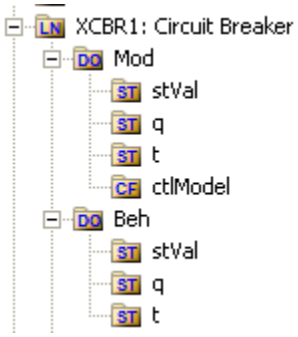
Double-click the *IEC-61850* icon, or right-mouse-click and choose **CONFIGURE**, to show the *IEC 61850 Mapping Tool* window.

In the tree view on the left, expand (click) the **+** sign. This shows the Logical Devices (notice the little "LD" in the icon) of an IED. Now expand one of the Logical Devices in the IED to see the Logical Nodes (notice the little "LN" in the icon) within it.



Functional Constraints

The little icons provide information. "DO" is for Data Object. Within the DO, there may be multiple levels of data. Down at the Data Attribute level, the functional constraint of the Data Attribute is shown in the icon, e.g. "CO" for Control, "ST" for Status Information, and "CF" for Configuration.



IEC 61850 MMS Read

For data that the ProSoft gateway needs to read from the IED, simply drag and drop the *Data Attribute*s from the tree view on the left to the right-hand side of the *IEC 61850 Mapping Tool* window.

If you want to choose several *Data Attributes* at the same time, you can drag and drop a Data Object (DO) at a higher level, rather than each individual *Data Attribute*.

The gateway processes its list of configured IEDs in order, one at a time, based upon its MMS Scan Delay timer. Each MMS Read command will be sent on the interval provided by the MMS Scan Delay parameter.

The *Data Attribute* data is put into the ProSoft gateway's internal tag database.

Note: if your application requires more *Data Attribute*s than the supported number of Modbus TCP/IP Client commands, then the application will require the PLC to operate as a Modbus TCP/IP Client and poll the remaining *Data Attribute*s from the gateway.

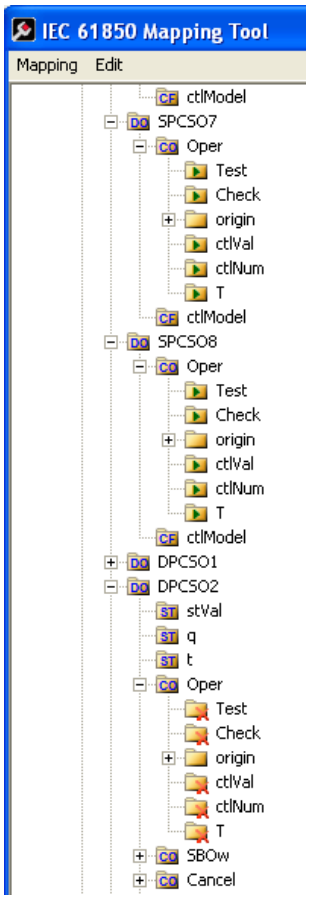
IEC 61850 MMS Write

For writable data, drag and drop the **OPER** structure from the tree view on the left to the right-hand side of the window.

Important: In addition to the **OPER** structure, some IEDs also offer **SBOW** and Cancel structures within the same Data Object. For the gateway, you only need to map the **OPER** structure. Do not map the **SBOW**. The **CANCEL** structure should only be mapped if it is required.

We strongly recommend the user map all of the *Data Attribute*s surrounding the actual controlled value, and setup another exchange to read it before changing the control value and performing a write from the PLC side.

In ProSoft EIP-61850 Configuration Manager **OPER** structures that are supported by the IED have a green indicator, meaning that these may be mapped to the gateway. Those with a red indicator are not required to be mapped.

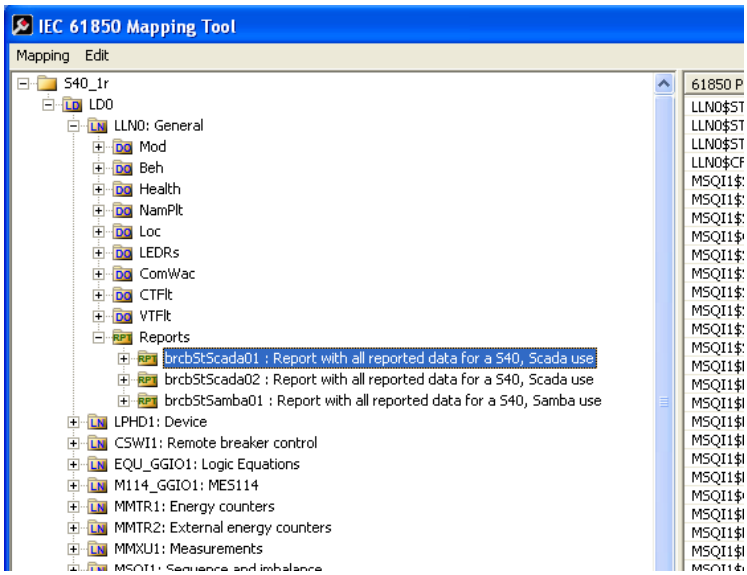


IEC 61850 Reports

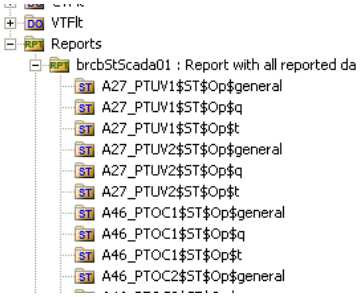
Both Buffered Report Control Blocks (BRCBs) and Unbuffered Report Control Blocks (URCBs) available for an IED will show in a Reports section in the tree view. ProSoft 61850 Configuration Manager will display the reports available for the IED based upon the information in the configured ICD file.

Within the Reports folder, if a report is available, ProSoft 61850 Configuration Manager will show the report name and a description.

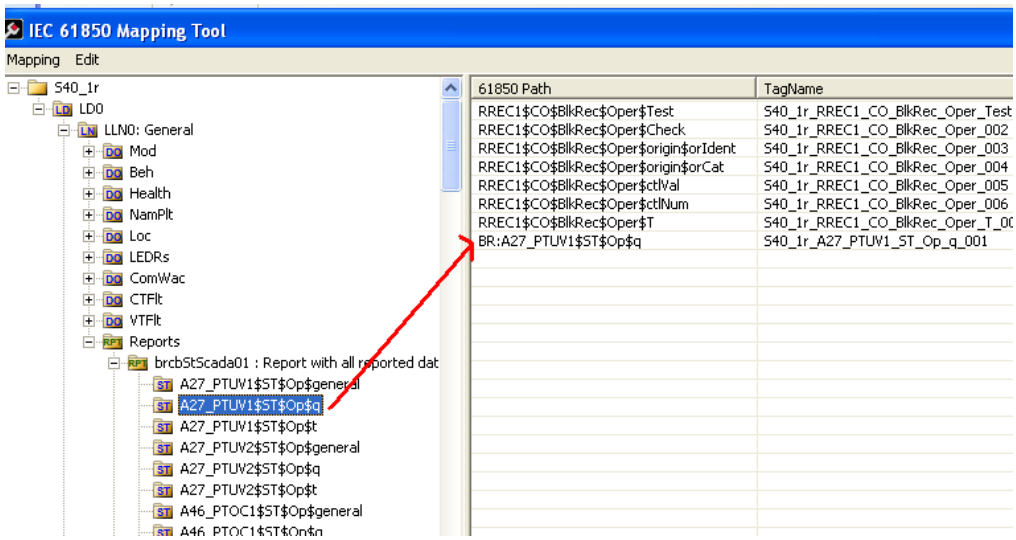
In ProSoft 61850 Configuration Manager, drag and drop the report name to be mapped. (A DATA-SET will have already been assigned to the report on the IED.) Be sure that your DATA-SET on your IED contains all Data Attributes and not Data Objects. The ProSoft gateway needs to map the Data Attributes in the DATA-SET.



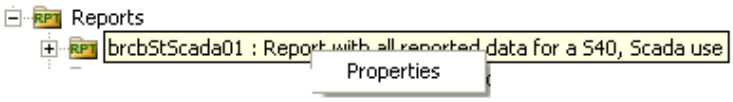
The DATA-SET name for the report can be expanded, so that all the Data Attributes defined for that DATA-SET can be seen.



In this example, only one *Reporting Data Attribute* is mapped.



The report's *Trigger Options*, and other report properties can be seen in ProSoft 61850 Configuration Manager. Right-click on the **REPORT NAME**, and choose **PROPERTIES**. This will show you *Report Control Block* information, as specified in the CID or SCD file.



Note: It is important to note that the gateway will store the entire DATA-SET of data in the tag database. This way, a consistently-sized set of data is available to the other protocol. The user will configure which Data Attributes he wants mapped to the other protocol.

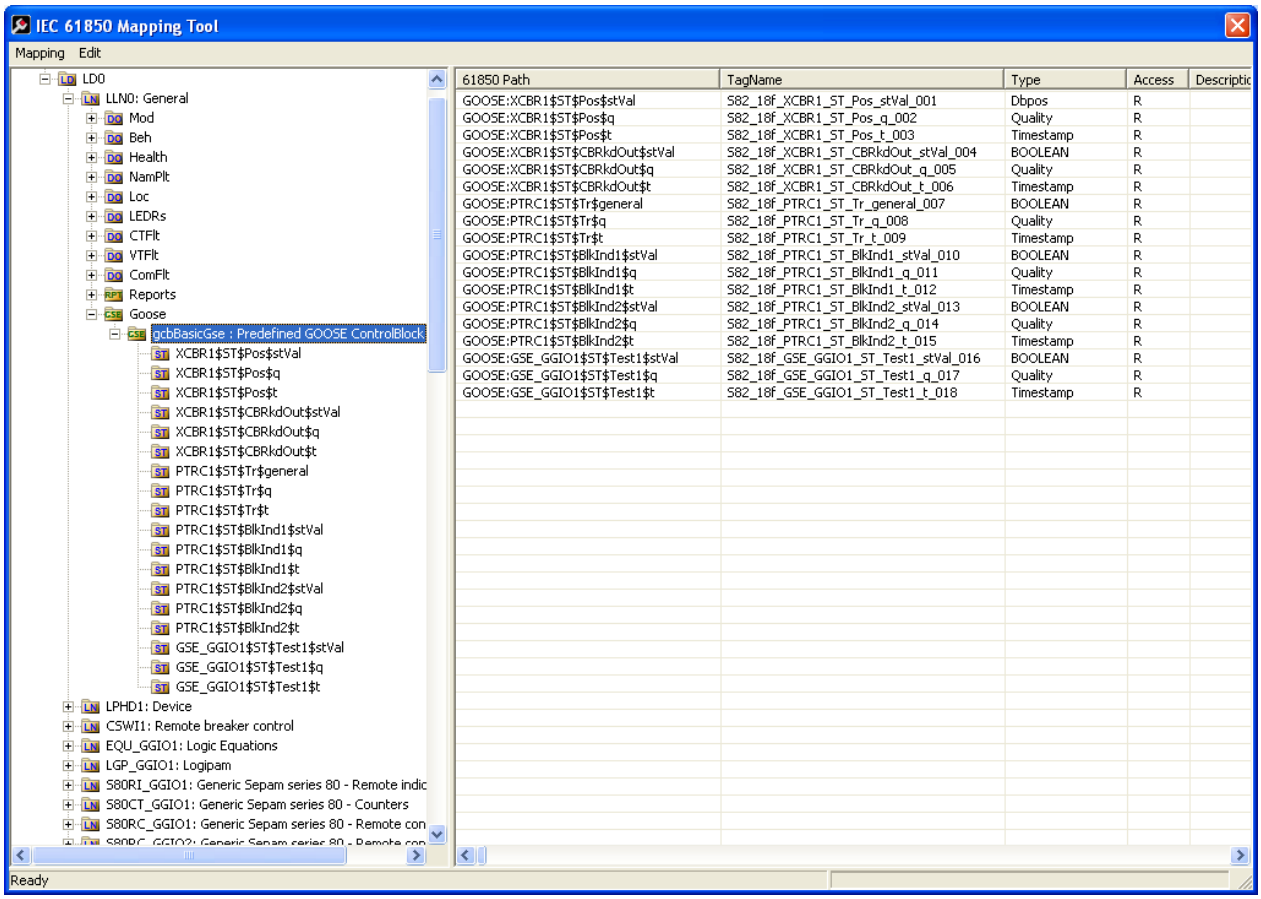
Report options are used as they are defined on the IED.

The gateway supports General Interrogation (GI). Upon report enable, the gateway will initiate a General Interrogation, if the Report's trigger options have it set to TRUE. This will occur during the first connection that the gateway makes to the IED, and upon any subsequent reconnections. This ensures the gateway has a current snapshot of the values of all members of the Report's DATA-SET.

IEC 61850 GOOSE

Map the Generic Object Oriented Substation Event (GOOSE) message that the IED will produce, and that the ProSoft gateway will send to the PLC. This will be a broadcast movement of data. GOOSE messages are based upon a DATA-SET. An entire GOOSE message must fit in one Ethernet packet.

According to the IEC 61850 Standard, *GSEControl* information is only allowed in the logical node LLN0.



The right-hand side of the window automatically populates with one row for each Data Attribute in that DATA-SET when the GOOSE DATA-Set is dragged and dropped to the right-hand side.

The ProSoft gateway supports multiple Data Attributes in a GOOSE DATA-SET.

The gateway allows mapping of the entire DATA-SET for GOOSE, or mapping only the data attributes of interest.

On the right-hand side of the window, all of the columns of data are automatically filled in:

- **61850 PATH** - You will notice that ProSoft 61850 Configuration Manager places a prefix of *GOOSE* into this column. The remainder is the standard IEC-61850 path as would be expected.

- **TAG NAME** - This is generally quite long, and is close to the actual data attribute name. Yet, since most Unity PLC's cannot handle a tag name this long, ProSoft 61850 Configuration Manager automatically shortens the name. If you wish to change the **TAG NAME**, click on this field and rename.
- **TYPE** – Data type for the *Data Attribute*

ACCESS – ProSoft 61850 Configuration Manager can determine from the functional constraint of the Data Attribute if its read or write. You will see an *R* if the Data Attribute can be read and a *W* if it can be written

Assumptions

The ProSoft gateway supports both Modbus TCP Client and server, and it can act as a Client and server at the same time. Once you have configured your application, ProSoft 61850 Configuration Manager will automatically generate the file that is required by Unity Pro for Quantum, Premium or M340 processors so that all data that is exchanged between the gateway and the PLC or PAC is already mapped to the correct Modbus addresses. These files are configured in such a way that:

- The data transferred from the gateway to the PLC or PAC is pushed from the gateway as a Modbus TCP/IP Client. The generated .XSY files will map the tag names to the Modbus addresses in the PLC or PAC which will receive the values from the gateway.
- The controllable *Data Attribute*s that are transferred from the PLC or PAC to the gateway are pushed from the PLC or PAC (operating as a Modbus TCP/IP Client) to the gateway operating as a Modbus TCP/IP Server. The generated .XFM file will generate the Function Block and associated Variables to write the data to the gateway.

The sample file generated by ProSoft 61850 Configuration Manager will assume that the read data will be transferred with the gateway as a Modbus TCP/IP Client, and the controllable data will be transferred with PLC or PAC as a Modbus TCP/IP Client.

You may wish to consider setting up GOOSE messages in the IEDs specifically for the purpose of what data you need to send to the ProSoft gateway. That way only the data that is needed is contained in the GOOSE message.

2.4 Modbus TCP/IP Configuration

2.4.1 Modbus TCP/IP Client Commands Overview

The Modbus TCP/IP Client driver uses a command list to define interactions between the ProSoft gateway and Modbus TCP/IP server devices. The commands in the list specify the server device to be addressed, the function to be performed (read or write), the data area in the device with which to interface, and the registers in the tag database to be associated with the command. The Client command list supports up to 1,000 commands.

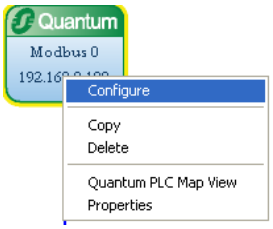
The command list is processed from top (item #1 in the *MODBUS Mapping Tool* window) to bottom. A poll interval parameter is associated with each command to specify a minimum delay time in tenths of a second between successive issuances of each particular command. If a value of 10 is specified for the parameter, the command will be executed no more frequently than once every second.

Write commands have a special feature; they can be set to execute only if the data in the data area associated with the write command changes. If the register data values in the data area associated with the command have not changed since the command was last issued, the command will not be re-executed until after a data change has happened. If the data in the command has changed since the command was last issued, the command will be executed again to send the new data. Use of this feature can reduce network traffic. In order to implement this feature, the enable code for the write command will need to be set to **ENABLE – ON DATA CHANGE**.

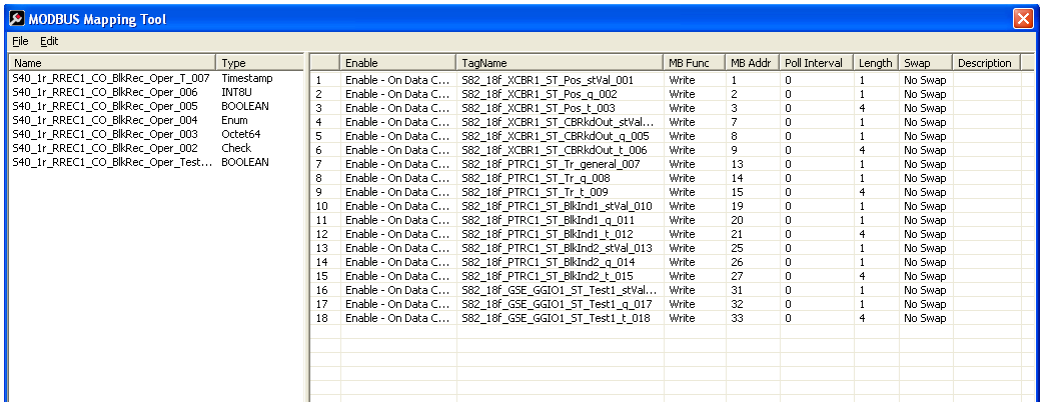
2.4.2 Schneider Electric PLC Device Configuration

Configuration

After the IEC 61850 Data Attributes to be mapped in the gateway have been chosen, then double-click, or right-click on the *Quantum, Premium, or M340* icon, and choose **CONFIGURE**.



This will bring up the *MODBUS Mapping Tool* window.



On the *Modbus Mapping Tool* window the *Data Attribute* is automatically showing on the left-hand side of the window. The right-hand side of the window is for mapping IED data to the gateway's Modbus Client. This is the data the gateway will push to the Modbus server.

Enable

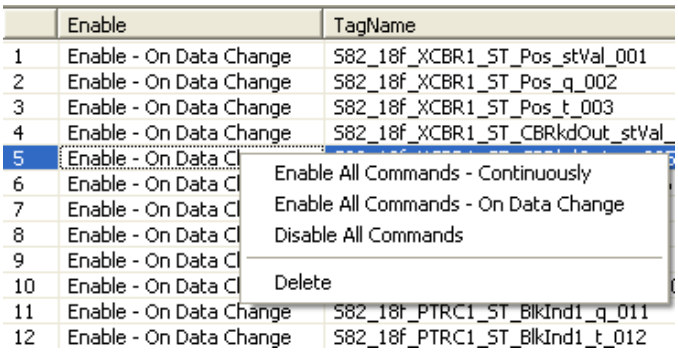
Options for this Modbus command are

- **ENABLE ALL COMMANDS - CONTINUOSLY**
- **ENABLE ALL COMMANDS - ON DATA CHANGE**
- **DISABLED**

The default is **ENABLE ALL COMMANDS - ON DATA CHANGE**.

This means that the data will only be pushed from the ProSoft gateway to the PLC when the data coming from changes in the gateway's internal database. This keeps the network traffic at a minimum.

To set all tags to the same *Enable* value, right-click and you will see the option for that.



MB Func

This is the Modbus Function code that the gateway will use. The default is **WRITE**, which will be Modbus Function code 16. If needed, this value can be set to **READ**, which will be Modbus Function code 3. For those tags set to **READ**, the gateway will act as a Modbus TCP/IP Client, and will actively read that tag from the PLC or PAC server.

MB Addr

This is the Modbus Address in the PLC which the gateway will write to or read from.

This parameter specifies the starting Modbus register address in the Modbus server device.

For Schneider Electric devices, the *MB Addr* is automatically determined based upon the *PLC Write Start Register (%MW)* entered on the *Modbus TCP/IP Device Configuration* window.

For Generic Modbus devices the user will need to enter the target Modbus address for each *Data Attribute* transfer.

Poll Interval

This parameter specifies the minimum interval to wait between successive executions of a given command when the enable code has been set for continuous execution. The parameter is entered in 1/10th of a second. Therefore, if a value of 100 is entered for a command, the command executes no more frequently than every 10 seconds. If poll interval is 0, then the command will be sent every time it is encountered as the firmware scans through in the poll list.

Length

This is determined based upon the data type of the *Data Attribute*.

For Schneider Electric devices, the *Length* field is not editable for Quantum, Premium, or M340 devices.

For Generic Modbus devices, the *Length* field can be edited for both read and write commands.

Swap

If MB Func is a Write, then this parameter defines if the data to be sent to the server needs to be ordered differently before it is sent out. If MB Func is a Read, then this parameter defines if the data received from the server is to be ordered differently than that received from the server device before being stored in the gateway's memory database. This parameter is helpful when dealing with floating-point or other multi-register values, as there is no standard method of storage of these data types in Modbus devices. This parameter can be set to reorder the four bytes of each two-register data group received. This can be in useful when passing data to other applications. The available options are:

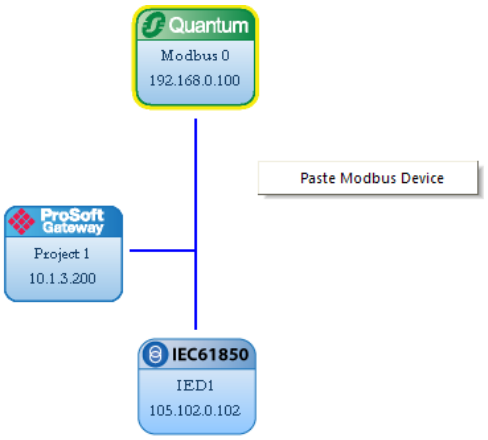
- **NO SWAP** (Default): No Change is made in the byte ordering. Order: 1-2-3-4.
- **SWAP WORD**: The words are swapped. Order: 3-4-1-2
- **SWAP WORD AND BYTE**: The words are swapped then the bytes in each word are swapped. Order: 4-3-2-1
- **SWAP BYTES**: The bytes in each word are swapped. The words should be swapped only when using an even number of words. Order 2-1-4-3

Copy

If you have multiple Modbus devices that need to be configured the same as one that has already been configured, you can use the **COPY** option.

1. Right-click on the Schneider Electric or Modbus Device icon to bring up the popup menu.
2. From the device popup menu, choose **COPY**.
3. In a white-space area of the Network View section, right-mouse-click and then left-click the **PASTE MODBUS DEVICE** option.

This will create a copy of the previous configuration with a new name.



Delete

To delete a Schneider Electric or Modbus device from the Network View section, right-click on the device icon and choose **DELETE** from the popup menu.

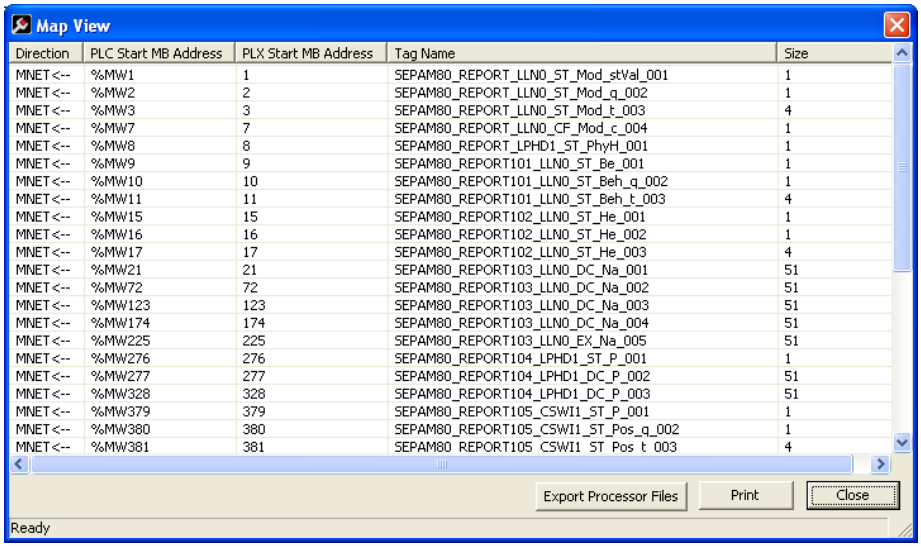
PLC Map View

Right-click on the Quantum, Premium, or M340 icon and choose **PLC MAP VIEW**.

The Map View window gives you information about all of the tags mapped to this PLC. The fields are:

- Direction
- PLC Start MB Address
- PLX Start MB Address
- Tag Name
- Size

From this window, you can **EXPORT THE PROCESSOR FILES** or **PRINT** this list.



DIRECTION: This shows "MNET" with an arrow. It indicates in which direction the data will move.

- "MNET →", indicates the data is moving from the gateway's MNET Client to a remote Modbus TCP/IP server device (usually a Modicon PLC or PAC). This is IEC 61850 data being read from the IED and pushed from the gateway to the Modbus device.
- "MNET ←" indicates the data is moving from a remote Modbus TCP/IP Client device to the gateway's MNET server. This is mapped to IEC 61850 writable data. The Modbus device (usually a Modicon PLC or PAC) writes the data to the gateway, and the gateway writes it to the IED.

PLC START MB ADDRESS: This is the PLC address in the PLC that this data will reside. This is derived, and based upon the address configured in the "Modbus TCP/IP Device Configuration" window, PLC Read Start Register (%MW) or PLC Write Start Register (%MW) field. In Unity Pro addressing, "%MW1" means the same as Modbus 40,001 or 400,001 in common Modbus addressing.

PLX START MB ADDRESS: This is the address in the ProSoft gateway where this data can be found.

TAG NAME: This is the tag name for this IEC-61850 *Data Attribute*, as named automatically by ProSoft 61850 Configuration Manager, or optionally changed by the user in the *IEC 61850 Mapping Tool* window.

SIZE: This is the size, in words, of the data. Please see the following chart, giving the mapping of the IEC-61850 data types to Modbus.

IEC 61850 Data Type	Number of Modbus Words	Modbus Data Type for Unity Pro	Size in Unity Pro
BOOLEAN	1	INT	1
INT8	1	INT	1
INT16	1	INT	1
INT24	2	INT	2
INT32	2	INT	2
INT128	Not Supported	Not Supported	Not Supported
INT8U	1	INT	1
INT16U	1	INT	1
INT24U	2	INT	2
INT32U	2	UDINT	1
FLOAT32	2	REAL	1
FLOAT64	Not Supported	Not Supported	Not Supported
Enum	1	INT	1
Dbpos	1	INT	1
Tcmd	1	INT	1
Quality	1	INT	1
Timestamp	4	INT	4
VisString32	51	INT	51
VisString64	51	INT	51
VisString255	51	INT	51
Octet64	32	INT	32
EntryTime	2	INT	2
Unicode255	51	INT	51
BitString	1	INT	1
Check	1	INT	1

When you choose **EXPORT PROCESSOR FILES**, ProSoft 61850 Configuration Manager will prompt you for a location for three new files.

- A Variable file (.xsy) , which contains Tag Names and Data Types
- A Function Block file (.xfm), which is only exported for Quantum, Premium, or M340 device types (not used with the generic Modbus Device option)

- A separate Tag Names file (.CSV), which lists tag names in a comma-separated value file format

Quantum processors with Ethernet ports can use the Function Block in the .xfm file only if the processor is using firmware version of 2.6 or later. But, if you use a NOE card for Ethernet connection between a Modicon PLC and the ProSoft gateway, the processor firmware version does not matter.

PLC Map Properties

The following general properties are available. Not all properties are used for all four Modbus device types:

Property	Description
Name	Name of the PLC, this is informational only.
IP	The IP address of the target device being accessed by the gateway's Modbus TCP/IP Client commands. Format is xxx.xxx.xxx.xxx
Netmask	This is the setting for the TCP/IP network hosting the ProSoft Gateway. The default value of 255.255.255.0 will work for many installations, or you can ask your network administrator for the correct setting.
Gateway	The gateway address is the address of the computer, server, or router that passes traffic between a workstation on the local subnet to devices on different subnets or remote networks.
PLC Read Start Register (%MW)	This is the starting address in the PLC to which the ProSoft gateway will write. (The gateway writes with Modbus Function Code 16.) Entering a value of 1 means the gateway will write to PLC starting address of 40001. The default value is 1
PLC Write Start Register (%MW)	This is the starting address in the PLC from which the ProSoft gateway will read. Entering a value of 1000 means the gateway will read from the PLC starting at address %MW1000 (41000). The default value is 1000
NOE Slot No (1-15)	**Note:** If you're using a Schneider Electric NOE Ethernet module in the rack, rather than the processor's built-in Ethernet port (available on certain processors), then check this checkbox. NOE Slot No (1-15): If using an NOE Ethernet module, enter the NOE's slot number in the rack here. This is informational only.
Minimum Command Delay	This is the minimum number of milliseconds between commands. Valid values range from 0 to 32767. The default value is 0. This parameter can be used to delay all commands sent to the Modbus TCP/IP Server (PLC) to avoid "flooding" commands on the network. This parameter does not affect retries of a command as they will be issued when failure is recognized.
Response Timeout	This is the time in milliseconds that the Modbus TCP/IP Client will wait before re-transmitting a command if no response is received from the addressed Server. Valid values range from 0 to 65535. The default value is 1000. The value to use depends upon the type of communication network used, and the expected response time of the slowest device on the network.

Retry Count	This parameter specifies the number of times a failed command will be retried before being skipped and sending the next command in the Command List. Valid values range from 0 to 10. The default value is 0.
Command Error Delay	This parameter specifies the number of 100 millisecond intervals to suspend execution of a command in the Command List after it fails. If this parameter is set to 0, there will be no delay. Valid values range from 0 to 300. The default value is 300.

Entering Modbus Parameters for different devices

To enter properties for a specific Modbus device:

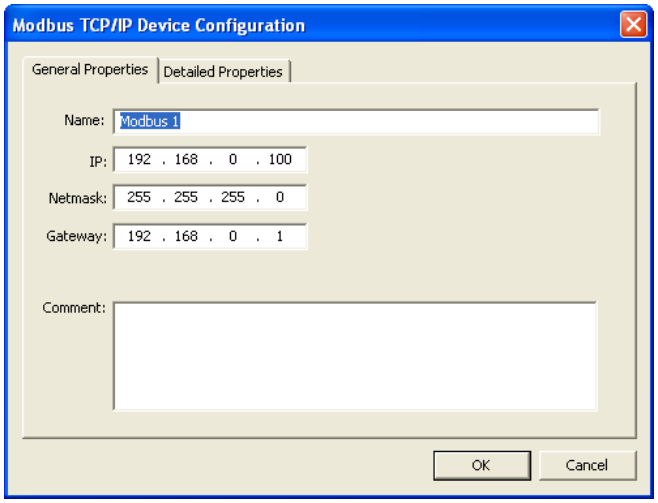
1. Once the device is showing in the Network View display section, right-click on the device icon and left-click **PROPERTIES** on the popup menu.

This will open the appropriate *Properties* window for the selected device. Any Modbus parameters that may be configured for that device will appear in this window.

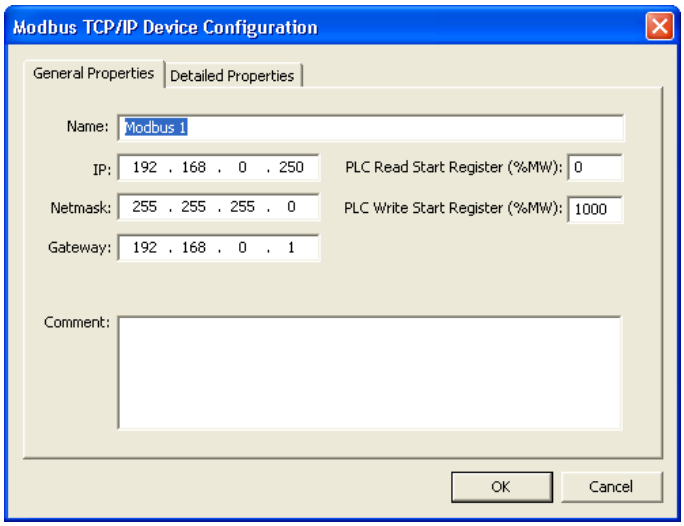
2. Enter desired values into the parameter entry boxes.
3. Click the **OK** button to save the values and close the Properties window.

The following graphics show examples of the different types of Properties boxes.

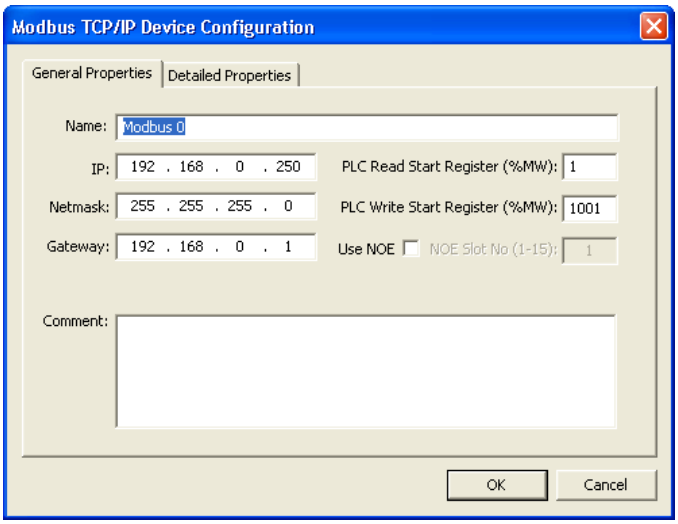
The Generic Modbus General Properties window:



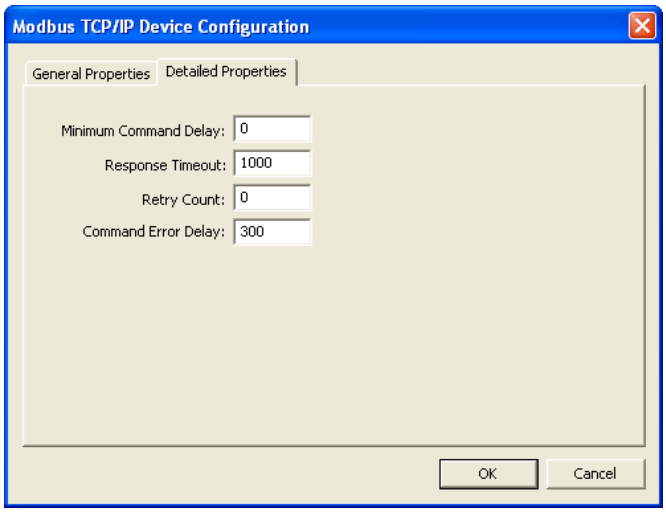
The Premium and the M340 General Properties tab:



The Quantum General Properties tab:



The *Detailed Properties* tab has the same configuration parameters available for all four devices.



3 Example Configurations

In This Chapter

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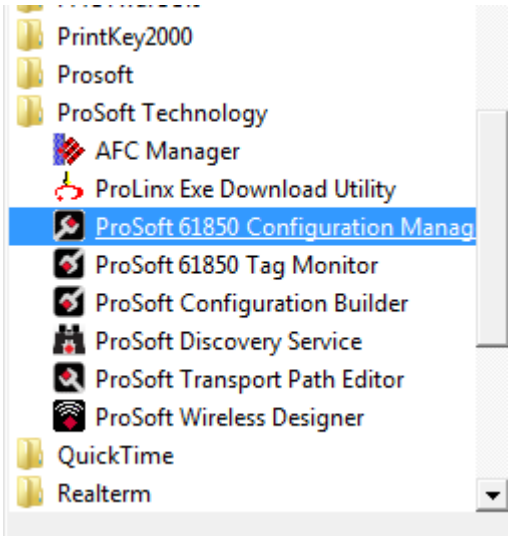
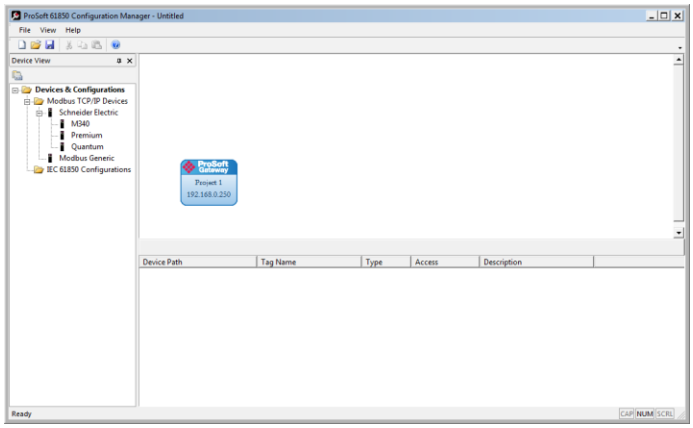
- Exporting Configuration 83
- Uploading the Configuration File 86
- Updating a CID File 87

3.1 Example: Configuring MMS Read Messages

To begin, start **PROSOFT 61850 CONFIGURATION MANAGER**.



If you have used other Windows configuration tools before, you will find the window layout familiar. ProSoft 61850 Configuration Manager's window consists of a Device View folder tree on the left, Network View pane in the upper-right, and Configuration Tags View pane in the lower-right. When ProSoft 61850 Configuration Manager is first started, the Device View shows default devices and configuration.

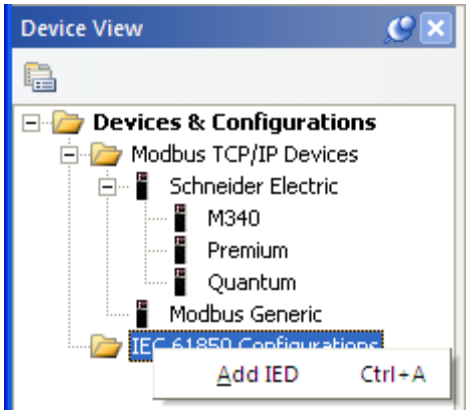


3.1.1 Importing Configured IED Files and Creating the IED Network

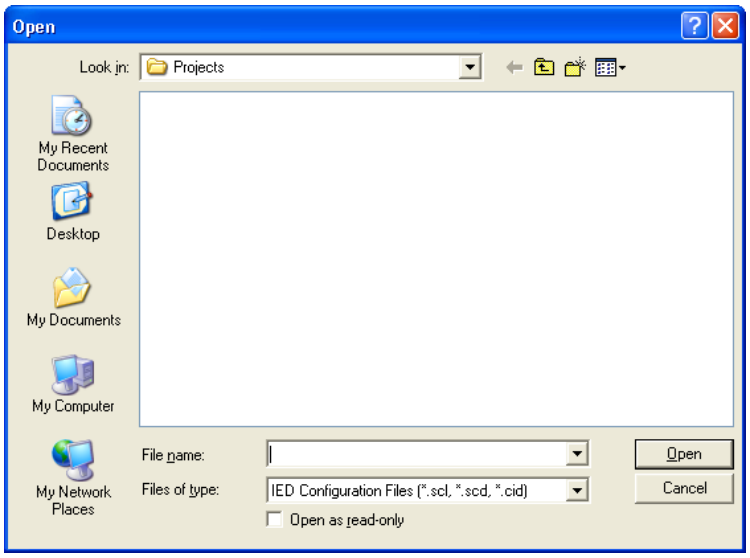
The first task is to import the configured IED files into the project. Every IED has a different identification number and should be set to a different IP address.

To Import Configured IED Files

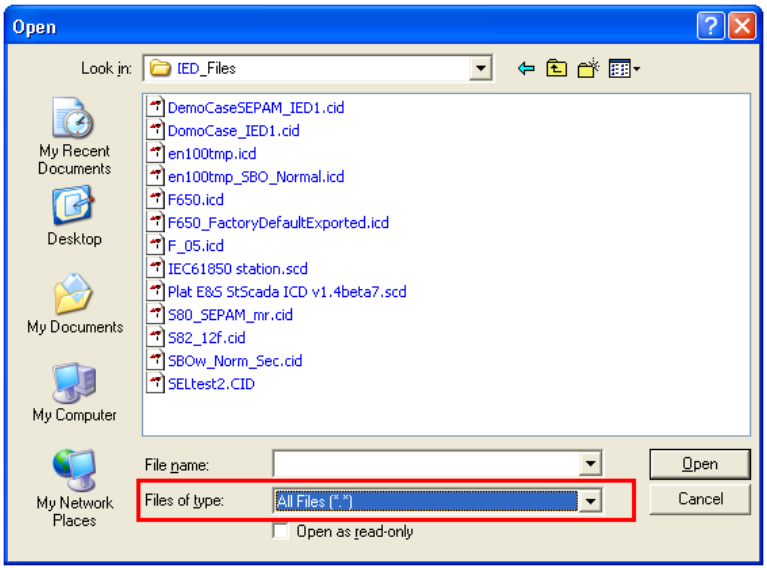
1 From the *Device View* section on the left side, position the mouse pointer over the *IEC 61850 Configuration* and click the right mouse button to open a shortcut menu. Choose the **ADD IED** option.



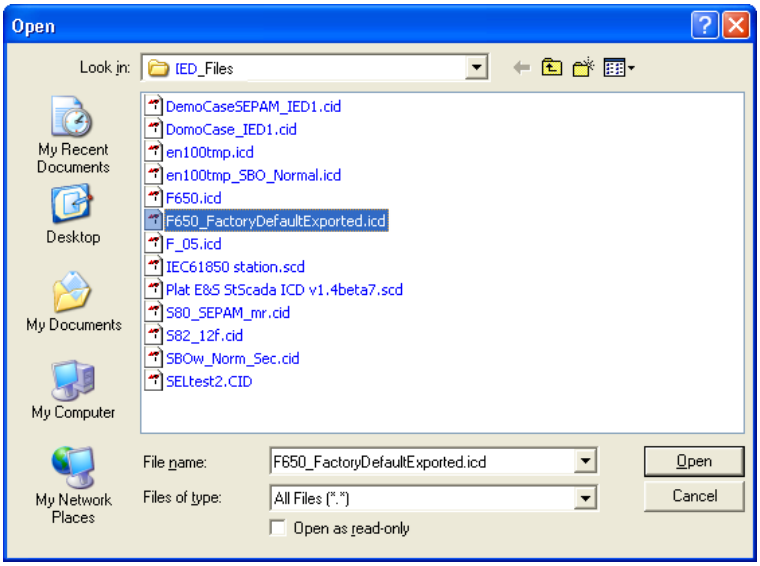
2 You will be prompted to open a SCL, SCD, or CID file. Browse to where the file is located.



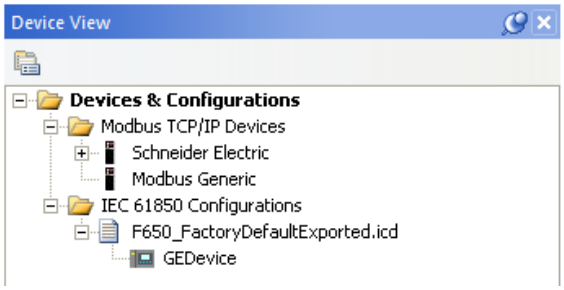
In this example, we will be browsing the created directory (IED_Files). Changing Files of type to **ALL FILES** will show the .ICD files along with the other file types.



1 Each IED will have its own ICD configuration file. For this example an ICD file from a GE Multilin relay is used.

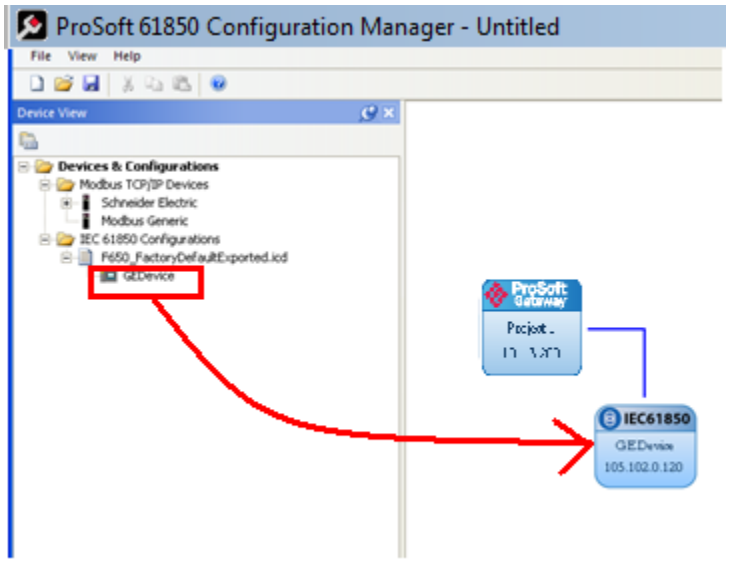


2 The imported ICD file is now listed in the *Device View* section. If an SCD file is imported then all of the contained devices are listed here.



To Create the IED Network Configuration

1 Highlight the device name by clicking on it, then drag and drop it below ProSoft Gateway Project 1 (Default Name).



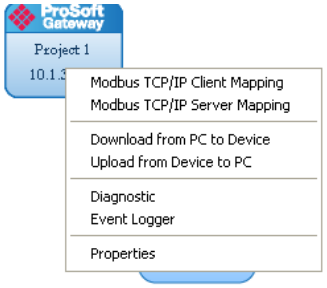
NOTE: Although no more IEDs will be added in this example, other IEDs can be added to the network in this same manner.

ProSoft 61850 Configuration Manager reads the Name and IP address of the IED, and puts them in the *IEC 61850* icon.

3.1.2 Configuring the ProSoft Gateway

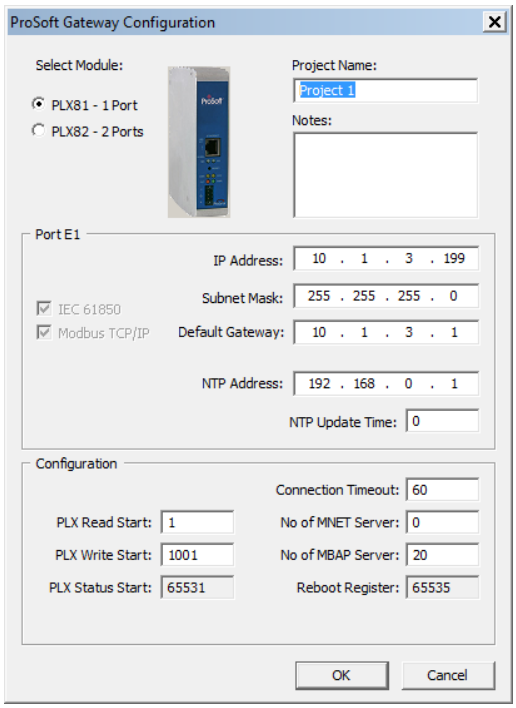
Before any MMS messages are mapped, the ProSoft Gateway must be configured so that the IP address will be in the same subnet as the GE Multilin relay device.

1 Right click on the *ProSoft Gateway* icon.



Choose **PROPERTIES** and another ProSoft Gateway Configuration window will open.

This configuration window is for the ProSoft Gateway device itself. On this window you can set the IP address, change the project name, set the SNTP server, and setup Modbus address mapping. The PLX Read Start and PLX Write Start are used to set the ProSoft gateway's beginning Modbus register addresses. This allows other Modbus Client devices to access the ProSoft gateway's internal memory database through the gateway's Modbus TCP/IP server.


ProSoft Gateway Configuration
Select Module:
PLX81 - 1 Port
PLX82 - 2 Ports
Project Name:
Project 1
Notes:
Port E1
IP Address: 10 . 1 . 3 . 199
Subnet Mask: 255 . 255 . 255 . 0
IEC 61850
Modbus TCP/IP
Default Gateway: 10 . 1 . 3 . 1
NTP Address: 192 . 168 . 0 . 1
NTP Update Time: 0
Configuration
Connection Timeout: 60
PLX Read Start: 1
No of MNET Server: 0
PLX Write Start: 1001
No of MBAP Server: 20
PLX Status Start: 65531
Reboot Register: 65535
OK
Cancel

3.1.3 Creating the Modbus Network Configuration

The gateway can operate as a Modbus TCP/IP client and / or server. In this example, it will operate as both, at the same time.

There four kinds of Modbus devices shown in the *Device View* section:

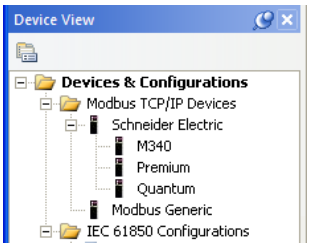
1 Schneider Electric M340 PAC devices
2 Schneider Electric Quantum PLC devices
3 Schneider Electric Premium PLC devices
4 Modbus Generic devices.

The ProSoft gateway offers tight integration with the Schneider Electric devices, when a Schneider Electric device is used.

When you map Data Attributes that need to be read from an IED and sent to a Schneider Electric device, the configuration software will automatically generate Modbus Function Code 16 commands to push that data to the Schneider Electric processor.

- Modbus Client write commands will be set by default to write only on data change. This means that the data will only be pushed from the ProSoft gateway to the PLC when new data has arrived from the IED. This keeps the network traffic efficient by sending data only when it needs to be sent.

These Modbus Client commands are already mapped to the PLC address which is already entered in the *ProSoft Gateway Configuration* window.

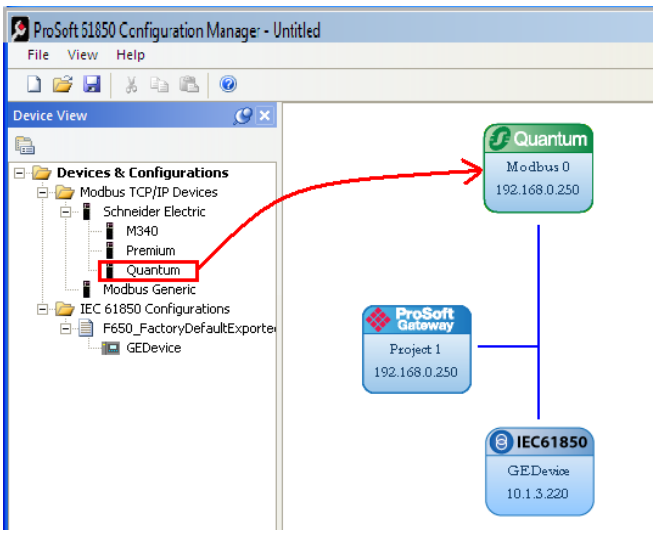


- The ProSoft gateway exports three files, two of which are used exclusivley for Schneider Electric Processors:
  a) A Variable File (.xsy), which contains Tag Names and Data Types
  b) A Function Block file (.xfm), which is currently exported for only the M340 and Quantum device types (export for Premium PLCs will be offered in a future ProSoft 61850 Configuration Manager release.)
  c) A Tag Name List file (.csv), which is a list of gateway internal tag names in a comma-separated -value format.

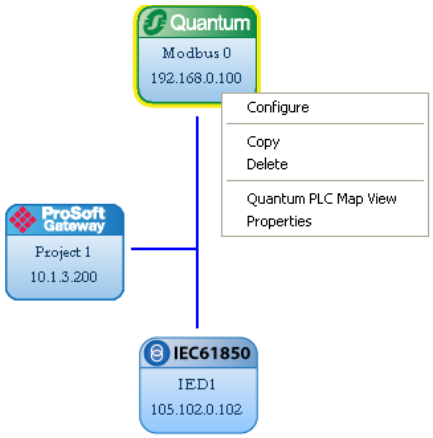
To Create the Modbus Network Configuration for Schneider Electric Devices

a In the *Device View* section, expand **SCHNEIDER ELECTRIC** to see **QUANTUM, PREMIUM, OR M340** device options.

Add the desired device to the network by clicking and dragging it from the Device View pane and dropping it into the whitespace above and to the right of the ProSoft Gateway icon in the Network View pane. ProSoft 61850 Configuration Manager will create a M340, Premium, or Quantum icon, as shown here.



a Right-click on the *Quantum, Premium, or M340* icon and choose **PROPERTIES** from the shortcut menu.

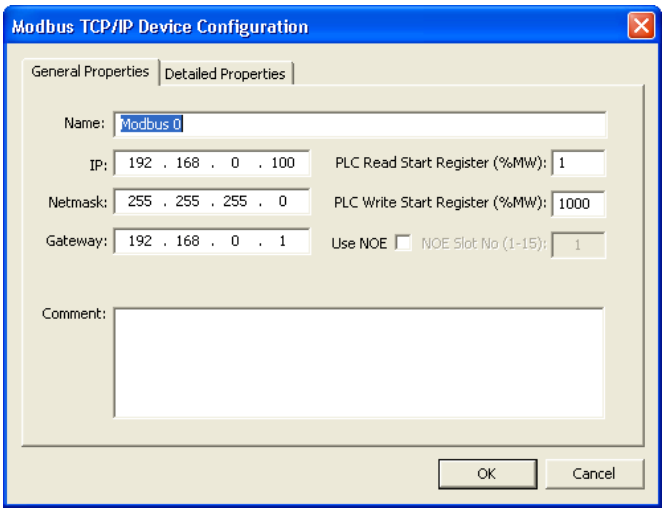


b Set the IP address of the PLC
c (Optional) Set the name of the device.
d For this example, leave the *PLC Read Start Register* and *PLC Write Start Register* at their default values.

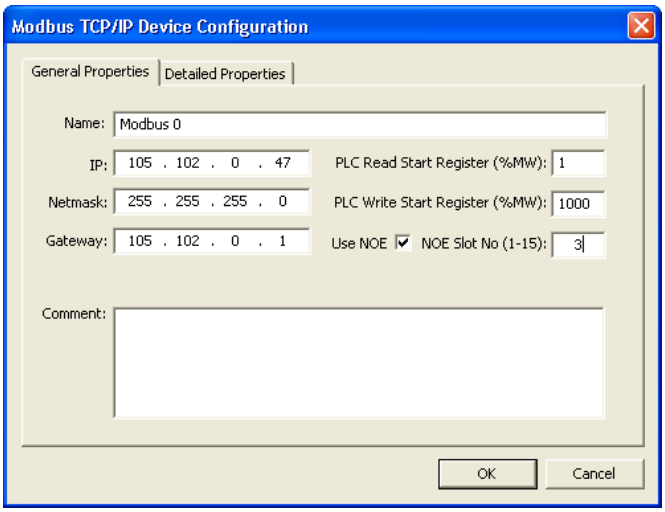
Leaving these two fields at their default settings of 1 (read) and 1000 (write) means:

- The Modbus Client will use Function Code 16 to send data to the PLC Holding Registers starting at address 40001 (400001 or % MW1, depending on device and programming software used).
- The Modbus Server will receive data to be mapped to IED Control tags to from PLC Holding Registers starting at address 41000 (401000 or %MW 1000).

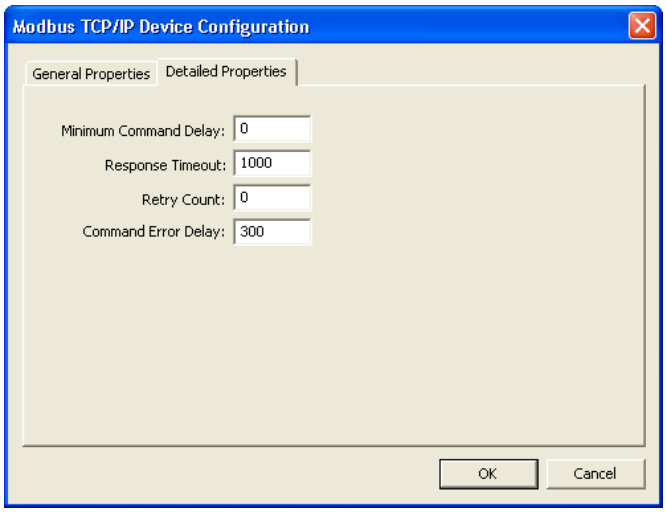
(After working through this example, if you wish to use the example in your own application, the *PLC Read Start Register* and *PLC Write Start Register* values can be set according to the PLC program settings.)



a If you're using an NOE Ethernet communication card in the Quantum chassis, instead of the built-in Ethernet port (available on certain processors), then enter the NOE slot number.

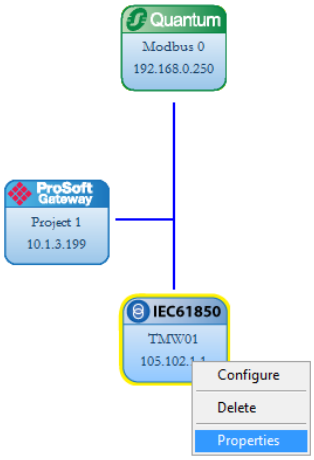


b Click on the **DETAILED PROPERTIES** tab to configure additional Modbus Client parameters. Configure the parameters as required.

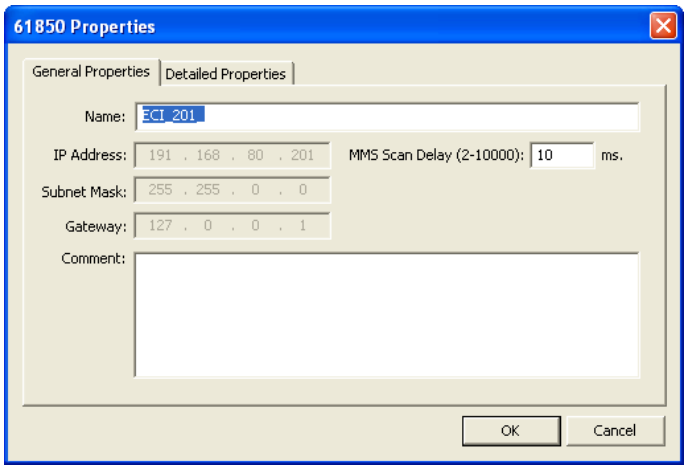


3.1.4 Creating the IEC-61850 Network Client Configuration

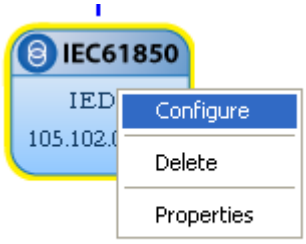
a Right-click on the *IEC 61850* icon and choose **PROPERTIES**.



b The IP address should already be filled in, because ProSoft 61850 Configuration Manager reads this from the CID file.
c Leave the MMS Scan Delay at the 10 millisecond default setting.
d (Optional) Set the name of the device.

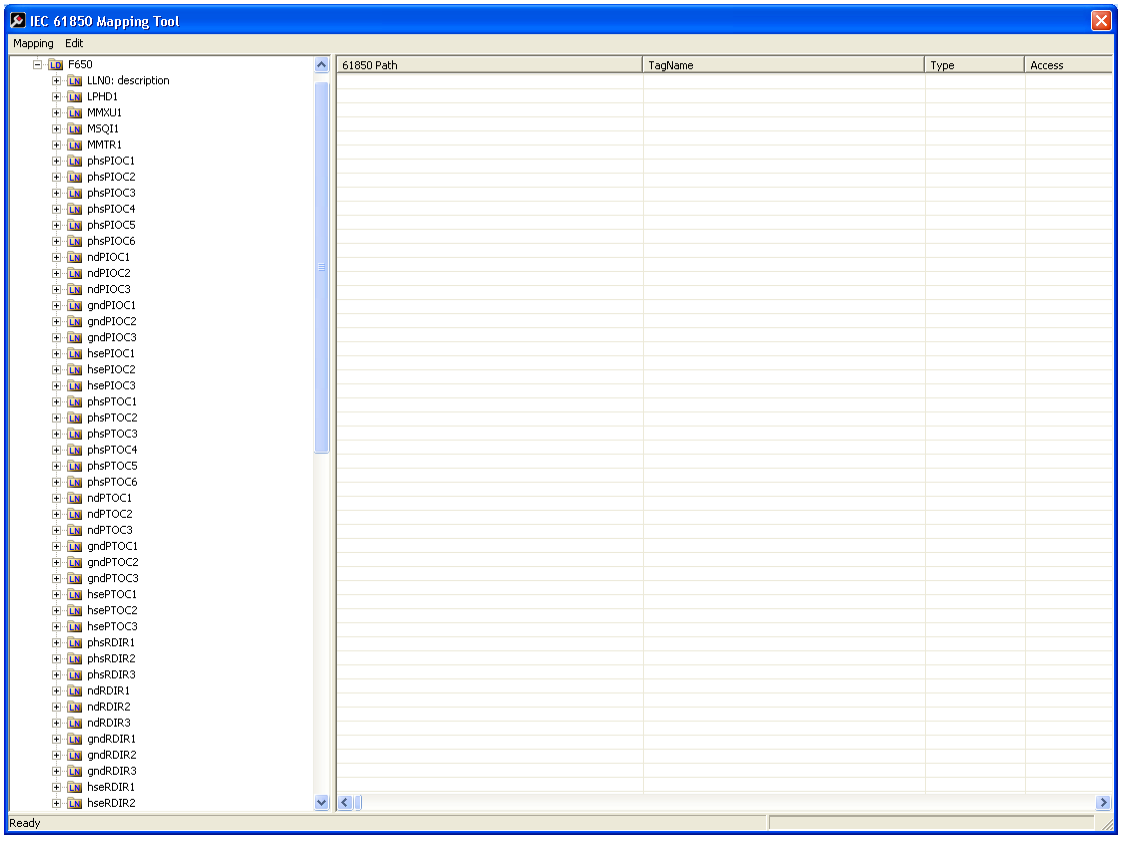


e The data that will be read from the IED and sent to the PLC needs to be mapped. This will be a MMS (IEC-61850-8-1) data movement. In this example, one Data Attribute will be moved. Double-click or right-click and choose **CONFIGURE** on *IEC 61850* icon, an *IEC 61850 Mapping Tool* window will appear.



f In the tree view on the left, expand (click) the **+** sign. This shows the Logical Devices (notice the little *LD* in the icon) in the IED.

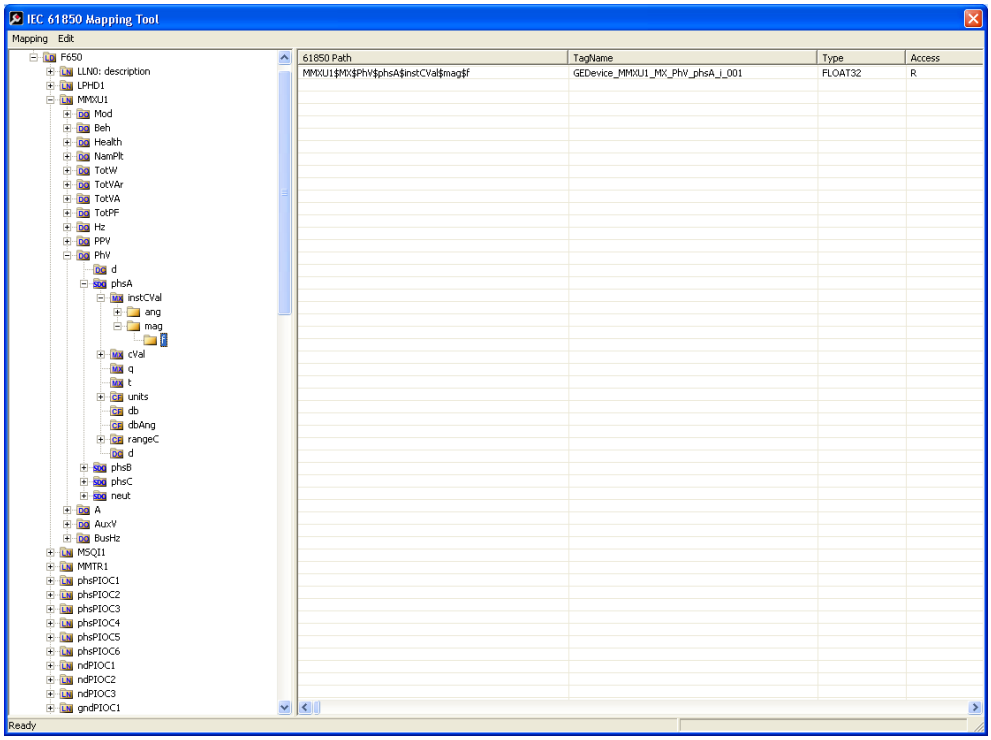
g Expand (click) the **+** sign on one of the Logical Devices in the IED to see the Logical Nodes (notice the little *LN* in the icon) within it.



h Choose the MMXU1 data to read the voltage on phase 1.

i Locate the *Data Attribute* to read from the IED.

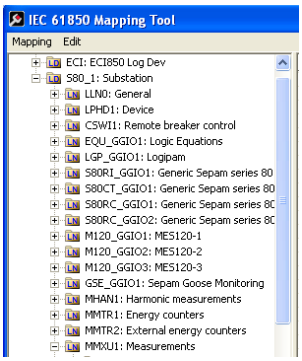
j Drag it to the right-hand side of the screen and drop it.



On the right-hand side of the screen, all of the columns of data will automatically be filled in:

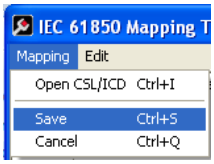
- **61850 PATH**
- **TAG NAME** (this is generally quite long, and is close to the actual data attribute name. Most Modbus devices cannot handle a tag name this long, ProSoft 61850 Configuration Manager automatically shortens the name, ending with *_001*. (you have the option to click on this field and rename the tag name if desired).
- **TYPE – DATA TYPE** for the *Data Attribute*
- **ACCESS** – ProSoft 61850 Configuration Manager can determine if the *Data Attribute* is read or write from its functional constraints. The letter *R* is shown to indicate readable data which the gateway will read from the IED.

- Some IED manufacturers provide descriptive information in their CID files. ProSoft 61850 Configuration Manager will display that data here, after the *Logical Node* name. For example, S80_1: Substation.

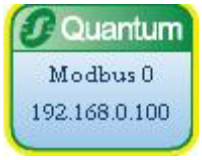


a Choose **MAPPING / SAVE**.

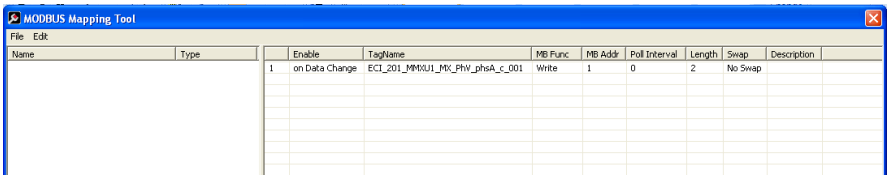
b If we download the configuration to the gateway at this point, the IEC 61850 Client will start reading the value of this *Data Attribute* from the IED.



c Double-click or right-click and choose **CONFIGURE** on the *Quantum, Premium, or M340* icon.

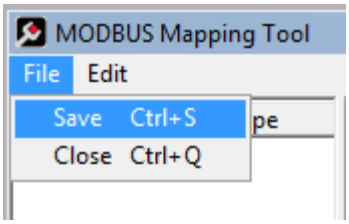


This will open the *Modbus Mapping Tool* window.



On the Modbus Mapping Tool window, the Data Attribute is automatically shown on the right-hand side of the window, which is the gateway's Modbus Client Command List. This gateway will use the commands in this list to send the IED data to the Schneider Electric PLC/PAC Modbus server.

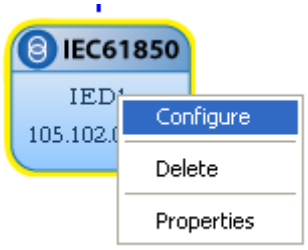
d Choose **FILE / SAVE**.



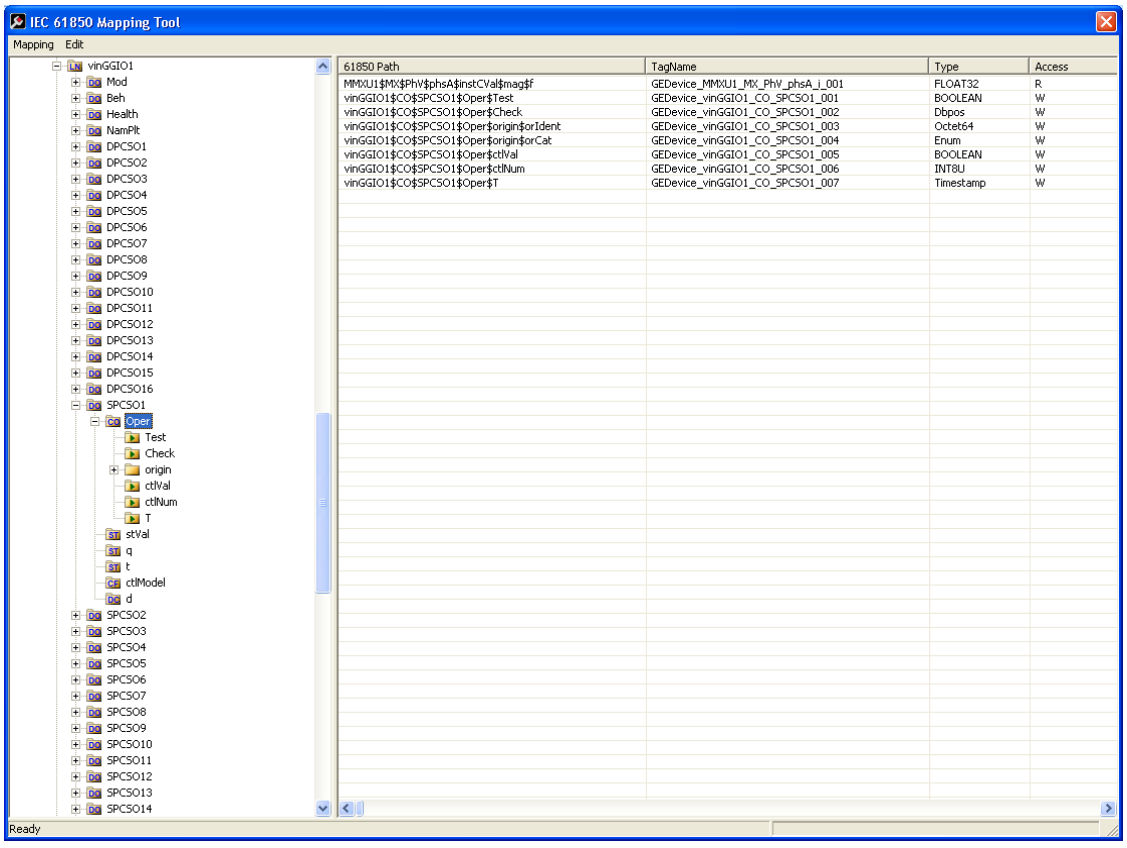
3.2 Example: Configuring MMS Write Messages

This example continues from the last section, and assumes the MMS Read example was followed.

a Double-click or right-click on the *IEC 61850* icon and choose **CONFIGURE**. The *IEC 61850 Mapping Tool* window will appear.



b Next, select writable data. In this example SPCSO1is chosen.

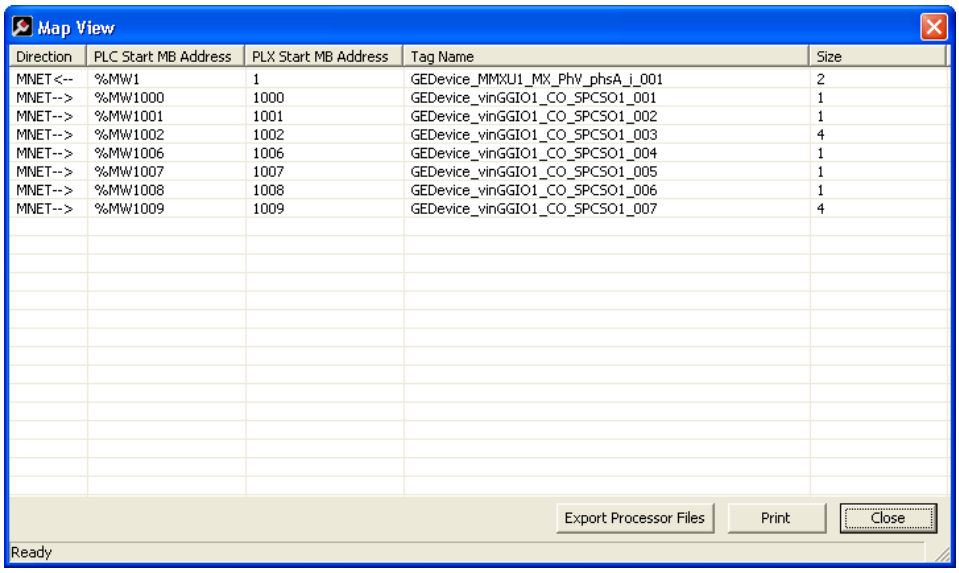


The small icons provide information. *DO* is for *Data Object*. Within the *DO*, there may be multiple levels of data. At the *Data Attribute* level, the functional constraint of the *Data Attribute* is shown in the icon, for example: *CO* for *Control*.
In this example writable data, *Oper* structure has been chosen.

c Drag and drop *Oper* to the right-hand side of the window.

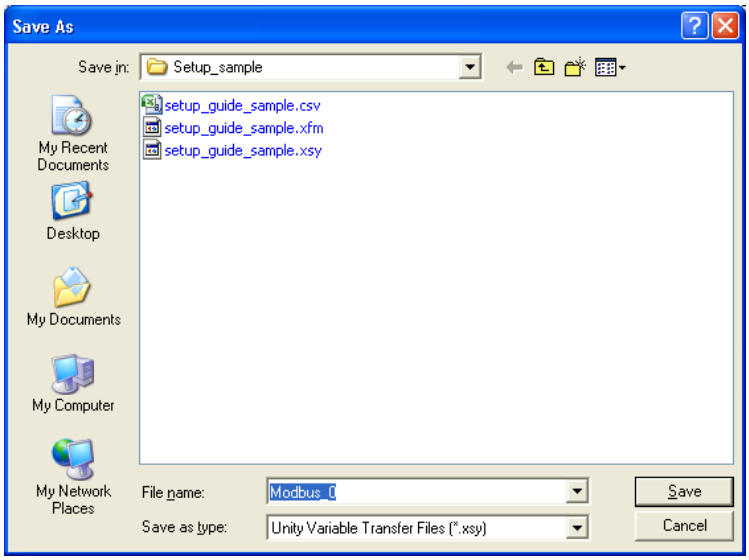
d Review the Modbus device, and to check *Map View* window. Right click on the *Quantum, Premium, or M340* icon and choose **PLC MAP VIEW.**

The *Map View* window will appear.



e Choose **EXPORT PROCESSOR FILES**.

ProSoft 61850 Configuration Manager will export .xfm, .xsy and .csv files. XFM and XSY files will be used by UnityPro.



f **SAVE** the Project.

See Downloading the Configuration File, and then see Configuring the Quantum Processor with Unity Pro section. (page 89)

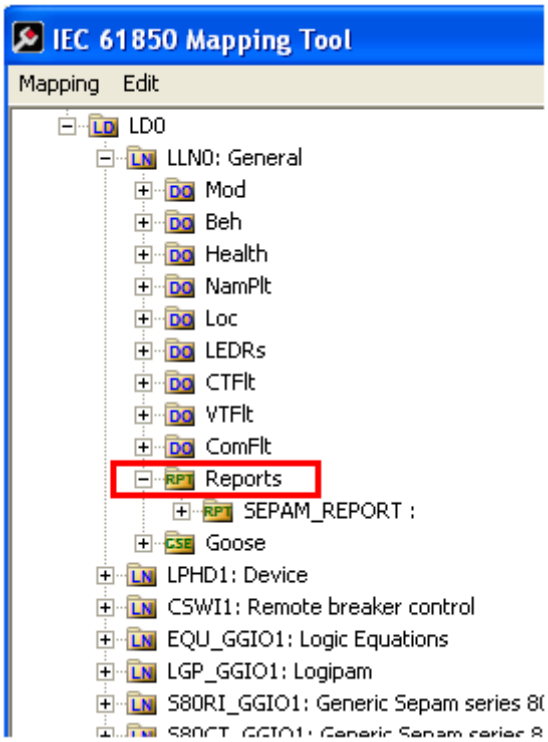
3.3 Example: Configuring Reports

This example assumes the MMS Read and Write examples have been setup as previously shown.

To Map a Report

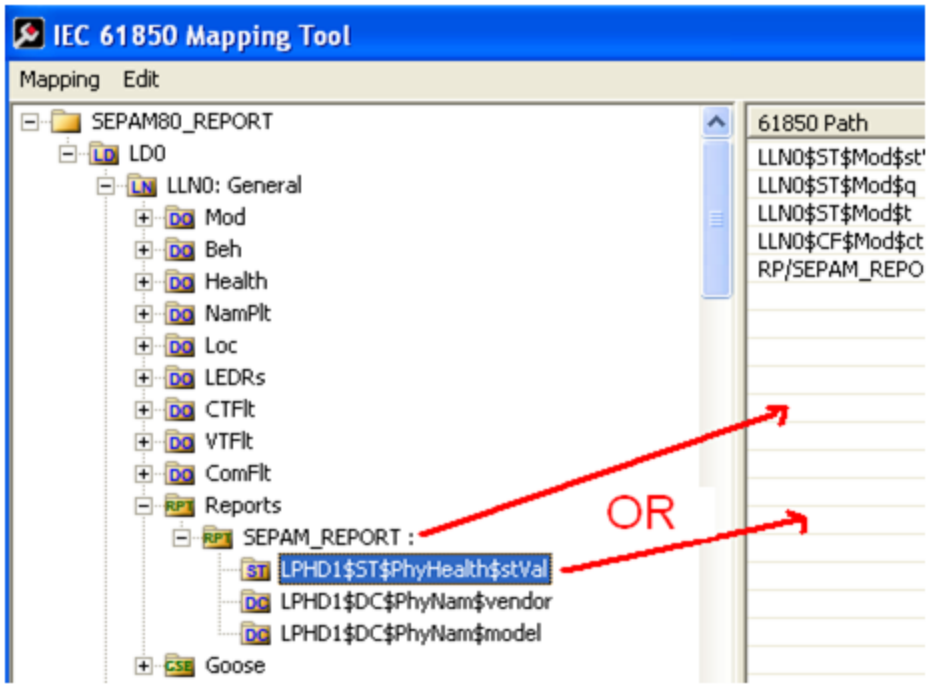
a Double-click or right mouse click on the *IEC 61850* icon and choose **CONFIGURE**, to display the *IEC 61850 Mapping Tool* window.

b Expand the *Device View* section on the left, until you find the **REPORTS** section.



Reports are based upon a DATA-SET, containing a specific collection of *Data Atributes.*

To configure the ProSoft gateway to enable an IED's Buffered Report Control Blocks (BRCBs) or Unbuffered Report Control Blocks (URCBs), drag and drop the yellow folder showing the report name to the right side of the window.

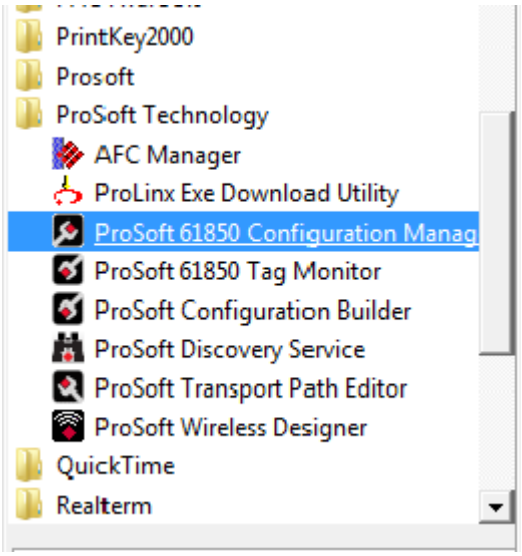


The ProSoft gateway is flexible with the reports. You can choose to map the whole report DATA-SET, by dragging and dropping the report name (for example SEPAM_REPORT). Or you can choose individual *Data Attributes* within the DATA-SET, and only drag and drop those.
When you drag and drop the Report DATA-SET or *Data Attributes*, the right-hand side of the window automatically populates with one row for each *Data Attribute* in that DATA-SET. Be sure that the DATA-SET on your IED contains all *Data Attributes* and not Data Objects.

a Choose **MAPPING / SAVE.**
b On the *Quantum, Premium, or M340* icon, choose **PLC MAP VIEW.**
c Click on the **EXPORT PROCESSOR FILES** button.
d Go into Unity Pro and import the files.

3.4 Example: Configuring GOOSE Messaging

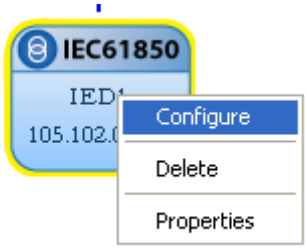
To begin, start **PROSOFT 61850 CONFIGURATION MANAGER**

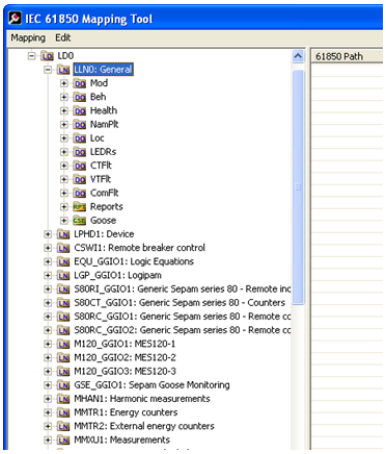


This example assumes that the MMS Read and Write examples have been setup as previously shown.

To Map the GOOSE message

Double-click or right-click on the *IEC 61850* icon and choose **CONFIGURE** to display the *IEC 61850 Mapping Too*l.

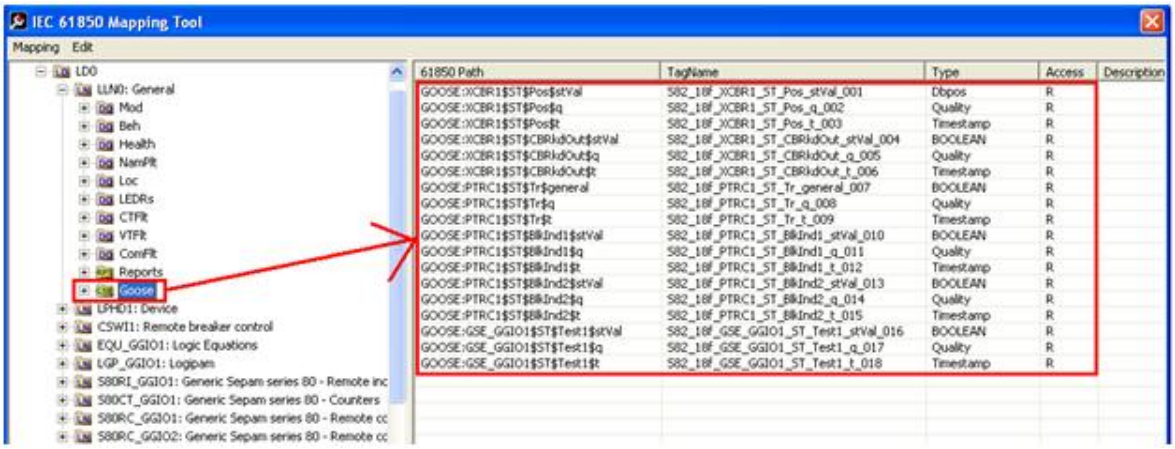




a Expand the *Device View* section on the left.

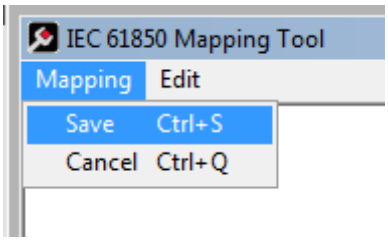
The GOOSE items will always show in logical node LLN0. GOOSE messages are based upon a specific

b DATA-SET. To configure the ProSoft gateway to subscribe to the IED's GOOSE message, drag and drop the yellow folder showing the GOOSE name to the right side of the window.



When you drag and drop the GOOSE DATA-SET, the right-hand side of the window will automatically populate with one row for each *Data Attribute* in that DATA-SET.

c Choose **MAPPING / SAVE**.



d On the *Quantum, Premium, or M340* icon, choose *PLC Map View*, and left-click the **EXPORT PROCESSOR FILES** button.

e Go into Unity Pro and import the files.

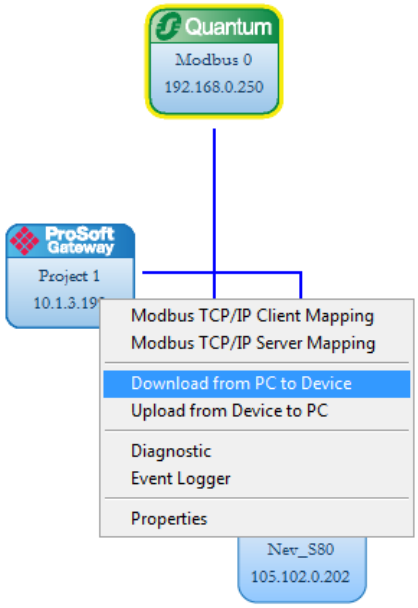
f **SAVE** the Project

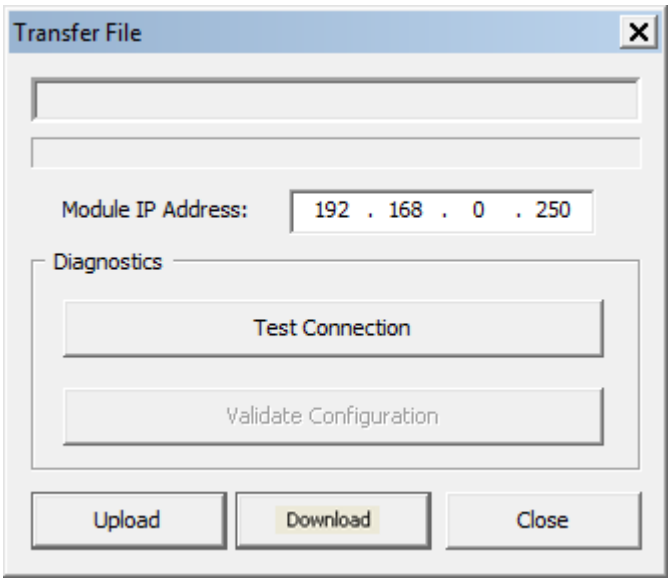
3.5 Downloading the Configuration File

After the ProSoft Gateway properties have been setup, the IEC-61850 Client-side of the gateway has been configured, and the Modbus-side of the gateway has been configured, the configuration will need to be downloaded to the physical ProSoft gateway. After the download has been performed, the gateway will reboot and run based upon the new configuration file.

To download the current configuration to the gateway

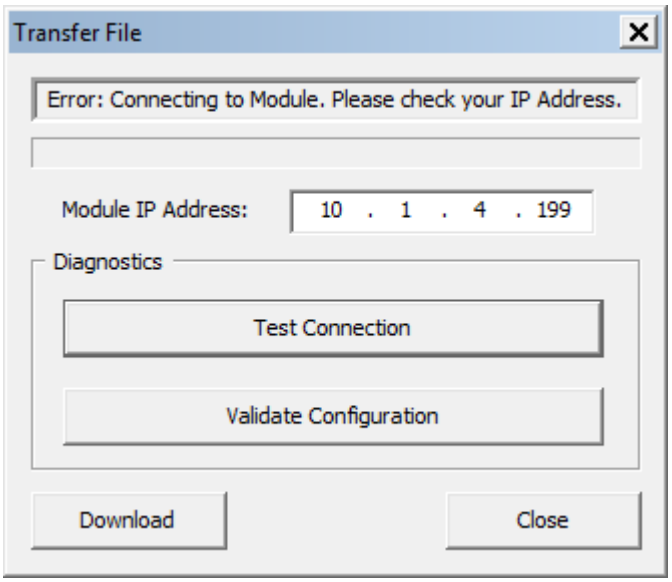
a Right-click on the *ProSoft Gateway icon*, and choose **DOWNLOAD FROM PC TO DEVICE**.



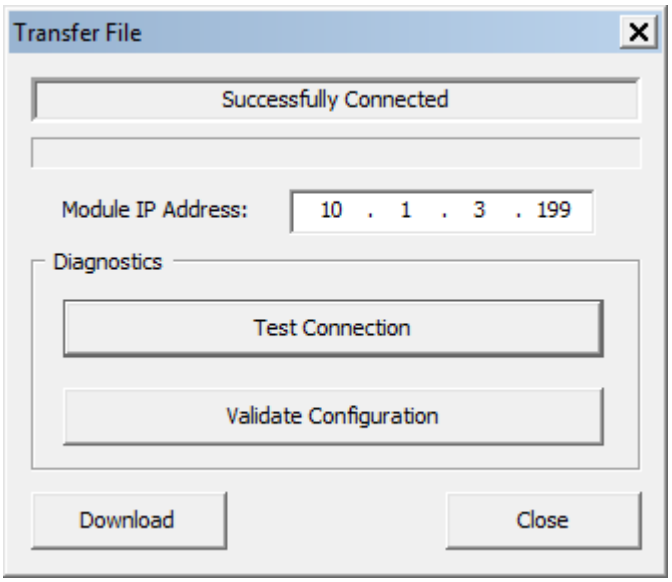


b Choose the **TEST CONNECTION** button before starting the download.

If the gateway's IP does not match what was entered in ProSoft 61850 Configuration Manager, it will show an error, like the one in this window.



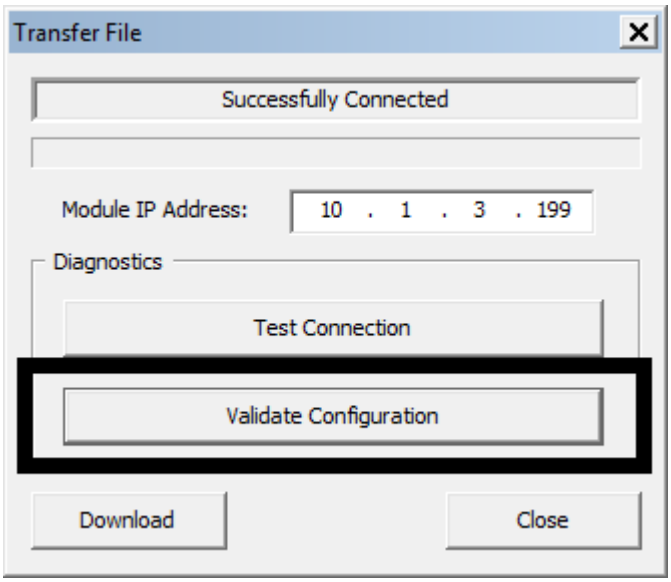
If the gateway's IP address matches what was entered in ProSoft 61850 Configuration Manager, the window will show a Successfully Connected message.



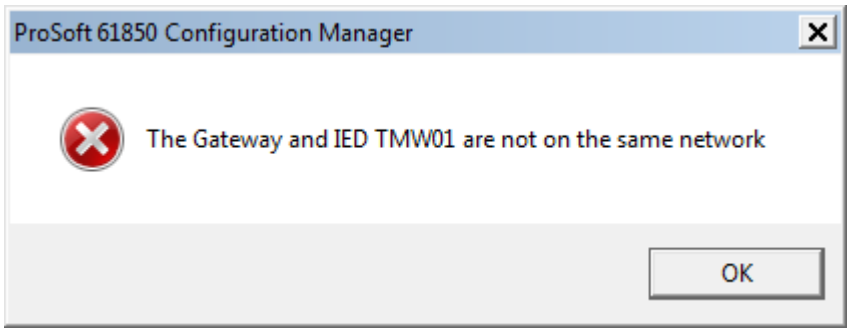
a Now click **DOWNLOAD**
b **SAVE** the project.

3.5.1 Validate Configuration Button

After the download is successfully completed successful, the validity of the configuration will need to be checked by verifying communication from the IED to the PLC and, possibly, from the PLC to the IED. The validation button is used to validate that the IED's are on the same network as the IEC 61850.



If the IED is not on the same network as the IEC 61850 then the following error message will appear and prevent validation.

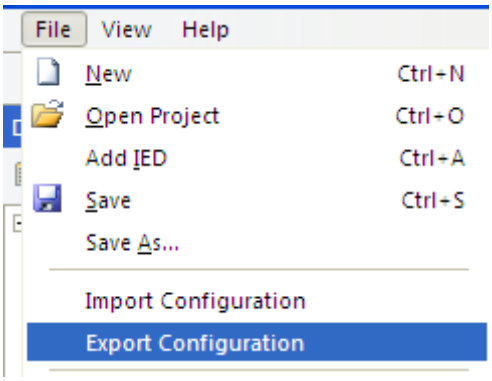


3.6 Exporting Configuration

In order to bring the configuration to another PC or save it in another location, the configuration will need to be exported. Also, if you need assistance from ProSoft Technology's Technical Support Team, they will ask for your configuration file so they can examine the details of your configuration.

To export your configuration

a Choose **FILE / EXPORT CONFIGURATION**. You will be prompted for the location for which to save your .cfg file.

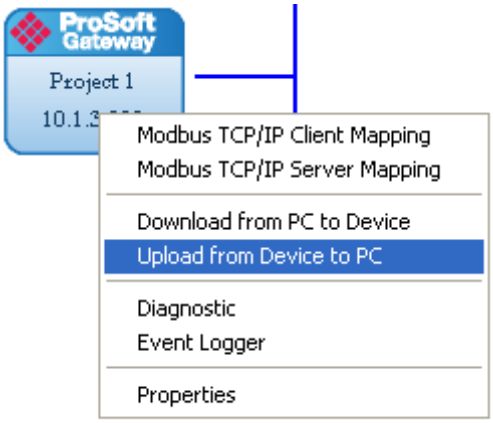


NOTE: Once you download the configuration file to the module, you can also retrieve it using the **UPLOAD FROM DEVICE TO PC**. That process uploads the entire project. After it has been uploaded, you can choose **FILE / EXPORT** to save the file to your PC.

3.7 Uploading the Configuration File

This feature can be used to obtain the configuration from the gateway that its currently using. When this is done, it will replace whatever configuration being used in ProSoft 61850 Configuration Manager with the one on the gateway. Not only will it retrieve the configuration, but also all the CID, ICD, and/or SCD files used in creating that configuration. This can be used for maintenance purposes.

On the *ProSoft Gateway icon*, right-mouse-click and choose **UPLOAD FROM DEVICE TO PC**.

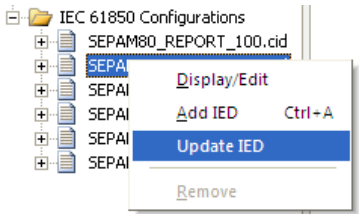


3.8 Updating a CID File

Changes may need to be made to the CID, ICD, or SCD files after the ProSoft gateway configuration has been setup.

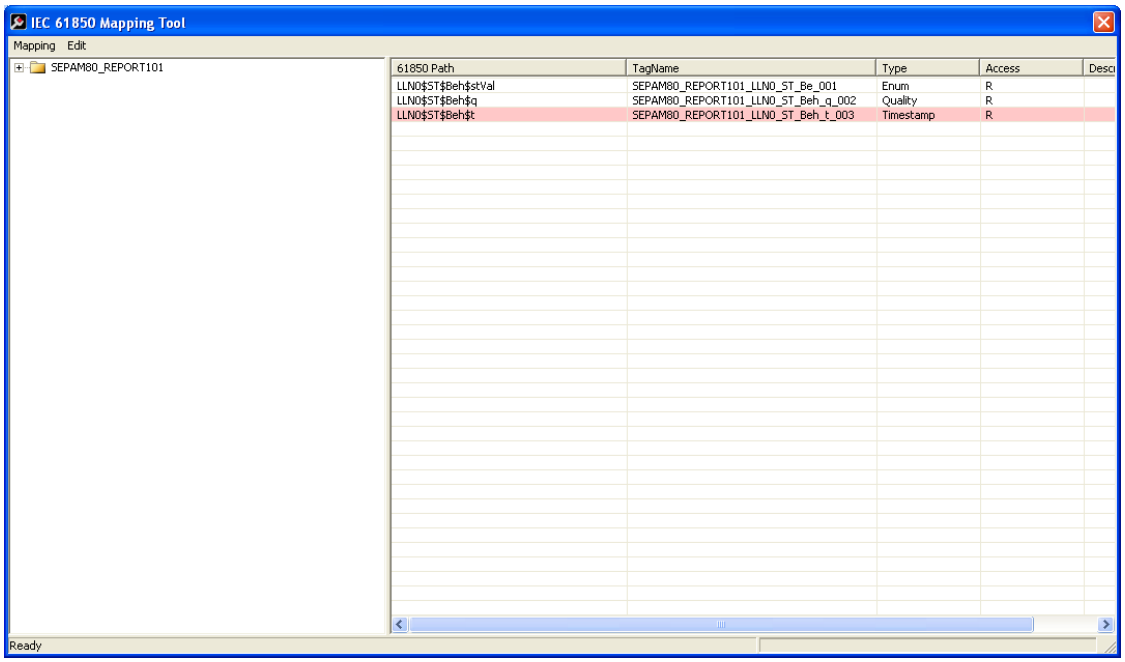
Perhaps on your IED you have modified a DATA-SET that's used by the ProSoft gateway, or added or removed some *Data Attributes*. When you make changes like this, its easy to update ProSoft 61850 Configuration Manager with this information.

Click on the **CID, SCD, OR ICD** filename in the *Device View* section of ProSoft 61850 Configuration Manager. Choose **UPDATE IED**.

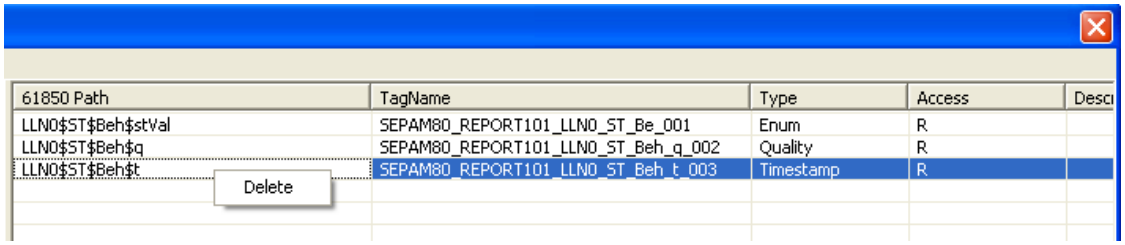


It will prompt you to browse for the new file. Oftentimes you'll use the exact same filename as you used when you imported the file into ProSoft 61850 Configuration Manager the first time.

When you double-click on the **IEC-61850** icon representing that IED, the previously configured tag names show on the *IEC 61850 Mapping Tool* window. If any of the previously configured *Data Attributes* for that IED are now missing from the new *CID, SCD, or ICD* file that you just imported, then those tag names will display as a red row on the *IEC 61850 Mapping Tool* window. This lets you know that they're now missing.



Make sure you delete them from the right-hand side of this window.



Then be sure to download the updated configuration to the ProSoft gateway, and export the files for Unity Pro.

4 Configuring the Quantum Processor with Unity Pro

In This Chapter

- Configuring the Quantum Hardware 90
- Importing the Quantum Functional Module (.XFM File) 93
- Importing the Quantum Variable File (.XSY File) 95
- Completing the Quantum Configuration 99
- Completing the Quantum Configuration 100

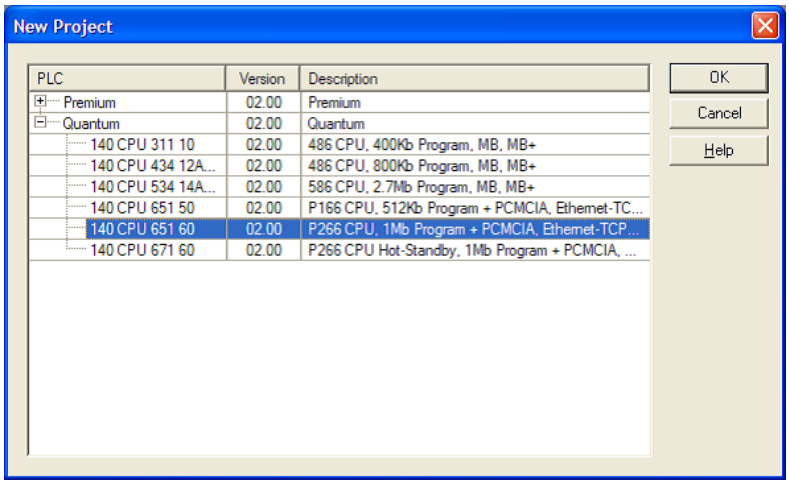
4.1 Configuring the Quantum Hardware

4.1.1 Picking the CPU Type

a The first step is to open Unity Pro and create a new project. In the *New Project* dialog box, choose the **CPU TYPE**.

In the following illustration, the CPU is 140 CPU 651 60. Choose the processor type that matches your own hardware configuration.

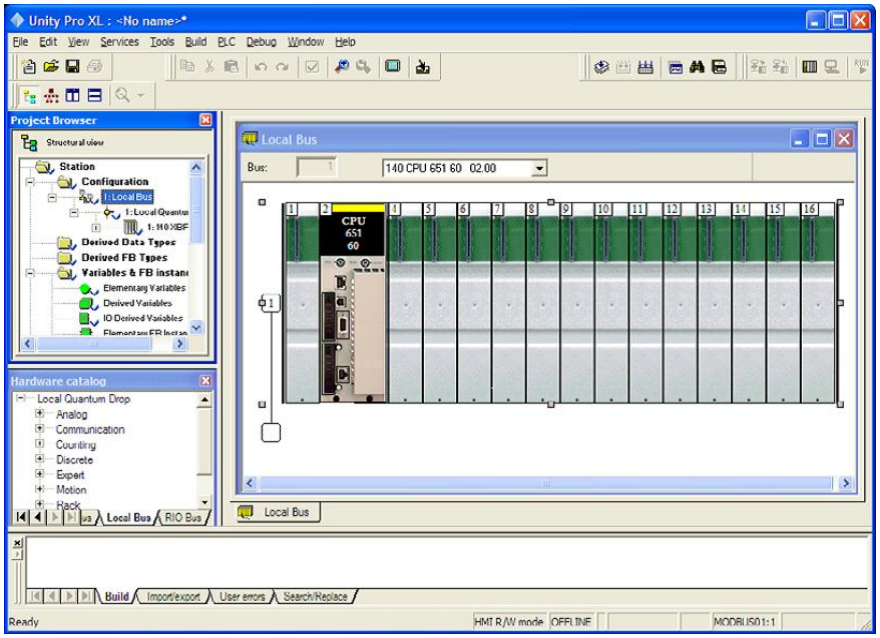
b Click **OK** to continue.



4.1.2 Adding a Power Supply

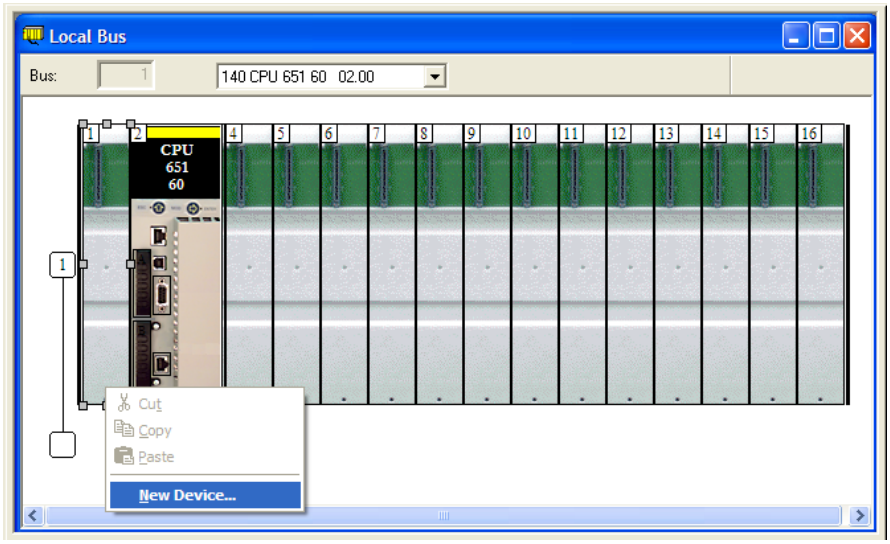
a In the *Project Browser*, expand the **CONFIGURATION** folder, and then double-click the **1:LOCALBUS** icon.

This action opens a graphical window showing the arrangement of devices in your Quantum rack.

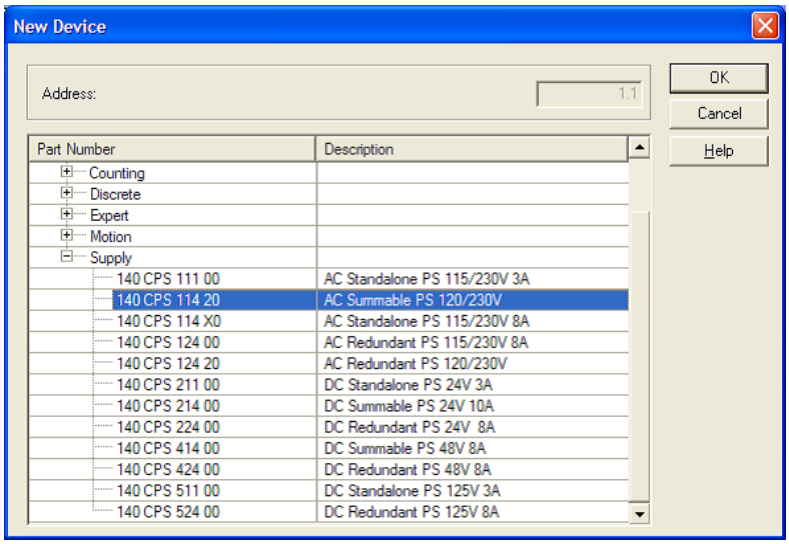


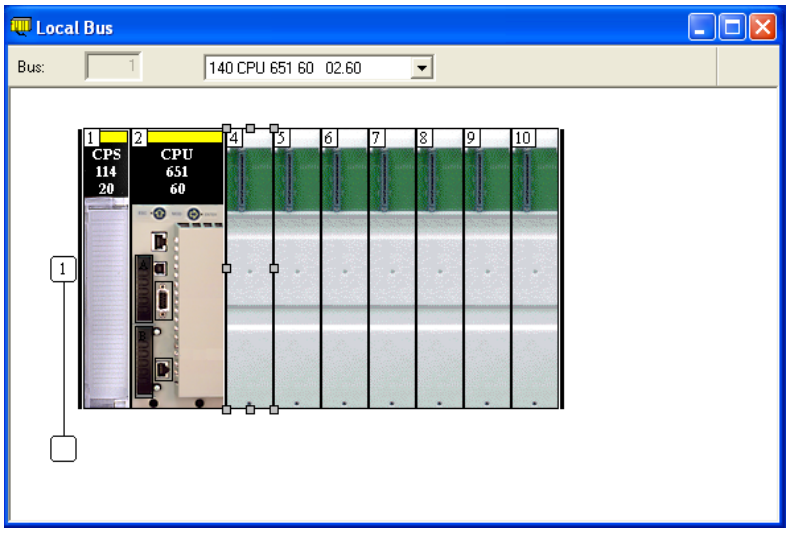
b Select the rack position for the power supply, and then click the right mouse button to open a shortcut menu.

c On the shortcut menu, choose **NEW DEVICE**.



d Expand the **SUPPLY** folder, and then select the power supply from the list.



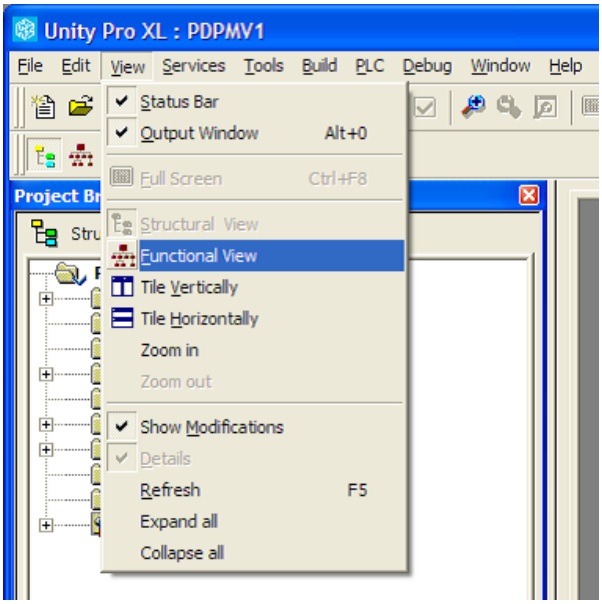


4.2 Importing the Quantum Functional Module (.XFM File)

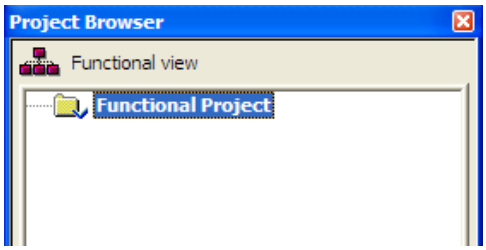
To simplify the task of programming the processor when communicating with the gateway, ProSoft 61850 Configuration Manager creates a Unity Pro Functional Module file (XFM).

Note: The Functional Module is intended only for new installations of the gateway. If an existing installation is present, the following procedure will overwrite all settings, and may cause loss of functionality. DO NOT overwrite a working application until the rest of the topics in this manual have been thoroughly reviewed.

a Open the **VIEW** menu, and then choose **FUNCTIONAL VIEW**.

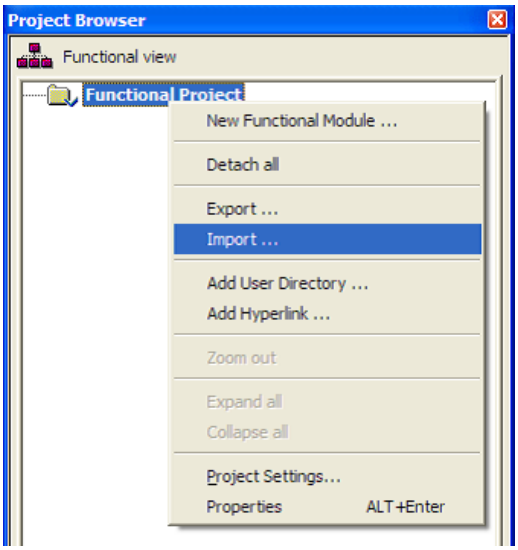


This action populates the *Project Browser* with a **FUNCTIONAL PROJECT** icon.

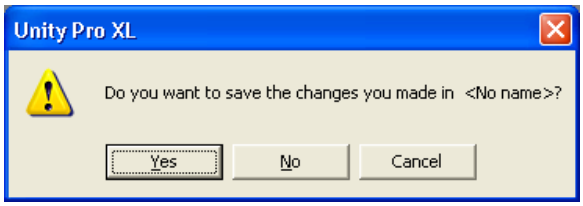


b Select **FUNCTIONAL PROJECT**, and then click the right mouse button to open a shortcut menu.

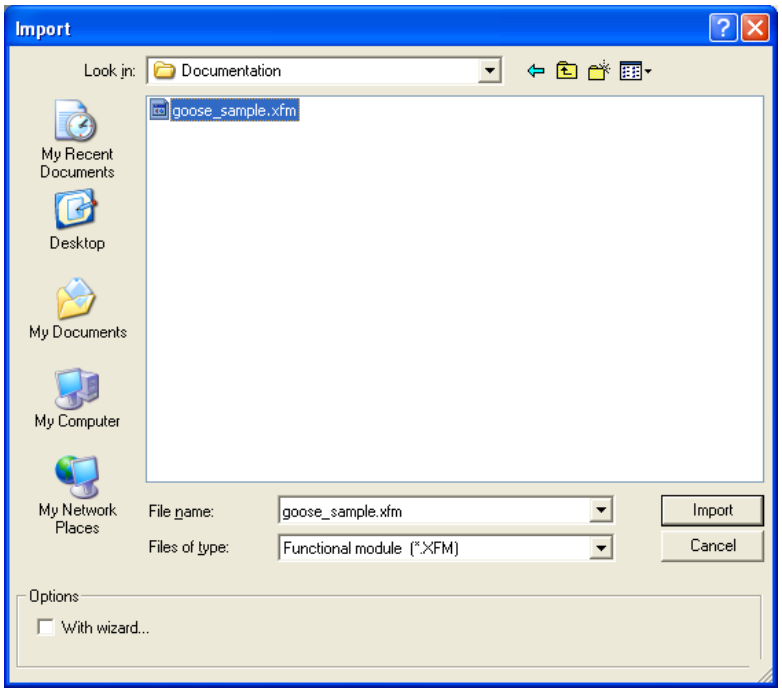
c On the shortcut menu, choose **IMPORT**.



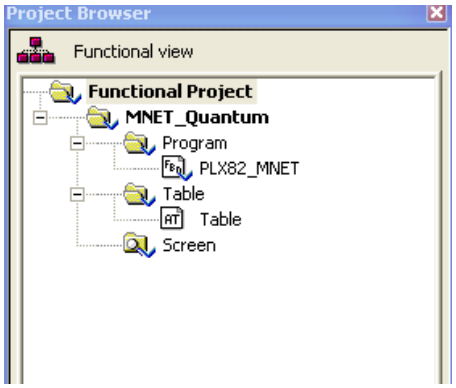
d If asked to save. Choose **NO** at this time.



e In the *Import* dialog box, choose **FUNCTIONAL MODULE** (*.XFM) in the Files of Type dropdown list, and then select the XFM file to import. Choose the XFM file that was created using ProSoft 61850 Configuration Manager.



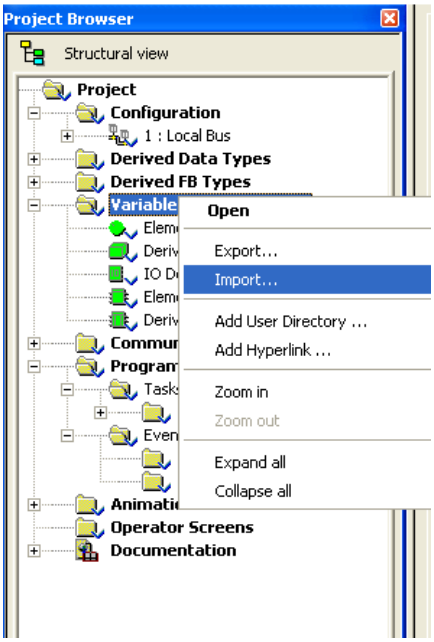
f Click **IMPORT** to import the file. The Project Browser is now populated with the Functional Module.



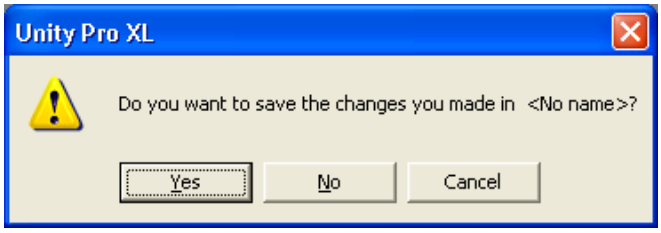
4.3 Importing the Quantum Variable File (.XSY File)

a Open the **VIEW** menu and choose **STRUCTURAL VIEW**.

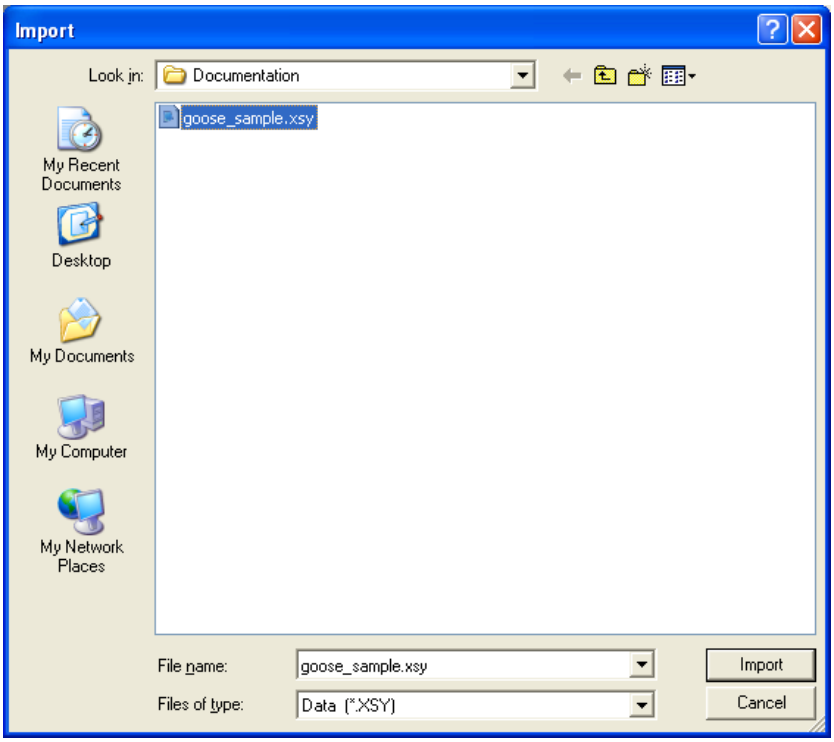
b Highlight *Variable and FB instances*, right-click, and choose **IMPORT** from the shortcut menu.



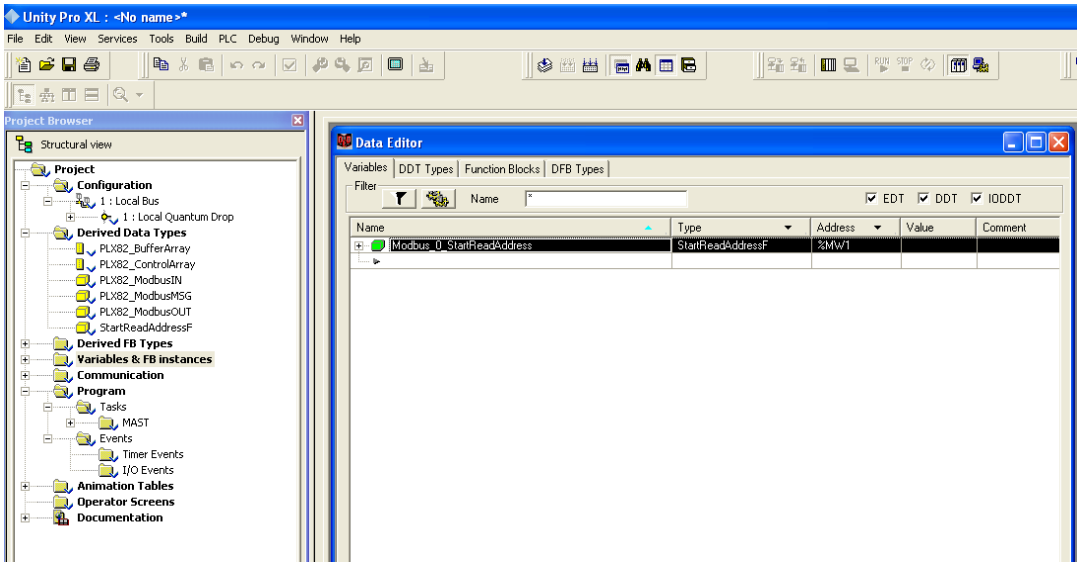
c If asked to save. Choose **NO** at this time.



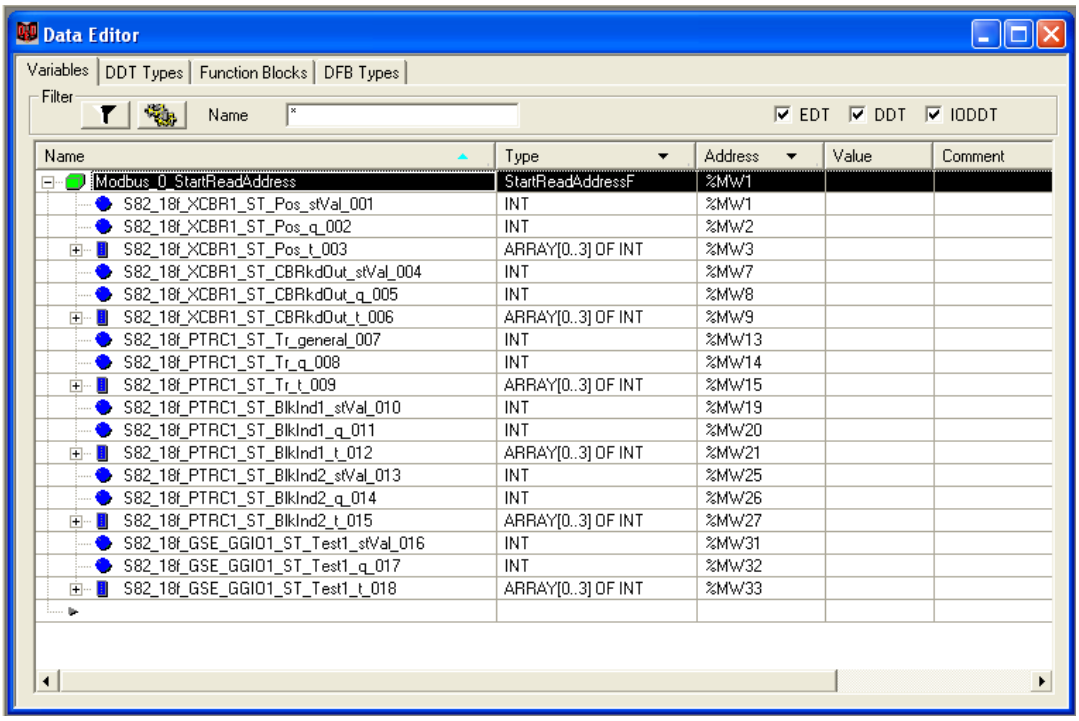
d In the *Files of Type* dropdown list, choose **DATA EXCHANGE FILE** (*.XSY). Choose the XSY file you created from ProSoft 61850 Configuration Manager. Click the **IMPORT** button.



e In the *Project Browser*, double-click on **VARIABLES AND INSTANCES**.

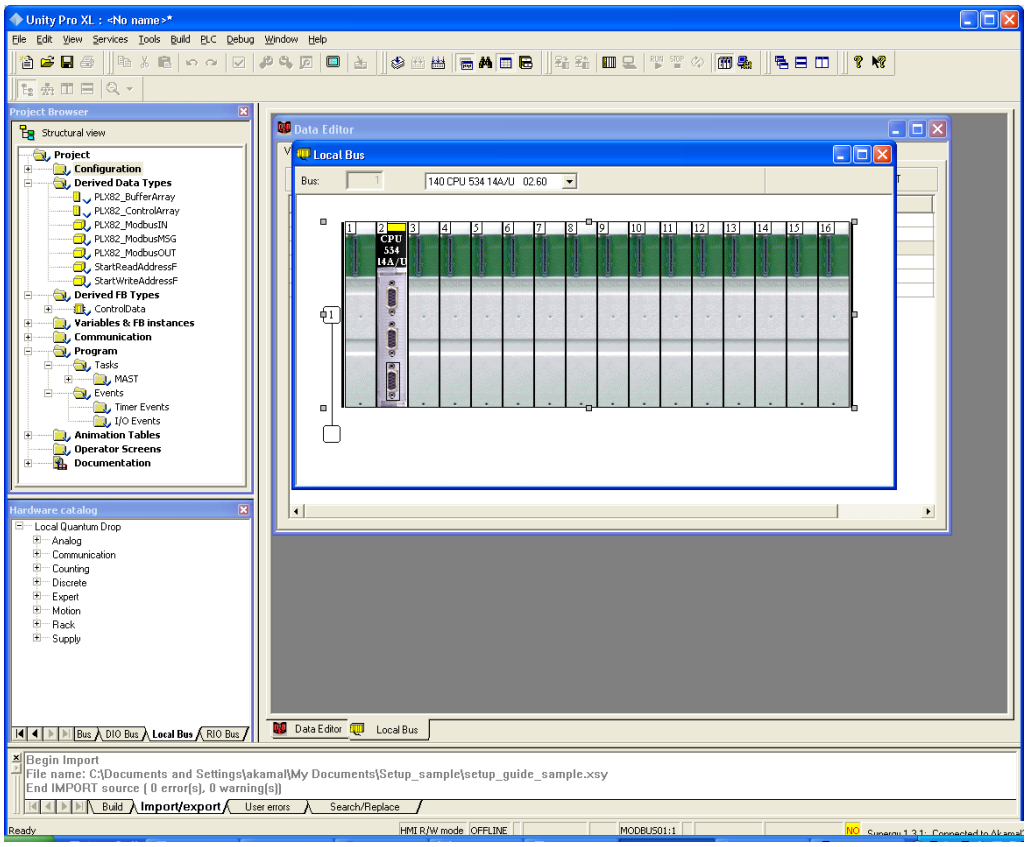


f Expand the variables to see these tags that are generated by ProSoft 61850 Configuration Manager.



4.4 Completing the Quantum Configuration

Now complete the configuration of the project, such as add any other modules in the rack.

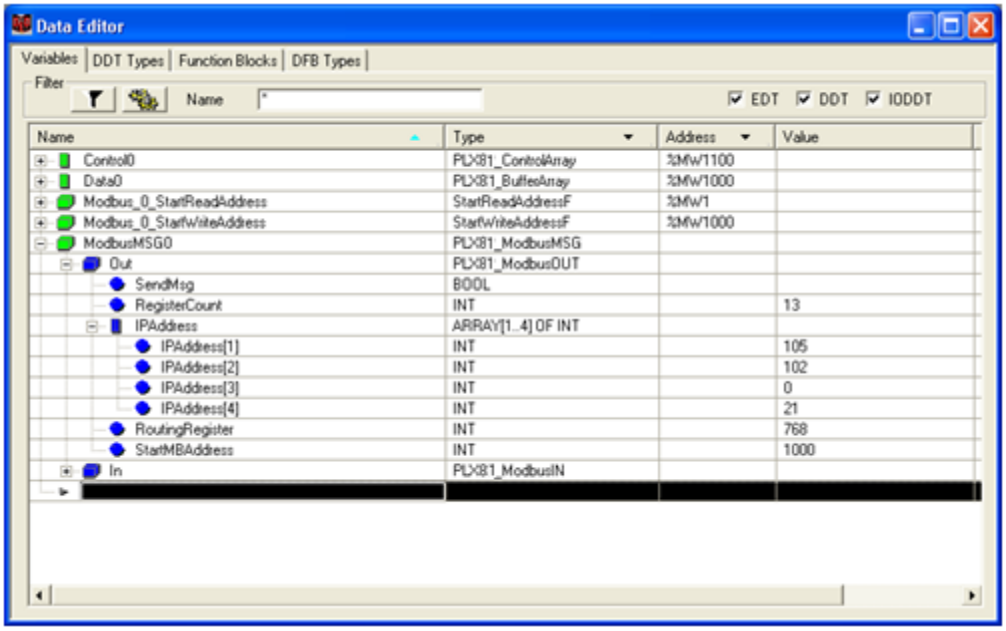


Once the rack configuration is complete, in order to verify data transfer you will have to build the project, download it to the processor and place the processor in *Run* mode.

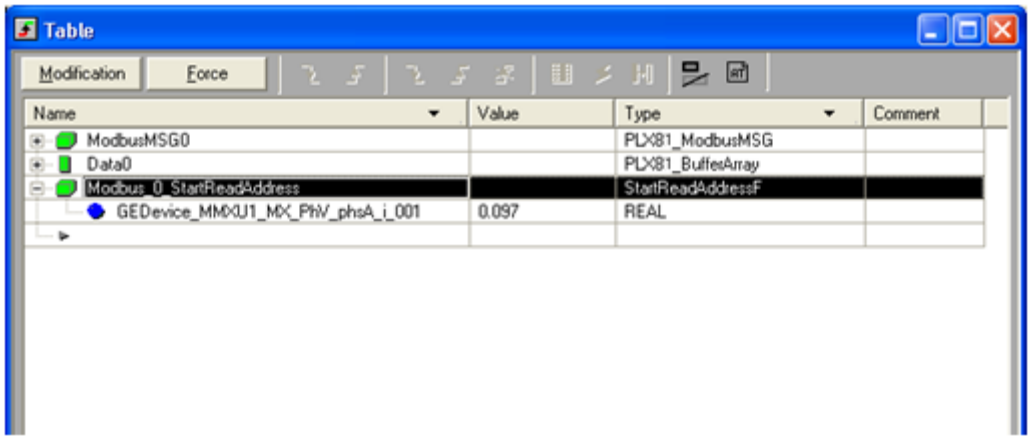
4.5 Confirming the Data Transfer

Once the steps in the previous topic have been followed it will be possible to verify that the data is transferring.

On the next window, the table shows the ProSoft gateway's configured IP address.



If it is configured correctly, then the table should show the voltage value we are trying to send from the IED to the PLC.



This value will be read from the IED.

5 Diagnostics and Troubleshooting

In This Chapter

- Known Anomolies 101
- Important Design Considerations 102
- Driver Status Data 103
- ProSoft 61850 Tag Monitor Diagnostics 105
- ProSoft 61850 Configuration Manager Diagnostics 108
- Web Service and Gateway Web Page 122
- Event Logger 124
- ProSoft gateway Troubleshooting 135

There are two ways to troubleshoot this ProSoft ProSoft gateway:

- Using the LEDs located on the front of the gateway
- Using the Debug port (E1) that provides a view into the gateway's internal database

5.1 Known Anomalies

In the unlikely event due to which an IED on the network causes a large number of reconnects to the PLX8x, the 61850 driver will eventually restart, causing re-initialization of the communication to all the IEDs on the Network. Until all the IEDs connected on the network have been reinitiated, the IED data being transferred to the Modbus TCP/IP is not being updated. To detect this condition, status bits are available that the user can effectively use in the PLC program for tracking.

5.2 Important Design Considerations

When utilizing any type of gateway device, careful consideration should be taken to make sure that in the event in loss of communications between devices on either the Modbus TCP/IP driver or the 61850 driver, this loss of communications is passed to the other driver.

Say for instance you have a loss of communications with an IED device on the 61850 network. This information should be shared with the Modbus TCP/IP device, so that the device can make an informed decision as to if they need to trigger any type of alarm or fail safe state for the attached device.

All applications should make careful consideration of each of the status words available to the various drivers. No application should be configured into a live system without mapping the driver status words and IEC 61850 IED status registers described below.

Additionally, if a Modbus TCP/IP client (like a Quantum, Premium, or M340 PLC) is issuing control commands to the ProSoft gateway as a Modbus TCP/IP server, then that device should also monitor its status information to make sure that this information is written to the module.

The reporting of this status information is crucial to the setup and configuration of a live system. Without mapping status data to the various drivers, it is impossible to tell if communications is actively occurring with the device, or if the data values are stale, and simply represent the last known conditions of that device.

Driver status, IED status, and client/server status information should be shared with the various drivers to ensure that a clear indication of loss of communications can be signaled to the devices on the network.

5.3 Driver Status Data

These are the status registers:

Driver	Gateway DB Address
NTP	65530
MNET Client	65531
MNET Server	65532
IEC-61850	65533
Reboot	65534

Driver Status Register's possible values are:

1 = Ok

0 = Failed or Driver startup/restart is occurring

61850 IED status registers:

Gateway DB Address	Description
65450	Node 0 status
65451	Node 1 status
65452	Node 2 status
...	...
65494	Node 44 status
65495	Reconnect count

Possible values are:

1 - Node connected

0 - Node initializing

-1 - Node disconnected. It may take up to 15 minutes to show this, and will first show as "-2".

-2 – Node in error

5.3.1 Rebooting the Gateway

If you need to reboot the ProSoft gateway, there are a few ways to do it:

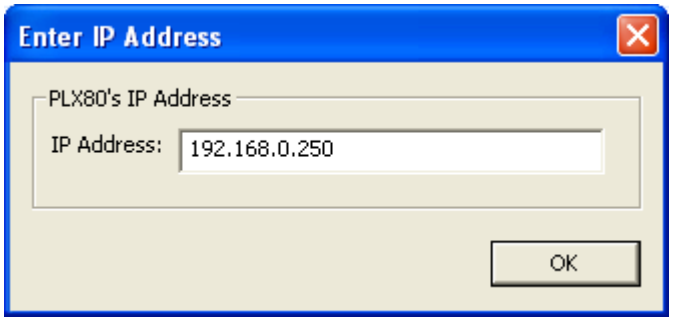
- Disconnect and reconnect power from the gateway.
- From the PLC or generic Modbus device, write to the gateway's address 65535 and it will reboot
- From the webpage on the ProSoft gateway, use the Reboot Gateway feature

Note: The ProSoft gateway will reboot automatically after you download a new configuration file.

5.4 ProSoft 61850 Tag Monitor Diagnostics

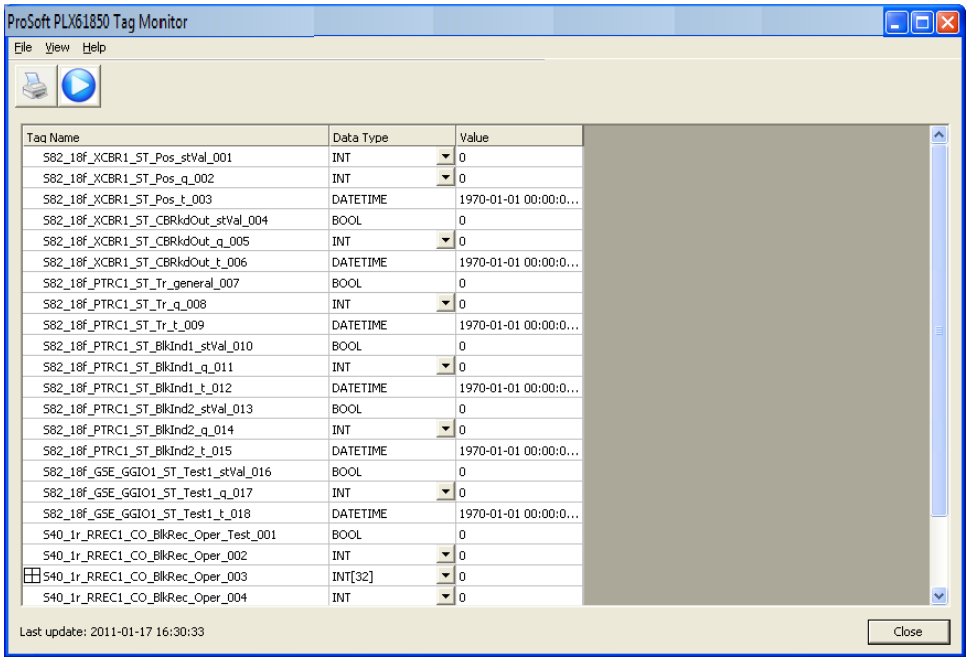
To start ProSoft 61850 Tag Monitor, choose *Start / Programs / ProSoft Technology / ProSoft 61850 Tag Monitor*.

ProSoft 61850 Tag Monitor will request the ProSoft gateway's IP address upon start-up.



Once ProSoft 61850 Tag Monitor locates the gateway, it will show information about the tags in the ProSoft gateway's tag database. ProSoft 61850 Tag Monitor allows values of a tag to be changed through the value field. Data movement from the devices connected to the gateway may overwrite any values that were provided on this window.

Here is an example window of ProSoft 61850 Tag Monitor.



The user interface shows three columns of data: **TAG NAME**, **DATA TYPE**, and **VALUE**. Tag names for complex data types contain a + to the left of them. The ProSoft gateway considers some of the IEC IEC-61850 data types to be complex. In the window shown here, this is next to Tag Name S40_1r_RREC1_CO_BlkRec_Oper_003.

In this example, this Tag Name is mapped to IEC-61850 Path RREC1COBlkRec$Oper$origin$orIdent. (The IEC 61850 Standard identifies *orIdent* is the originator identification, and will show the address of the originator who caused the change of the value.) Data for which there are several levels of hierarchy are considered complex, as well as some longer data types. The data type *orIdent* is Octet64.

ProSoft 61850 Tag Monitor Toolbar Features

The ProSoft 61850 Tag Monitor toolbar features are as follows:

- Print
- Start / Stop

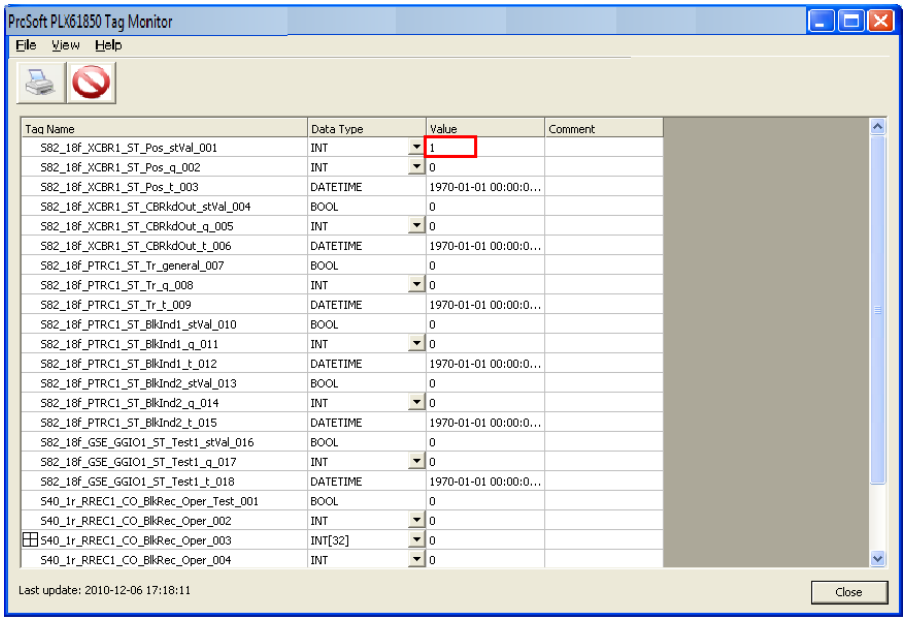
Print

The data will be sent to a printer.

Start / Stop

This toggle button provides the Start and Stop of on-line data monitor.

After the on-line data monitor has been started, the value of S82_18f_XCBR1_ST_Pos_stVal_001 will change from 0 to 1.



Since the right-most toolbar icon has changed, the on-line data monitor can now be stopped.

5.5 ProSoft 61850 Configuration Manager Diagnostics

5.5.1 IEC 61850 Client Diagnostics

The following sets of IEC 61850 Client diagnostics data are available from the ProSoft gateway:

- Configuration Settings
- Driver Status
- Remote Node Config
- Remote Node Status
- Report Status
- GOOSE Subscription Status

Configuration Settings

Setting	Description
TimeOut	The value in seconds for the command to timeout from a request
GOOSE Support	TRUE or FALSE value, indicating if GOOSE messaging is supported and configured on the gateway
Sampled Values Support	TRUE or FALSE value, indicating is Sampled Values is supported and configured on the gateway
Number of Remote Addresses	The count of remote addresses present in the current operating configuration of the gateway, in the IEC-61850 driver
Reports Configured	TRUE or FALSE value in driver indicating if reports are currently configured in the IEC-61850 driver
Number of Commands	The total count of Read and Write commands present in the current operating configuration of the IEC-61850 driver
Number of GOOSE Subscriptions	The total count of GOOSE subscriptions present in the current operating configuration of the IEC-61850 driver
Number of Reports Configured	The total count of reports (Buffered and Unbuffered) present in the current operating configuration of the IEC-61850 driver

Driver Status

Status	Description
Remote Node Status	This displays a bitmap of 1s or 0s, to indicate the communication status of each IED where 1=communication is good, and 0=no communication.
Command Read Requests	The count of total IEC61850 (MMS type) read command requests sent to nodes defined in the configuration file
Command Write Requests	The count of total IEC61850 (MMS type) write command requests sent to nodes defined in the configuration file
Command Read Errors	The count of total IEC61850 (MMS type) read errors received from requests sent to nodes defined in the configuration file
Command Write Errors	The count of total IEC61850 (MMS type) write errors received from requests sent to nodes defined in the configuration file
GOOSE messages Processed	The total count of GOOSE messages received per all subscriptions defined in the current operating configuration of the IEC61850 driver
Report Messages Processed	The total count of reports received per all reports that are enabled, and present in the current operating configuration of the IEC61850 driver
Identification Response Errors	The total count of Identification response errors per the nodes/devices defined in the current operating configuration of the IEC61850 driver
Create DataType Errors	The total count of errors received when making a request for datatypes defined for the configured commands in the current operating configuration of the IEC61850 driver

Remote Node Config

Command	Description
Remote Node Configured Index, or (Not Configured)	Value is the current index used of the addressed node, indicating that the node is configured in the current operating configuration file… or the value will indicate that the node is not configured
Remote Node IP Address	The IP Address of the indexed node being requested that is defined in the configuration file
Remote Node Name	The Node Name identifier of the indexed node being requested that is defined in the configuration file
Command Index Entry(s)	Lists the commands defined in the configuration file for the indexed node being requested, where each command entry is defined with this start tag to identify the command with a unique entry index used
Command Domain Name	Identifies the Domain Name used when accessing the IEC61850 variable via the command entry index in the previously returned information
Command Datapath Name	Identifies the Datapath Name used when accessing the IEC61850 Data Attribute via the command entry index in the previously returned information
Command Tag name(s)	Identifies the gateway's tag names for the command, which are allocated in the current operating configuration file for the indexed command entry

Command	Description
GOOSE Index Entry(s)	Lists the GOOSE subscriptions defined in the configuration file for indexed node being requested, where each GOOSE subscription is defined with this start tag to identify the GOOSE subscription unique entry index
Data Set Reference	Identifies the DATA-SET Reference used when receiving the GOOSE message
GOOSE CB Reference	Identifies the GOOSE Control Block Reference used on the remote node for this specific GOOSE Subscription indexed entry
Application ID	Identifies the Application ID used on the remote node for this specific GOOSE subscription indexed entry
Multicast Address	Identifies the Multicast Address used on the remote node for this specific GOOSE subscription indexed entry.
Configuration Revision	Identifies the Configuration Revision used on the remote node for this specific GOOSE subscription indexed entry
Decode Mode	Identifies the Decode Mode used on the remote node for this specific GOOSE subscription indexed entry. Implemented to use Decode Mode Immediate. Could be flexible in the future if required
GOOSE Domain Name Entry	The domain name entry for each of the data objects specified in the DATA-SET used by the GOOSE subscription
GOOSE Data Ref Entry(s)	The data reference entry for each of the data objects specified in the DATA-SET used by the GOOSE subscription
Report Index Entry(s)	Lists the reports defined in the configuration file for indexed node being requested, where each report is defined with this start tag to identify the report with a unique entry index
Report Domain Name Entry	The domain name entry for the report control block specified along with the DATA-SET used by the report, in order to accurately decode the reported message to the ProSoft module's Tag Database Tags
Report Data Reference Entry	The data reference entry for the report control block specified along with the DATA-SET used by the report, in order to accurately decode the reported message to the Tag Database
Report ID	The report ID associated with this Report Entry
# of Tags Associated w/ Report	The number of tags associated with this report entry in the Tag database

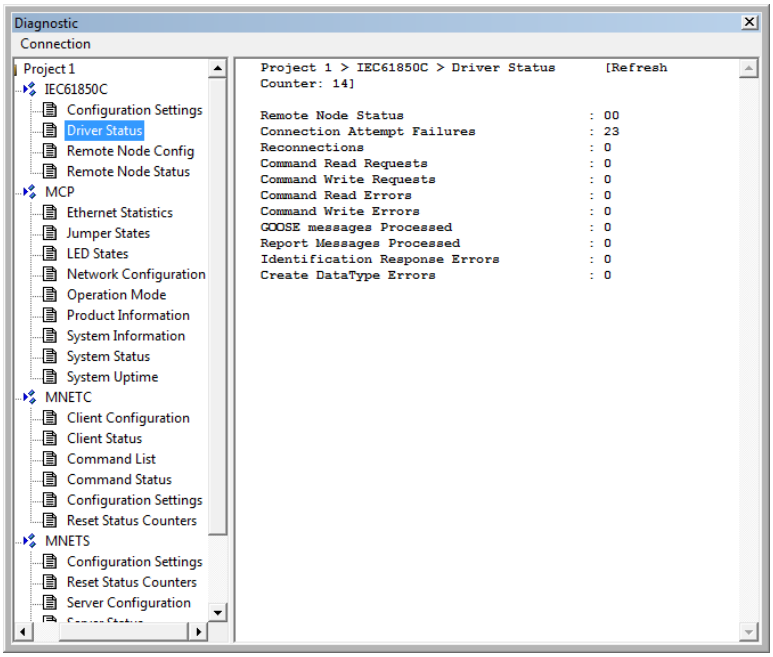
Remote Node Status

Command	Description
Remote Node Status 0	Indicates if the remote node for this index is configured or not. If the remote node is configured the unique index is included to indicate the reference start of the following for the status information
Remote Node IP Address	The IP Address used by the remote node for this index
Remote Node Name	The remote node name used by the remote node for this index
Remote Node Vendor	The Vendor that manufactures the remote node for this index
Remote Node Model	The Model Number used by the remote node for this index
Remote Node Revision	The revision used by the remote node for this index
Remote IED Command Status	Lists the commands by individual unique index as corresponding to the current operating configuration in the gateway, in which the following data are returned to indicate the command status

Report Status

Command	Name	Description
Command Status Entry(s) LIST…	*Command Status List []… for each command entry…*	Lists the commands by individual unique index as corresponding to the current operating configuration in the ProSoft module, in which the following data are returned to indicate the command status
Current Command Status	<currentstatus value = "" description = "" />	Indicates the last available status of the command sent to the remote node and the result, being either "OK" or "ERR"
Command Total Error Count	<cmderrcount value = "" description = "" />	Indicates the total error count for this unique command as it was processed by the IEC-61850 drive
Report Status Entry(s) LIST…	*Report Status List []… for each report entry…*	Lists the reports by individual unique index as corresponding to the current operating configuration, in which the following data are returned to indicate the report received count
Report Status Entry	<rptindex value = "" description = "" />	Lists the report control block status by individual unique index as corresponding to the current operating configuration
Reports Received Count	<rptcount value = "" description = "" />	Indicates the total report received count for this unique report as it was processed by the PLX8X IEC-61850 driver

GOOSE Subscription Status	
Command	**Description**
GOOSE Status Entry	An individual unique index as corresponding to the current operating configuration, in which the following data are returned to indicate the GOOSE Message received count
Goose Messages Received Count	Indicates the total GOOSE message received count for this unique GOOSE subscription as it was processed by the IED 61850 driver. It has been observed that sometimes this number shows fewer than expected



If the gateway loses connection with the IED but is able to reconnect then the Reconnection value will read 1. The value will read 0 if it is not able to reconnect.

5.5.2 MCP Diagnostics

The following MCP (internal gateway) diagnostic data is available from the gateway:

- Ethernet Statistics
- Jumper States
- LED States
- Network Configuration
- Operation Mode
- Product Information
- System Information
- System Status
- System Uptime

Ethernet Statistics

Function	Description
RX Bytes	Total received byte count
RX Packets	Total number of received Ethernet packets
TX Bytes	Total number of transmitted bytes
TX Packets	Total number of transmitted Ethernet packets

Jumper States

Jumper Name	States	Description
Setup	ON or OFF	This is the top jumper in the back of the gateway
Default IP	ON or OFF	This is the middle jumper
Reserved	ON or OFF	This is the bottom jumper. It is reserved for internal ProSoft Technology use

LED States

State	Description
Error	ON or OFF. This is the "ERR" LED above the power connector
Config	ON or OFF. This is the "CFG" LED above the power connector
Fault	ON or OFF. This is the "FLT" LED above the power connector
ms	OFF. This is not used by PLX8X-MNET-61850
ns	OFF. This is not used by PLX8X-MNET-61850

Network Configuration

Function	Description
IP Address	This is the gateway's configured IP address set by the user in ProSoft 61850 Configuration Manager.
Network Mask	This is the gateway's configured network mask, set by the user.
Gateway	This is the ProSoft Gateway's configured gateway, set by the user.

Operation Mode

Values may be:

- Init
- Start
- Ready
- Run
- Stop
- Restart
- Shutdown
- Done

Product Information

Field	Description
Product Type	ProSoft Gateway
Product Name	PLX8X-MNET-61850
Module Name	This the gateway gateway's name, as configured by the user in the *ProSoft Gateway Configuration* window
Product Version	Version of the PLX8X-MNET-61850
MAC Address	MAC address of the gateway
Serial Number	Serial Number of the gateway

System Information

Version: This is the version of the PLX8X-MNET-61850 product.

System Status

This shows the setting of the *FLT* LED. Values shown here may be *OK* and *FLT* (meaning *fault*)

System Uptime

The total system uptime is number of days plus number of hours plus number of minutes plus number of seconds.

Value	Description
Days	Number of days the gateway has been operating since the last power-up
Hours	Number of hours the gateway has been operating since the last power-up
Minutes	Number of minutes the gateway has been operating since the last power-up
Seconds	Number of seconds the gateway has been operating since the last power-up

5.5.3 Modbus TCP/IP Diagnostics

The following Modbus TCP/IP Client diagnostics data is available from the gateway

Modbus TCP/IP Client

The following Modbus TCP/IP Client diagnostic data is available from the gateway:

- Client Status
- Command List
- Command Status
- Configuration
- Driver Information
- Reset Status Counters

Client Status

The following Client diagnostics data is available from the gateway:

Function	Description
Client	This is a number 0 to 19 referring to the Modbus device to which we are talking. The name is supposed to come from the configuration file
Client Name	Optional
Command Requests	Total count of commands executed by the MNET driver since its last startup
Command Responses	Total count of responses received to commands sent
Command Responses Parsed	Total count of responses received to commands sent
Exception Responses Received	Total number of exception responses received
Bad Packets Received	Total number of bad packets received. The Client polled for some information from the Server, and the response was something unknown to the driver. The MNET driver can't make sense of the response. Usually, nothing is shown here

Command List

The following Command List diagnostics data is available from the gateway

Value	Description
Client Name	This data is shown for each command, in a scrolling list: Command <command number>:
Enable	0 = The command is disabled and will not be executed in the normal polling sequence. 1 = The command is executed each scan of the command list if the Poll Interval Time is set to zero. If the Poll Interval time is set, the command is executed when the interval timer expires. 2 = The command executes only if the internal data associated with the command changes
Poll Interval	This parameter specifies the minimum interval to execute continuous commands (Enable code of 1). The parameter is entered in 1/10th of a second. Therefore, if a value of 100 is entered for a command, the command executes no more frequently than every 10 seconds.
Function	This parameter specifies the Modbus function to be executed by the command. These function codes are defined in the Modbus protocol. The following table defines the purpose of each function supported by the gateway. More information on the protocol is available from the Schneider Electric web site (www.modicon.com). 3 = Read Holding Registers(4X) 6 = Preset (Write) Single Register(4X)
Start Register/Register Count	Registers 1 to 125 (or Coils 1 to 800). This parameter specifies the number of registers or digital points to be associated with the command. For functions 3 and 16, this parameter sets the number of registers to be associated with the command. In the case of floats the count will be 1 for each float.
Swap Code	0 = None - No Change is made in the byte ordering 1 = Words - The words are swapped 2 = Words & Bytes - The words are swapped then the bytes in each word are swapped 3 = Bytes - The bytes in each word are swapped. The words should be swapped only when using an even number of words.
Node IP	This is the IP address of the device being addressed by the command.
Service Port	This will be 502 or 2000. A value of 502 is used to address Modbus TCP/IP servers which are compatible with the Schneider Electric MBAP specifications (this will be most devices)
Slave Address	This parameter is always 1 for Modbus TCP/IP.
FC 23 Read Address	FC 23 Read Address: This is always 0. This function code is not supported for PLX8X-MNET-61850.
FC 23 Write Address	FC 23 Write Address: This is always 0. This function code is not supported for PLX8X-MNET-61850.

Configuration

Minimum Command Delay

This value is set by the user in the configuration window. This is the minimum number of microseconds between commands. This can be a value in the range **0** to **32767**, with a default value of **0**. This parameter can be used to delay all commands sent to the Modbus TCP/IP Server (PLC) to avoid "flooding" commands on the network. This parameter does not affect retries of a command as they will be issued when failure is recognized.

Response Timeout

This value is set by the user in the configuration window. This is the time in milliseconds that the Modbus TCP/IP Client will wait before re-transmitting a command if no response is received from the addressed Server. This can be a value in the range **0** to **65535**, with a default value of **1000**. The value to use depends upon the type of communication network used, and the expected response time of the slowest device on the network.

Retry Count

This value is set by the user in the configuration window. This parameter specifies the number of times a command will be retried if it fails. The default value is **0**, and can be a value in the range **0** to **10**.

Command Error Delay

This value is set by the user in the configuration window. This parameter specifies the number of 100 millisecond intervals to turn off a command in the error list after an error is recognized for the command. If this parameter is set to **0**, there will be no delay. The default value is **300**, valid values range from **0** to **300**, with a default value of **300**

Driver Information

This displays the version# of the MNET driver in the ProSoft gateway.

Reset Status Counters

The purpose of this item is to cause a reset action in the MNET driver. When you click this, you will see a *Response* field with the value of **OK**. Do this when you would like to reset the counters shown on the *Client Status and Command Status* diagnostic windows.

Modbus TCP/IP Server

The following Modbus TCP/IP server diagnostic data is available from the gateway:

- Configuration
- Driver Information
- Reset Status Counters
- Server Status

Configuration

Value	Description
Connection Timeout	This is the connection timeout, as set on the ProSoft Gateway Configuration window by the user. This is in seconds. The default value is **60**.
MBAP Ports	This is the *No of MBAP Server* value as set on the ProSoft Gateway Configuration window by the user. The default value is **20**. Most Modbus devices use MBAP
MNET Ports	This is the *No of MBAP Server* value as set on the ProSoft Gateway Configuration window by the user. The default value is **20**. Most Modbus devices use MBAP

Driver Information

This displays the version# of the MNET driver in the ProSoft gateway.

Reset Status Counters

The purpose of this item is to cause a reset action in the MNET driver. When you click this, you will see a *Response* field with the default value of **OK**. Do this when you would like to reset the counters shown on the *Server Status* diagnostic window.

Server Status

MBAP Server: Number of connections to the gateway MBAP Server.

Requests: Total count of requests received for data.

Responses: Total count of responses sent.

Errors Received: Total number of errors received.

Errors Sent: Total number of errors sent.

Current Error: The current error number.

Exception Code	MODBUS name	Description
01	Illegal Function Code	The function code is unknown by the server
02	Illegal Data Address	Dependent upon the request
03	Illegal Data Value	Dependent on the request
04	Server Failure	The server failed during the execution
05	Acknowledge	The server accepted the service invocation but the service requires a relatively long time to execute. The server therefore returns only an acknowledgement of the service invocation receipt.
06	Server Busy	The server was unable to accept the MB Request PDU. The Client application has the responsibility of deciding if and when to re-send the request.

1 = communicating, 0 = not communicating.

Current Error

The following Current Error diagnostics data is available from the gateway:

- Standard Modbus Protocol Errors
- Module Communication Error Codes
- MNET Client Specific Errors
- Command List Entry Errors

Standard Modbus Protocol Errors

Code	Description
1	Illegal function
2	Illegal Data Address
3	Illegal Data Value
4	Failure in Associated Device
5	Acknowledge
6	Busy, Rejected Message

Modbus Communication Error Codes

Code	Description
-1	CTS modem control line not set before transmit
-2	Timeout while transmitting message
-11	Timeout waiting for response after request
253	Incorrect slave address in response
254	Incorrect function code in response
255	Invalid CRC/LRC value in response

MNET Client Specific Errors

Code	Description
-33	Failed to connect to server specified in command
-36	MNET command response timeout
-37	TCP/IP connection ended before session finished

Command List Entry Errors

Code	Description
-40	Too few parameters
-41	Invalid enable code
-42	Internal address > maximum address
-43	Invalid node address (<0 or >255)
-44	Count parameter set to 0
-45	Invalid function code
-46	Invalid swap code
-47	ARP could not resolve MAC from IP (bad IP address, not part of a network, invalid parameter to ARP routine).
-48	Error during ARP operation: the response to the ARP request did not arrive to the gateway after a user-adjustable ARP Timeout.

Last Error

Execution Count: Total number of times this command was sent / triggered.

5.5.4 SNTP/NTP

Status:

Time from SNTP/NTP server: This will show the time retrieved by the SNTP/NTP server.

Poll Count:

Clock Update Count: This will display the number of times the ProSoft gateway's clock has been updated.

Error Count: This is the number of unsuccessful times the ProSoft gateway has attempted to reach the SNTP/ NTP Server.

Configuration Settings

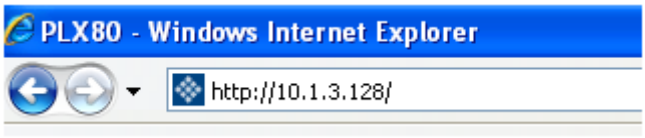
- **UPDATE RATE IN MINUTES**: How frequently the time is synchronized via SNTP/NTP. This is a configured value that is set on the *ProSoft Gateway Configuration* window, in the SNTP/NTP Update Time field.
- **SERVER ADDRESS**: The IP address or domain name for the SNTP/NTP server. This is a configured value that is set on the *ProSoft Gateway Configuration* window, in the SNTP/NTP Address field.

Driver Status

- **STATUS**: This is the result of the latest poll, and is one of *OK* or *Error retrieving time from SNTP/NTP server*.
- **POLL COUNT:** This is the number of update attempts (at the configured frequency) since startup (*unsigned long* rolls over at 4 billion plus). If *Poll Count* is zero (before first attempt, or configured update time is **0** for *never poll*) *Status* is *OK*.

5.6 Web Service and Gateway Web Page

When the gateway's IP address is accessed through a browser (such as Internet Explorer) or ProSoft Discovery Service, it will show the gateway's Web page. The gateway's Web services are connection-based, and therefore can accept multiple connections at a time. Multiple users can view the gateway's Web page at the same time. ProSoft 61850 Configuration Manager uses the gateway's Web services as well. Multiple users can request configuration data and diagnostic data at the same time.



- **FUNCTIONS / FIRMWARE UPGRADE**: Click on this to upgrade the firmware in the ProSoft gateway. The top jumper (Mode 3) must be jumpered to upgrade the firmware. Only do this if instructed to do so by ProSoft Technical Support.
- **FUNCTIONS / SET DATE & TIME**: Click here to set the date and time on the ProSoft gateway.
- **FUNCTIONS / REBOOT MODULE**: Click here to begin a reboot sequence of the gateway.

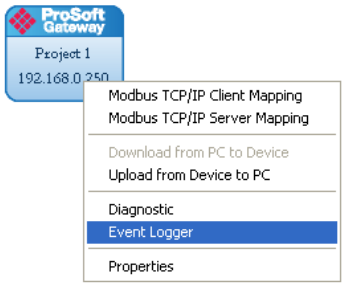
- **TECHNICAL SUPPORT**: Click here to be directed to ProSoft's Technical Support website.
- **HOMEPAGE**: Click here to go to the ProSoft gateway's homepage (shown above).
- **RESOURCES / PROSOFT TECHNOLOGY**: Click here to be directed to ProSoft Technology's Web site.
- **RESOURCES / MODBUS ORGANIZATION**: Click here to be directed to the Modbus Organization's Web site.

The following information is shown on the Home Page of the Gateway Web page:

- **DEVICE NAME**: This is the Project Name as set by the user in ProSoft 61850 Configuration Manager, in the ProSoft Gateway Configuration window.
- **ETHERNET ADDRESS (MAC)**: This is the gateway's MAC address.
- **IP ADDRESS**: This is the gateway's IP Address.
- **PRODUCT REVISION**: This is the product revision number. This is determined by the version# of the firmware that currently resides in the gateway.
- **SERIAL NUMBER**: This is the gateway's serial number.
- **UPTIME**: This is the number of hours, minutes, and seconds that the gateway has been "up" or alive since the last reboot or reconnection of power.
- **CURRENT TIME**: This is the gateway's current time. You can change the gateway's time by use of SNTP, or choosing Functions / Set Date & Time.
- **ERROR LED**: ON or OFF. This is the "ERR" LED above the power connector.
- **CONFIG LED**: ON or OFF. This is the "CFG" LED above the power connector.
- **FAULT LED**: OK or ON. This is the "FLT" LED above the power connector.

5.7 Event Logger

The ProSoft gateway's internal processes and drivers write event log data to the Event Logger. You can access the Event Logger from ProSoft 61850 Configuration Manager by right-mouse-clicking on the *ProSoft Gateway* icon, and choose **EVENT LOGGER**.

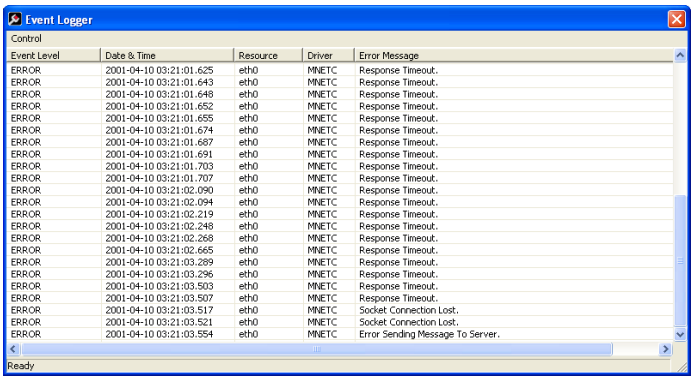


The data written to the Event Logger is:

- Event Level
- Date & Time
- Resource
- Driver
- Error Message

Here are the possible Event Levels and their descriptions:

Event	Description
DEBUG	Very detailed debug data to the event log that will help ProSoft Technical Support
INFO	Potential problem, but not an error
WARNING	Potential problem, but not an error
ERROR	System errors
FATAL	Fatal system problem that is causing a process to terminate



5.7.1 61850C Events

"61850C_CREATE_EVENTLOG_INFO", "Created Event Log."};

"61850C_CREATE_EVENTLOG_FATAL", "Failed Create Event Log."};

"61850C_LOADING_DATABASE_FATAL", "Error Loading Database."};

"61850C_LOADING_SYSDATABASE_FATAL", "Error Loading System Database."};

"61850C_GET_VAR_TYPE_ID_FATAL", "Error getting initial var type id."};

"IEC61850C_ERROR_CONNECTING_MCPINTERFACE_FATAL", "Cannot Connect to MCP Interface."};

"IEC61850C_CONTROL_NOT_SUPPORTED_INFO", "Control Method Not Supported."};

"IEC61850C_CNXN_DIDNT_START_INFO", "End Node Connection did not start."};

"IEC61850C_NEED_ONE_VAR_MAPPED_INFO", "Need at least one 61850 Var mapped."};

"IEC61850C_ERROR_STARTING_MVL_ACSE_FATAL", "Error Starting MVL_ACSE Subsystem."};

"IEC61850C_ERROR_FINDING_REPORT_TYPEIDS_FATAL", "Error Finding Report Type ID's."};

"61850C_CMD_TAG_PTR_IS_NULL_FATAL", "Error getting Tag Pointer for command."};

"61850C_RPT_TAG_PTR_IS_NULL_FATAL", "Error getting Tag Pointer for report."};

"61850C_GSE_TAG_PTR_IS_NULL_FATAL", "Error getting Tag Pointer for goose subscription."};

"IEC61850C_RPT_INTEGRITY_PERIOD_SET_DEFAULT_INFO", "Report Intergity Period Set to Default."};

"IEC61850C_ISCAN_DELAY_SET_DEFAULT_INFO", "Interscan Delay Period (2ms) Set to Default."};

"IEC61850C_RPT_CONFREV_TYPE_NOT_VALID_INFO", "Report Config Rev type not Valid."};

"IEC61850C_RPT_CONFREV_READ_ERROR_INFO", "Report Config Rev Read Error."};

"IEC61850C_RPT_CONFREV_DOESNT_MATCH_CFG_INFO", "Rpt confRev doesnt match, Rpt Not Started."};

"IEC61850C_RPT_CONFREV_RECONNECT_NO_MATCH_CFG_INFO", "Rpt confRev doesnt match, Rpt Not Reconnected."};

"IEC61850C_GSE_DATA_TYPE_ERROR_INFO", "GOOSE Data Type NULL Error."};

"IEC61850C_GCB_CONFREV_TYPE_NOT_VALID_INFO", "GCB Config Rev type not Valid."};

"IEC61850C_GCB_CONFREV_READ_ERROR_INFO", "GCB Config Rev Read Error."};

"IEC61850C_GCB_CONFREV_DOESNT_MATCH_CFG_INFO","GCB confRev doesnt match, Subscribe Not Started."};

5.7.2 MNET Events

"MNET_CREATE_CLIENT_FATAL", "Cannot Create Client"};

"MNET_CREATE_THREAD_FATAL", "Cannot Create Thread."};

"MNET_LOADING_DATABASE_FATAL", "Error Loading Database"};

"MNET_ERROR_CREATING_SOCKET_FATAL", "Error creating network socket"};

"MNET_ERROR_SETTING_SOCKET_OPTION_FATAL", "Error setting socket option."};

"MNET_ERROR_BINDING_SOCKET", "Error binding network socket. Port number = {0}."};

"MNET_ERROR_CONNECTING_TO_SOCKET_ERROR", "Error connecting to network socket at {0} port {1}."};

"MNET_CONNECTION_SUCCESSFUL_INFO", "Successfully connected to {0}."};

"MNET_CLIENT_CONFIGURATION_FILE_PARSED_INFO", "Configuration file parsed."};

"MNET_CONFIG_BAD_FORMAT_RESOURCE_FATAL", "Bad Configuration file format. Missing Resource: {0}."};

"MNET_CONFIG_BAD_FORMAT_RESOURCE_FATAL", "Bad Configuration file format. Missing Driver: {0}."};

"MNET_CONFIG_EXCEED_MAX_CLIENTS_ERROR", "Client number {0} exceeds maximum Clients."};

"MNET_CONFIG_GET_TAG_ERROR", "Get Tag error: Error code {0}, Error position {1}."};

"MNET_CONFIG_MAP_RANGE_ERROR", "Tag Map Out Of Range."};

"MNET_CONFIG_COPY_TABLE_PTR_ERROR", "Copy Table Pointer is NULL."};

"MNET_CONFIG_DATAMAP_PTR_ERROR", "Datamap Pointer is NULL."};

"MNET_CONFIG_COMMAND_LIST_PTR_ERROR", "Command List Pointer is NULL."};

"MNET_CONFIG_CLIENT_LIST_PTR_ERROR", "Client List Pointer is NULL."};

"MNET_CONFIG_TAG_PTR_ERROR", "Tag Pointer is NULL."};

"MNET_BUILD_COMMAND_ERROR", "Error Building Command {0}."};

"MNET_SEND_ERROR", "Error Sending Message To Server."};

"MNET_SELECT_FAIL_ERROR", "Select Function Failed."};

"MNET_RESPONSE_TIMEOUT_ERROR", "Response Timeout."};

"MNET_RESPONSE_PARSE_ERROR", "Response Parsing Error {0}."};

"MNET_TAG_COPY_COUNT_ZERO_ERROR", "Tag Copy Count Is Zero."};

"MNET_ERROR_CONNECTING_MCPINTERFACE_FATAL", "Cannot Connect to MCP Interface"};

"MNET_SOCKET_CONNECTION_LOST_ERROR", "Socket Connection Lost."};

"MNET_CREATE_OBJ_FATAL", "Cannot Create class object."};

5.7.3 MNET Events

"MNET_CREATE_SERVER_FATAL", "Cannot Create Server"};

"MNET_CREATE_THREAD_FATAL", "Cannot Create Thread."};

"MNET_LOADING_DATABASE_FATAL", "Error Loading Database"};

"MNET_ERROR_CREATING_SOCKET_FATAL", "Error creating network socket"};

"MNET_ERROR_SETTING_SOCKET_OPTION_FATAL", "Error setting socket option."};

"MNET_ERROR_BINDING_SOCKET", "Error binding network socket. Port number = {0}."};

"MNET_SERVER_CONFIGURATION_FILE_PARSED_INFO", "Configuration file parsed."};

"MNET_CONFIG_BAD_FORMAT_RESOURCE_FATAL", "Bad Configuration file format. Missing Resource: {0}."};

"MNET_CONFIG_BAD_FORMAT_RESOURCE_FATAL", "Bad Configuration file format. Missing Driver: {0}."};

"MNET_CONFIG_EXCEED_MAX_SERVERS_ERROR", "Server number {0} exceeds maximum servers."};

"MNET_CONFIG_GET_TAG_ERROR", "Get Tag error: Error code {0}, Error position {1}."};

"MNET_CONFIG_MAP_RANGE_ERROR", "Tag Map Out Of Range."};

"MNET_CONFIG_COPY_TABLE_PTR_ERROR", "Copy Table Pointer is NULL."};

"MNET_CONFIG_DATAMAP_PTR_ERROR", "Datamap Pointer is NULL."};

"MNET_CONFIG_SERVER_LIST_PTR_ERROR", "Server List Pointer is NULL."};

"MNET_CONFIG_TAG_PTR_ERROR", "Tag Pointer is NULL."};

"MNET_SEND_ERROR", "Error Sending Message To Client."};

"MNET_SELECT_FAIL_ERROR", "Select Function Failed."};

"MNET_TAG_COPY_COUNT_ZERO_ERROR", "Tag Copy Count Is Zero."};

"MNET_ERROR_GETTING_SOCKET_NAME_FATAL", "Error getting socket name."};

"MNET_ERROR_SETTING_PORT_FATAL", "Error setting socket port."};

"MNET_LISTEN_ERROR_FATAL", "Socket listen failed."};

"MNET_CONFIG_CREATE_OBJ_ERROR", "Error creating object."};

"MNET_ACCEPT_ERROR_FATAL", "Socket accept failed."};

"MNET_ALLOC_MEMORY_FATAL", "Unable to allocate memory."};

"MNET_CREATING_CONFIGURATION_FATAL", "Error Creating Configuration"};

"MNET_SERVER_TIMEOUT_ERROR", "Server connection timed out."};

"MNET_CREATE_OBJ_FATAL", "Cannot Create class object."};

"MNET_RECV_FAIL_ERROR", "Recv Function Failed."};

"MNET_ERROR_CONNECTING_MCPINTERFACE_FATAL", "Cannot Connect to MCP Interface"};

"MNET_SOCKET_CONNECTION_LOST_ERROR", "Socket Connection Lost."};

5.7.4 MCP Events

"MCP_START_INFO", "Info: Starting MCP."};

"MCP_CAPABILITIES_FILE_PARSED_INFO", "Capabilities file read successfully."};

"MCP_CONFIGURATION_FILE_PARSED_INFO", "Configuration file read successfully."};

"MCP_DRIVER_STOPPED_UNEXPECTEDLY_ERROR", "Driver stopped unexpectedly, Resource: {1} Driver: {2}."};

"MCP_CAPABILITIES_FILE_NOT_FOUND_FATAL", "Capabilities file not found."};

"MCP_CAPABILITIES_FILE_EMPTY_FATAL", "Capabilities file empty."};

"MCP_CAPABILITIES_BAD_FORMAT_FATAL", "Bad Capabilities file format. Missing: {1}."};

"MCP_CONFIG_FILE_NOT_FOUND_FATAL", "Configuration file not found."};

"MCP_CONFIG_FILE_EMPTY_FATAL", "Configuration file empty."};

"MCP_CONFIG_BAD_FORMAT_FATAL", "Bad Configuration file format. Missing: {1}."};

"MCP_TERMINATING_FATAL", "Fatal error found! Terminating MCP in {1} seconds."};

"MCP_START_DEBUG", "Debug: Starting MCP."};

"MCP_START_WARNING", "Warning: Starting MCP."};

"MCP_START_ERROR", "Error: Starting MCP."};

"MCP_START_FATAL", "Fatal: Starting MCP."};

"MCP_CREATE_THREAD_FATAL", "Error creating thread. Return code from pthread_create() = {1}."};

"MCP_FILE_ERROR", "Error opening file."};

"MCP_TAGDB_FAIL_FATAL", "Failure opening Tag Database."};

"MCP_SYSDB_FAIL_FATAL", "Failure opening System Database."};

"MCP_OPEN_TAGDB_INFO", "Info: Opening Tag Database."};

"MCP_OPEN_SYSDB_INFO", "Info: Opening System Tag Database."};

"MCP_CONNECT_SYSDB_INFO", "Info: Connecting to System Tag Database."};

"MCP_LOADING_DATABASE_FATAL", "Failure connecting to Tag Database."};

"MCP_UNSCHEDULED_TERMINATION_INFO", "Driver termination."};

"MCP_DRIVER_KILL_INFO", "Info: Issuing kill signal to driver."};

"MCP_SYSTEM_TAG_INIT_FAILURE_FATAL", "Failure initializing system tags."};

"MCP_SYSTEM_OPERATIONS_STOPPED_FATAL", "MCP Stopped operations."};

MCP Interface Events

"MCP_INTERFACE_INIT_FAILED_FATAL", "Initialization failed."};

"MCP_INTERFACE_LOADING_DATABASE_FATAL", "Error Loading Database."};

"MCP_INTERFACE_GET_TAG_ERROR", "Get Tag error: Error code {0}, Error position {1}."};

5.7.5 SNTP/NTP Events

"SNTP_CREATE_EVENTLOG_INFO", "Created Event Log."};

"SNTP_CREATE_EVENTLOG_FATAL", "Failed Create Event Log."};

"SNTP_LOADING_DATABASE_FATAL", "Error Loading Database."};

"SNTP_ERROR_CONNECTING_MCPINTERFACE_FATAL", "Cannot Connect to MCP Interface."};

"SNTP_UPDATE_TIME_FROM_SNTPSERVER_INFO", "Updated Time from SNTP Server."};

5.7.6 InterProcess Communication (IPC) Events

"IPC_ACCEPTED_SOCKET", "Accepted new connection from Client %s on socket %d."};

"IPC_BAD_MESSAGE_HEADER", "Start of IPC message header was not equal to {0}. Socket will be closed."};

"IPC_CONNECTION_SUCCESSFUL", "Successfully connected to {0}."};

"IPC_ERROR_BINDING_SOCKET", "Error binding network socket. Port number = {0}."};

"eIPC_ERROR_CLOSING_SOCKET", "Error closing network socket."};

"IPC_ERROR_CONNECTING_TO_SOCKET", "Error connecting to network socket at {0} port {1}."};

"IPC_ERROR_CREATING_SOCKET", "Error creating network socket."};

"IPC_ERROR_GETTING_SOCKET_NAME", "Error getting socket name."};

"IPC_ERROR_READING_MESSAGE_FORMAT", "Error reading message format from IPC message header. Expected to read {0} bytes, but only read {1} bytes."};

"IPC_ERROR_READING_MESSAGE_LENGTH", "Error reading message length from IPC message header. Expected to read {0} bytes, but only read {1} bytes."};

"IPC_ERROR_SENDING_DATA", "Error sending data to remote system."};

"IPC_ERROR_SENDING_MESSAGE", "Error sending message to remote system."};

"IPC_ERROR_SETTING_SOCKET_OPTION", "Error setting socket option."};

"IPC_INVALID_MESSAGE_FORMAT", "Invalid message format found in IPC message header. Invalid message format value = {0}."};

"IPC_LISTEN_ERROR", "Error listening on network socket."};

"IPC_MESSAGE_LENGTH_MISMATCH", "Error reading IPC message. Message length did not match number of bytes read. Message length = {0}. Number bytes read = {1}."};

"IPC_RECEIVE_BUFFER_TOO_SMALL", "Unable to receive IPC message because message length is larger than receive buffer. IPC message length = {0}. Receive buffer size = {1}."};

"IPC_REMOTE_CLIENT_DISCONNECTED", "Closing socket because remote Client disconnected."};

"IPC_SOCKET_ACCEPT_ERROR", "Error accepting new network socket connection."};

"IPC_SOCKET_ERROR", "Socket error occurred. Closing socket."};

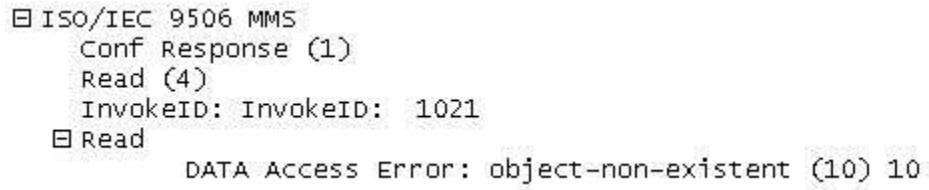
"IPC_SOCKET_SELECT_ERROR", "Error returned from socket select()."};

5.8 ProSoft gateway Troubleshooting

When doing detailed trouble-shooting, ProSoft Technology's engineering and technical support group uses MMS Ethereal. With it, the stream of data can be analyzed, from both the IEC 61850 and Modbus TCP/IP points of view. Looking at the data in this way may be useful when troubleshooting.

ISO 9506-1:2003 and ISO 9506-2:2003, along with RFC 1006, make up the protocols used for MMS (IEC-61850-8-1).

Example screen snapshot:



This is an IED responding to a MMS request with an object-non-existent error (code = 10).

These are the possible Data Access Errors, from ISO 9506-2:

DataAccessError ::= INTEGER {
object-invalidated (0),
hardware-fault (1),
temporarily-unavailable (2),
object-access-denied (3),
object-undefined (4),
invalid-address (5),
type-unsupported (6),
type-inconsistent (7),
object-attribute-inconsistent (8),
object-access-unsupported (9),
object-non-existent (10),
object-value-invalid (11)
} (0..11)

6 Reference

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6.1 Functional Specifications

6.1.1 Specifications

The gateway is enclosed in a sturdy extruded aluminum case which uses DIN-rail-mounting.

Hardware	One (1) or two (2) Ethernet ports for Modbus TCP/IP and IEC 61850 communication, depending on gateway
Software	ProSoft 61850 Configuration Manager for configuration and diagnostic viewing ProSoft 61850 Tag Monitor for viewing live tag data ProSoft Discovery Service for setting a temporary IP address
Configuration Storage	Configuration settings saved on a removable 1GB industrial SD Card ProSoft 61850 Configuration Manager saves configuration information to an offline file.

6.1.2 Specifications - Modbus TCP/IP

The Modbus TCP/IP driver allows multiple independent, concurrent Ethernet connections. The connections may be all Clients, all servers, or a combination of both Client and server connections.

Modbus TCP/IP Client

- Actively reads data from and writes data to Modbus TCP/IP devices using MBAP
- Up to 10 Client connections with multiple commands to talk to multiple servers

Modbus TCP/IP Server

- The server driver accepts incoming connections on Service Port 502 for Clients using Modbus TCP/IP MBAP messages and connections on Service Port 2000 (or other Service Ports) for Clients using Encapsulated Modbus messages.
- Supports multiple independent server connections for any combination of Service Port 502 (MBAP) and Service Port 2000 (Encapsulated)
- Up to 20 Servers are supported

Modbus Commands Supported (Client and Server)	3: Read Holding Registers	16: Preset (Write) Multiple Holding Registers
Configurable Parameters: (Client and Server)	Gateway IP Address PLC Read Start Register (%MW) PLC Write Start Register (%MW) Number of MBAP and MNET servers Gateway Modbus Read Start Address Gateway Modbus Write Start Address	
Configurable Parameters: Client Only	Minimum Command Delay Response Timeout Retry Count Command Error Pointer	
Command List	Up to 2000 Modbus commands (one tag per command)	
Status Data	Error codes reported individually for each command. High-level status data available from Modbus TCP/IP Client (for example PLC)	
Command List Polling	Each command can be individually enabled or disabled; write-only-on-data-change is available	

6.1.3 Specifications - IEC 61850 Client

- Supports up to 20 IEDs
- Send commands from the PLC to the IED using Control Types
  - Direct-with-normal-security
  - Select Before Operate (SBO)-with-normal-security
  - Direct-with-enhanced-security
  - Select Before Operate (SBO)-with-enhanced-security

ACSI Basic Conformance	
SCSMs supported	SCSM: IEC 61850-8-1 used
ACSI Model Conformance	
Reporting	Buffered Report Control Block (BRCB) Unbuffered Report Control Block (URCB)
GOOSE:	entryID, DataReflnc
Control	Direct-with-normal-security SBO-with-normal-security Direct-with-enhanced-security SBO-with-enhanced-security
Logical Nodes	IEC 61850 Logical Nodes, including Logical Nodes for Hydro Power Plants and Logical Nodes for Wind Power Plants
Configurable Parameters	MMS Command Delay
Status Data	Status available per node Report and GOOSE status available High-level status data available from Modbus TCP/IP Client (for example PLC)

6.1.4 Specifications –SNTP/NTP Client

The gateway supports a Simple Network Time Protocol (SNTP/NTP) client service that can synchronize the gateway's time by periodic updates to a Co-ordinated Universal Time (UTC) system. The user can configure the SNTP/NTP server details in ProSoft 61850 Configuration Manager. The resolution of the time is in milliseconds (ms).

Configurable Parameters:	SNTP/NTP server synchronization rate (in minutes) SNTP/NTP Address

6.2 Hardware Specifications PLX8x-MNET-61850

Specification	Description
Power Supply	24 Vdc nominal 10 Vdc to 32 Vdc power input allowed Positive, Negative, GND Terminals 2.5 mm screwdriver blade
Current Load	200 mA max @ 24 Vdc 150 mA max @ 32 Vdc 450 mA max @ 10 Vdc
Operating Temperature	32°F to 140°F (0°C to 60°C)
Storage Temperature	-40°F to 185°F (-40°C to 85°C)
Relative Humidity	5% to 95% RH, with no condensation
Dimensions	Standard: Height x Width x Depth 4.72 inches x 1.90 inches x 4.18 inches
LED Indicators	ERR, CFG, FLT, PWR
Ethernet Port / Ports PLX 81 (E1) PLX82 (E1)(E2)	10/100 Base-T half duplex RJ45 Connector Link and Activity LED indicators Electrical Isolation 1500 V rms at 50 Hz to 60 Hz for 60 s, applied as specified in section 5.3.2 of IEC 60950: 1991 Ethernet Broadcast Storm Resiliency = less than or equal to 5000 [ARP] frames-per-second and less than or equal to 5 minutes duration
Shock and Vibration	Shock and Vibration tested to EN 60068 Standard
Shipped with Each Unit	1 Ethernet straight-through cable (gray) J180 screw terminal plug ProSoft Solutions DVD HRD250 screwdriver 1 GB Industrial SD Card

LEDs

LED	State	Description
Pwr	Off	Power is not connected to the power terminals or source is insufficient to properly power the gateway (800mA at 24vdc minimum required)
	Green Solid	Power is connected to the power terminals. Verify that the other LEDs for operational and functional status come on briefly after power-up (check for burned-out LEDs).
Flt	Off	Normal operation
	Red Solid	A critical error has occurred. Program executable has failed or has been user-terminated and is no longer running. Press Reset p/b or cycle power to clear error.
Cfg	Off	Normal operation
	Amber Solid	The unit is in configuration mode. The configuration file is currently being downloaded or, after power-up, is being read, the unit is implementing the configuration values, and initializing the hardware. This will occur during power cycle, or after pressing the reset button. It also occurs after a cold/warm boot command is received.
Err	Off	Normal operation
	Flashing	An error condition has been detected and is occurring on one of the application ports. Check configuration and troubleshoot for communication errors.
	Solid Amber	This error flag is cleared at the start of each command attempt (Client) or on each receipt of data (server); so, if this condition exists, it indicates a large number of errors are occurring in the application (due to bad configuration) or on one or more ports (network communication failures).
LED	State	Description
Data	Off	No activity on the Ethernet port.
	Green Flash	The Ethernet port is actively transmitting or receiving data.
Link	Off	No physical network connection is detected. No Ethernet communication is possible. Check wiring and cables.
	Green Solid	Physical network connection detected. This LED must be on solid for Ethernet communication to be possible.

6.3 ProSoft gateway

6.3.1 Asynchronous Processes

The gateway has a number of processes and drivers running in it in a multitasking firmware environment. An IEC 61850 Client driver, a Modbus TCP/IP Client driver, and a Modbus TCP/IP server driver operate asynchronously within this multitasking environment, along with other firmware processes. The drivers are independently processing the commands and messages in their queues as quickly as possible, giving priority to GOOSE messages.

The Modbus TCP/IP Client driver processes commands that have been enabled for continuous execution in the command list, starting with the first command and going through them sequentially until it gets to the last one. After the last command in the list has been completed, the driver starts over again at the first command and continues to cycle through the list, over and over again, as quickly as possible. The larger the Client Command List is, the longer it takes the driver to cycle through the list.

Meanwhile, the IEC 61850 Client may be receiving large amounts of data from the configured IEDs. If so, the IEC 61850 Client will be updating the Tag Database with data coming from the IEDs asynchronously from what's happening with the MNET Client driver.

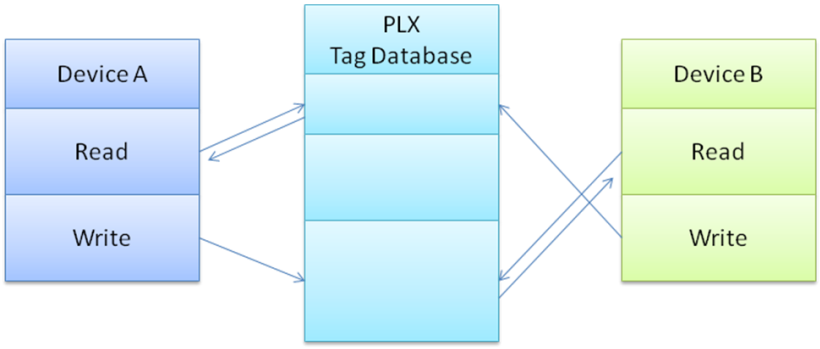
Since the different drivers run asynchronously from each other and depending upon how fast or how often IEDs send data, it is possible that a tag in the tag database may be updated more than one time by the IEC 61850 Client driver before the Modbus TCP/IP Client driver sees the update and can send the data to a Modbus server.

IED data changes are not buffered, so, the Modbus TCP/IP Client driver may not be able to transfer every data change that happens in the IEC 61850 Client tag database. Only the data most recently stored in the tag database by the IEC 61850 Client driver will be available for the MNET Client driver to transfer to Modbus Devices. So, it is possible that some changes in data values on some IEDs may be lost in the process, especially during times of high volume IED data traffic.

6.3.2 Tag Database

The Tag Database is a key part of the internal workings of the gateway. Upon restart, the Tag Database will read the configuration file, and process the tags. Data is stored in the gateway's memory, and referenced through tag names. The number of tags is limited to the memory capability of the hardware and the process memory required by gateway.

The data of varying data types are stored in the gateway. This impacts that maximum number of tags the gateway can hold.



Some data types are considered *Native* data types to the gateway, and some are considered *Complex*. Complex data types are for the creation of the user defined data types, which are necessary for many IEC 61850 data types.

Native data types

Native data types are the data types used internal to the gateway. When the data is transferred from IEC 61850 to Modbus TCP/IP, it is first stored in the tag database, using the following data types:

Name	Definition	Bits
BOOL	Boolean	1
BYTE	Byte	8
UBYTE	Unsigned Byte	8
INT	Integer	16
UINT	Unsigned Integer	16
DINT	Double Integer	32
UDINT	Unsigned Double Integer	32
REAL	IEEE 754 Single Precision Floating-Point	32
DREAL	IEEE 754 Double Precision Floating-Point	64
STRING	ASCII Character Array	32 + 8* Length
DATETIME	UTC microsecond precision date and time	64

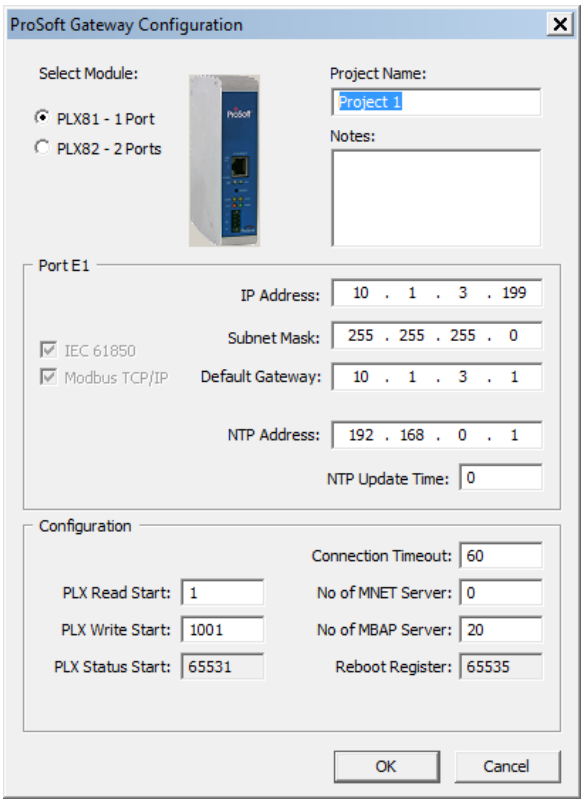
6.3.3 SNTP/NTP

This section covers the gateway's implementation of IEC 61850-7-2 Clause 18: Time and time-synchronization model (SNTP/NTP).

The IEC 61850 driver in the gateway is dependent upon the gateway's SNTP/NTP server. The gateway can set its time by making periodic requests for the current time to a Coordinated Universal Time (UTC) system. The user can define a NTP server in ProSoft 61850 Configuration Manager. It must be synchronized to some known level of accuracy, and the elapsed seconds received by the NTP server are since a defined Epoch, and the time server shall indicate LeapSecondsKnown (true or false).

There are two configuration parameters:

- SNTP/NTP server Address
- SNTP/NTP server Update Time (in minutes)



The ProSoft gateway hardware will be 17 seconds off per day for a Linux clock. If better time sync is required, the setup for the SNTP/NTP time server will need to be performed either from the internet or local clock that can sync up every one (1) minute as configured on the gateway.

6.4 IEC 61850 Detailed Specifications

The IEC 61850 Client driver supports MMS (ISO 9506-1 and ISO 9506-2) communication profile.

Part 7-2 of the IEC-61850 protocol specification lists the basic communication structure and abstract communication service interface (ACSI). This IEC 61850 Client driver supports the following 7-2 models:

- Association
- Data Set
- Report Control Block (Data is updated based upon various trigger options)
- GOOSE (Data is updated based upon data change only. GOOSE message is subscribed to.)
- Control
- Time and time-synchronization
- Naming conventions

Part 8.1: MMS later in this document lists the data types supported by IEC 61850. This is important for understanding how data mapping in the gateway will work. Other protocols do not all support the many data types that IEC 61850 does, so the IEC 61850 data will be converted to an appropriate data type in the other protocol. For example, in the case of Modbus, much of the IEC 61850 data will be converted to 16-bit integer words.

6.4.1 Application Association Model

This section describes the gateway's implementation of IEC-61850-72- Clause 7: Application association model. This clause describes how the association between two devices is achieved: *TWO-PARTY-APPLICATION-ASSOCIATION* and/or *MULTICAST-APPLICATION-ASSOCIATION*. Both types are used.

Two Party Messaging

Two Party messaging is the most common type of messaging our IEC 61850 driver performs. The following diagrams show the execution of two-party messages, and their associated abort sequence. In the diagrams, the IEC 61850 Client driver is the Client. This information has been taken directly from the IEC 61850 standard.

The services for associate, data exchange, and association release of the two-party application association class is depicted in Figure 7.

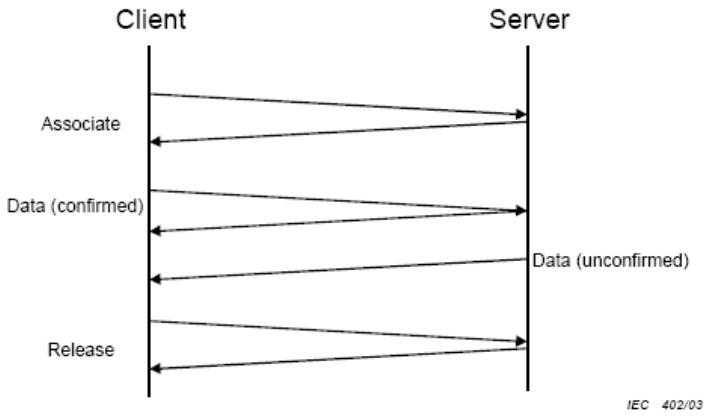


Figure 7 – Normal operation

The abort service for the two-party application association class is depicted in Figure 8.

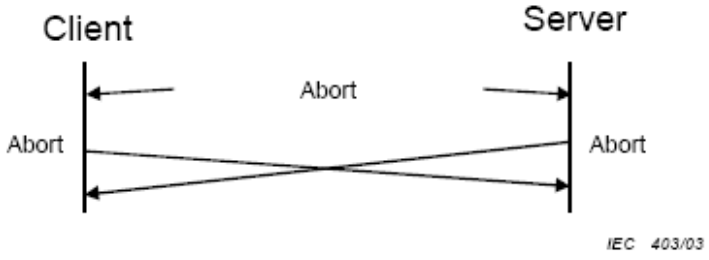


Figure 8 – Aborting association

Two party messages use these services: *Associate, Abort, and Release*.

For **TWO-PARTY-APPLICATION-ASSOCIATION** the following services are defined.

Service	Description
Associate	Establish an association
Abort	Abort an association
Release	Release an association

{These diagrams have been taken directly from the IEC 61850 Standard.}

Multicast

Multicast information exchange is performed between a source (publisher) and one or more destinations (subscribers). For the IEC-61850 protocol, this is known as GOOSE and GSSE messages. See the ACSI Service Conformance Statement later in this document, with the AA (Application Association) column marked with MC (Multicast).

The subscriber shall be capable to detect loss and duplication of information received. The receiver shall notify the loss of information to its user and shall discard duplicated information.

NOTE The possible restriction of multicast messages to be exchanged on a single subnet or sent through routers is an issue to be defined in an SCSM.

The multicast application association class is depicted in Figure 9.

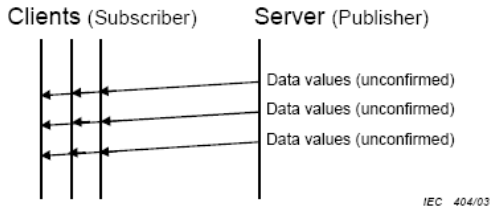


Figure 9 – Principle of multicast application association

{This diagram has been taken directly from the IEC 61850 Standards document.}

6.4.2 DATA-SET

The DATA-SETs are important for Buffered Report Control Blocks (BRCBs), Unbuffered Report Control Blocks (URCBs), and GOOSE Control Blocks. These Report Control Blocks (RCBs) reference a DATA-SET to know what data to send to the IEC 61850 Client. For some IEDs, the DATA-SET may be:

- Static
- Dynamic
- Optionally not reported in its entirety

This varibility is based on features of specific IEDs. ProSoft 61850 Configuration Manager does not allow the user to dynamically create a DATA-SET on the IED.

The definition of a DATA-SET is the group of Data Attributes that make up the DATA-SET. DATA-SETs (if they exist) are defined as part of the IED's configuration, as provided by the IED manufacturer.

The assignment of the DATA-SET to a BRCB, URCB, or GOOSE Control Block is set on the IED. These DATA-SET definitions are currently outside the scope of the gateway. See the BRCB, URCB, and GOOSE sections of this document to understand how DATA-SETs are used by the gateway, and for examples.

For **DATA-SET** the following services are defined.

Service	Description
GetDataSetValues	Retrieve all values of **DATA** referenced by the members of the **DATA-SET**
SetDataSetValues	Write all values of **DATA** referenced by the members of the **DATA-SET**
CreateDataSet	Create a **DATA-SET** by providing the **FCD** (**FCDA**) references or that form the **DATA-SET**
DeleteDataSet	Delete a **DATA-SET**
GetDataSetDirectory	Retrieve **FCD** references of all **members** referenced in the **DATA-SET**

{This diagram has been taken directly from the IEC 61850 Standards document.}

6.4.3 Report Control Block

This section describes the gateway's implementation of IEC 61850-7-2 Clause 14: REPORT-CONTROL-BLOCK.

Log and logging is not supported at this time.

The Report Control Block (RCB) is made available to the user through ProSoft 61850 Configuration Manager. The parsing of the CID/SCD file will discover the ReportControl element, which will be unique within the Logical Node (LN). ProSoft 61850 Configuration Manager will present the ReportControl items to the user, for the user to map to the other protocol in the gateway, if required or desired.

Supported Report Control Block Features

- RptEnabled
- TrgOps

When the gateway is configured to use an IED's report, after the gateway establishes a connection with the IED, it turns on *RptEnabled.* The gateway will then receive the reports.

TrgOps tells the gateway which internal event will produce the inclusion of a DATA-SET member onto a report. TrgOps options are:

- Data change (dchg)
- Quality change (qchg)
- Data update (dupd)
- General Interrogation

The reason for inclusion of a piece of data in the report is because the IED is dependent upon the TrgOps (Trigger Options) in the CID/SCD file.

Report Control Block Services

There are three typical RCB services:

- Report
- GetBRCBValues
- SetBRCBValues

The process starts with the Client issuing *RptEna* (report enable), as follows:

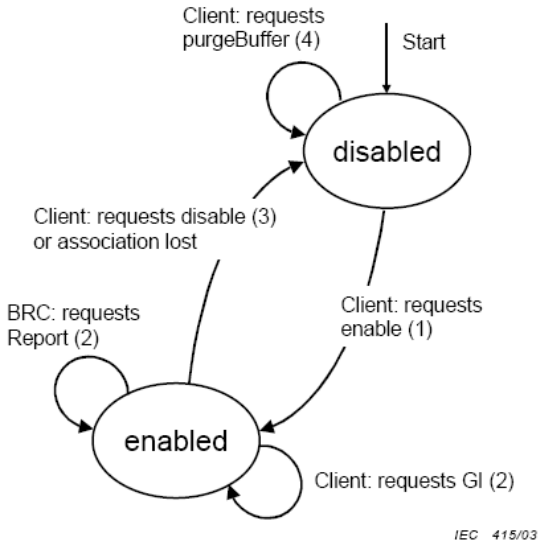


Figure 20 – BRCB state machine

(This diagram has been taken directly from the IEC 61850 Standard document)

The Report service is used by the BRCB to send reports from the server to the Client. Transmission is unconfirmed, meaning there is no validation check at the Client or acknowledement from the Client back to the server.

Table 24 – Report format specification

ReportFormat		
Parameter name	**Parameter type**	**Explanation**
RptID	VISIBLE STRING65 [a]	Report identification
OptFlds	[a]	Optional fields to be included in the report
IF sequence-number = TRUE in optFlds		
SqNum	INT16U	Sequence number
SubSqNum	INT16U	Subsequence number
MoreSegmentsFollow	BOOLEAN	More report segments with the same sequence number follow
IF dat-set-name = TRUE in optFlds		
DatSet	ObjectReference [a]	Data set reference
IF buffer-overflow = TRUE in optFlds		
BufOvfl	BOOLEAN	TRUE shall indicate that a buffer overflow has occurred.
If conf-revision = TRUE in optFlds		
ConfRev	INT32U	
Entry		
IF report-time-stamp = TRUE in optFlds		
TimeOfEntry [b]	EntryTime	
IF entryID = TRUE in optFlds		
EntryID [b]	EntryID	
EntryData [1..n]		
IF data-reference = TRUE in optFlds		
DataRef	ObjectReference	Respective DataAttrRef
Value	(*)	(*) type(s) depend on the definition of common data classes in IEC 61850-7-3
ReasonCode	TriggerConditions	If reason-for-inclusion (= TRUE) in optFlds

[a] The type and value of this parameter shall be derived from the respective attribute of the **BRCB**.

[b] TimeOfEntry and EntryID shall be available only if both report-time-stamp = TRUE AND entryID = TRUE in optFlds.

(This table has been taken directly from the IEC 61850 Standard document)

RptID is derived.

The entire contents of Table 24 will NOT be created as tags and therefore not brought over to the other protocol. Only the Tag Names (mapped Data Attributes) will be available to the other protocol. Although the IED buffers data changes, only the most recent data values sent by the IED will be processed by the gateway.

There are two types of Report Control Blocks (RCBs):

- **a** Buffered Report Control Blocks (BRCB)
- **b** Unbuffered Report Control Blocks (UCRB)

Buffered Report Control Block

The BRCB report controls are used by a Client implementing a well-defined functionality, for example, a SCADA master. If the IEC-61850 Client cannot access the report, its probably due to access control. When one BRCB for the IED is in use, no other Clients may access it.

The configuration file gives the IEC-61850 Client driver the following:

- Domain Name
- Data Path
- Report ID
- Enable Flag
- Intpd
- Confrev
- Trgopdchg
- Tag Names

The Tag Names will be a list of the Data Attributes as defined by the DATA-SET for the report. ProSoft 61850 Configuration Manager parses through the DATA-SET definition to determine the lowest level of the Data Attributes contained in it and creates those tags in the configuration file with the proper data type. The user will be able to choose which elements of the DATA-SET are mapped to Modbus.

For those DATA-SET Data Attributes that are not mapped, ProSoft 61850 Configuration Manager creates dummy tags as place holders for those data attributes. The dummy tags take up space in the tag database, even if they are not mapped to the Modbus driver.

The IEC 61850 driver processes report data from the IED by offsets, not by actual Data Attribute name. If the DATA-SET on the IED changes, the CID/SCD file needs to be re-imported in ProSoft 61850 Configuration Manager to reconfigure the gateway, so that the gateway's internal processing of the report is done correctly.

If the BRCB is mapped in the gateway's configuration, then the IEC 61850 driver will automatically turn on the Report Enable (RptEna) for the IED's BRCB.

Unbuffered Report Control Block

URCB data is sent immediately to the connected IEC 61850 Client. If the transport data flow is not fast enough to support the movement of this data, some may be lost. The IED can have multiple instances of the URCB data, and in this case, the IED server manages the separation of the instances transmitted to the IEC 61850 Clients.

If a URCB is mapped in the gateway's configuration, then the IEC 61850 driver will automatically turn on the Report Enable (RptEna) for the IED's URCB.

The unbuffered reports will be sent automatically from the IED to the gateway while Report Enable is on.

The IEC 61850 driver and configuration software implements URBCs the same as BRCBs.

Unsupported Report Control Block Features

OptFlds are the optional fields that the IED can include in the report:

- Sequence number
- Report time stamp
- Reason for inclusion
- Data set name
- Data reference
- Buffer overflow
- entryID

The gateway will only update the value of the tags (*Data Attribute*s) in the tag database. The optional fields from the reports are not stored in the tag database, and unsupported.

6.4.4 GOOSE Control Block

GOOSE control block class definition:

GOOSE control block class definition

GoCB class				
Attribute name	**Attribute type**	**FC**	**TrgOp**	**Value/value range/explanation**
GoCBName	ObjectName	GO	-	Instance name of an instance of GoCB
GoCBRef	ObjectReference	GO	-	Path-name of an instance of GoCB
GoEna	BOOLEAN	GO	dchg	Enabled (TRUE) | disabled (FALSE)
AppID	VISIBLE STRING65	GO		Attribute that allows a user to assign a system unique identification for the application that is issuing the GOOSE. DEFAULT GoCBRef
DatSet	ObjectReference	GO	dchg	
ConfRev	INT32U	GO	dchg	
NdsCom	BOOLEAN	GO	dchg	
Services SendGOOSEMessage GetGoReference GetGOOSEElementNumber GetGoCBValues SetGoCBValues				

(This table has been taken directly from the IEC 61850 Standard document)

You can set up GOOSE messages in the IEDs for only that data needs to be sent to the gateway. That way, GOOSE messages will contain only needed data.

GOOSE message format:

Table 29 – GOOSE message definition

GOOSE message		
Parameter name	**Parameter type**	**Value/value range/explanation**
DatSet	ObjectReference	Value from the instance of GoCB
AppID	VISIBLE STRING65	Value from the instance of GoCB
GoCBRef	ObjectReference	Value from the instance of GoCB
T	EntryTime	
StNum	INT32U	
SqNum	INT32U	
Test	BOOLEAN	(TRUE) test | (FALSE) no-test
ConfRev	INT32U	Value from the instance of GoCB
NdsCom	BOOLEAN	Value from the instance of GoCB
GOOSEData [1..n]		
Value	(*)	(*) type depends on the common data classes defined in IEC 61850-7-3. The parameter shall be derived from GOOSE control

(This table has been taken directly from the IEC 61850 Standard document)

Although this entire GOOSE message is received, the gateway will only store GOOSEData [1...n] in the tag database.

GOOSE Priority

The gateway gives GOOSE messages processing priority over other IEC data messages. If a GOOSE message is received, the GOOSE message is processed ahead of all other data transfer (MMS, Reporting) in the gateway at that moment.

GOOSE Subscription Status

The gateway's GOOSE subscription verifies match of confRev in a manner identical to the verification performed when enabling a report.

If the confRev does not match (unavailable, wrong type, different value), then the GOOSE is not subscribed and an Event is logged in the Event Logger describing the reason.

If the data type of confRev fetched from the IEC device is not *RT_UNSIGNED*, then no event is logged.

The command, *confRev* must match what is running in the IED when the gateway comes on-line with the current configuration, or the gateway will not successfully subscribe to the GOOSE message.

The gateway does not check for a match of the GOOSE appid from the CID file to the actual running IED when performing a GOOSE subscription.

IED Disconnect/Reconnect

If for any reason an IED disconnects from the network, the ProSoft gateway will continually poll for the device and attempt to reconnect.

6.4.5 Control

Operate

Used by *Direct control with normal security*, *SBO control with normal security*, *Direct control with enhanced security*, and *SBO control with enhanced security* to write data to IED devices.

In the case where the logical node has (for example) *Pos* data that has *SBOw*, *Oper*, and *Cancel*, the user needs to map the *Oper* structure only when wanting to control that data. *SBOw*, *Oper*, and *Cancel* all refer to controlling the same data attributes on the IED. The gateway automatically handles the select with value. So although the *SBOw* and *Cancel* can be seen in the configuration software, they should not be mapped. Only the *Oper* should be mapped. (The *Cancel* structure should only be mapped if it is required.)

The IEC 61850 *Oper* Structure has D*ata Attribute*s as defined by the standard. When you make MMS Writes from the Modbus device to the IED, if you do not populate all data elements of *Oper*, the gateway will by default populate the other data elements with 0 (zero). The exception to this is *T* which is always set to the current time in the gateway.

The IEC-61850 Client driver needs to provide the following information to the IED. These *Data Attribute*s will be available for the user to select and set.

The **Operate** service shall define the following service parameters.

Parameter name
Request
ControlObjectReference
Value
T
Test
Check
Response+
ControlObjectReference
Value
T
Test
Response–
ControlObjectReference
Value
T
Test
AddCause

(This table has been taken directly from the IEC 61850 Standard document)

ctlVal

This must be set for:

- SPC (Single Point Control)
- DPC (Double Point Control)
- INC (Controllable Integer Status)
- BSC (Binary Controlled Step Position Information)
- ISC (Integer Controlled Step Position Information
- CDCs (Common Data Classes)

17.5.2.2 Value

The parameter **Value** shall include values for all implemented **DataAttributes** of a controllable common **DATA** class that are accessed by various control services.

NOTE Common **DATA** classes and their **DataAttributes** are defined in IEC 61850-7-3.

EXAMPLE For the case of an **Operate** request, the value may include the following parameters:
– control value (on, off),
– originator category (remote, station, bay...),
– control sequence number.

(This table has been taken directly from the IEC 61850 Standard document)

setMag

- This must be set by the user for APC (Controllable Analogue Set Point Information) CDC.

operTm

- The PLC user sends a command with operate time to the gateway, and the gateway uses time activated control, e.g. it sends the time of operation to the IED. The IED needs to support the time activated control.

origin.orCat

- The *orCat* could have these values. The value depends upon the role of the PLC. E.g. if the PLC is a station control, then this value will never change.

not-supported	*orCat* is not supported
bay-control	Control operation issued from an operator using a Client located at bay level
station-control	Control operation issued from an operator using a Client located at station level
remote-control	Control operation from a remote operater outside the substation (for example network control center)
automatic-bay	Control operation issued from an automatic function at bay level
automatic-station	Control operation issued from an automatic function at station level
automatic-remote	Control operation issued from a automatic function outside of the substation
maintenance	Control operation issued from a maintenance/service tool

process	Status change occurred without control action (for example external trip of a circuit breaker or failure inside the breaker)

origin.orIdent

- This is the address of the originator. The value the user wants depends upon the role of the PLC.

ctlNum

- This is of no consequence to the IED and only appears in reports. This is an optional parameter. The ctlNum may be of interest to the user when the Client uses the same control number for a complete control sequence: select, operate, …

T

- This is the time the IEC-61850 Client sent the control request. The IEC-61850 Client driver writes this value using the current gateway time.

17.5.2.3 T – control time-stamp

The parameter **T** shall be the time when the client sends the control request.

Table 36 – Control time-stamp definition

Control time-stamp type		
Attribute name	**Attribute type**	**Value/value range/explanation**
T	EntryTime	

(This table has been taken directly from the IEC 61850 Standard document)

Test

- Test issues are still early in IEC-61850 use. This is only required if the customer really wants to issue a control command which should be interpreted by the IED as a command that should not cause a real operation.

Check

- The user's specific application determines if or how this parameter will be used. This parameter determines whether control actions are done immediately without interlock or synchrocheck, or if an interlock or synchrocheck will be done before the operation is done. Some other part of the user's application may do these checks anyway, even if checks are not used here. The PLC can be set to always use or always not use checks, or it can enable or disable checks for each control action when the control message is sent.

17.5.2.5 Check – check condition

The parameter **Check** shall specify the kind of checks a control object shall perform before issuing the control operation if common **DATA** class is **DPC** (double-point control – see IEC 61850-7-3).

Table 38 – Check condition definition

Check condition type		
Attribute name	**Attribute type**	**Value/value range/explanation**
Check	PACKED LIST	
synchrocheck	BOOLEAN	TRUE means run synchrocheck
interlock-check	BOOLEAN	TRUE means run interlock-check

(This table has been taken directly from the IEC 61850 Standard document)

IEC 61850 MMS Write

This covers the gateway's implementation of IEC 61850-7-2 Clause 17: CONTROL Class model (Writable Data).

The IEC 61850 driver will be able to write to some IED data attributes. The writable data attributes will be those that are identified in the ICD file with control classes of:

- *Direct with normal security*
- *Select Before Operate (SBO) with normal security*
- *Direct with enhanced security*
- *Select Before Operate (SBO) with enhanced security*

Control with normal security is for data attributes in which the Client will not receive failure information. This implies that there would not need to be any action taken by a supervisory control on the system if the value of the data attribute didn't change to the value the IEC 61850 driver was trying to write to it. The gateway will receive an acknowledgment (*ack*) telling if the operation worked or not.

The control function may optionally include a *Select* step, used to check that the control may be valid and to eventually lock a resource. *SBO-with-normal-security* and *SBO-with-enhanced-security* include the *Select* step. This is handled automatically by the gateway.

IEDs have certain filters in them that check that there will be no damage if the control is issued. These functions are listed under "System control functions".

- *Control unity* (on the controlled item, in the bay, in the voltage level, in the substation).
- *Interlock validity*: Interlocking is a parallel function that delivers a status to enable or disable a control (if interlock is set to on). The control message may contain an interlock violation status to bypass it.
- *Synchrocheck validity*: When closing a breaker, the synchrocheck will verify some electrotechnical conditions and enable or disable the control, depending on its type.
- *Time validity*: The control contains a time attribute that specifies the time limit for issuing the control. This avoids issuing an old control that would have been stacked into the network.
- *Locked status*: A controlled item may be under lock status when the substation is partly in maintenance mode. This prohibits any control, for example, on a breaker if an operator is performing some repair on the line. Note that locking an item is an example of control.
- *Control privilege*: This is needed if an operator expects to control an item to check his privileges.
- *Substation and bay mode status*: The substation should be in remote mode to enable remote control (i.e. from SCADA) and in local mode to enable control issued inside the substation. The bay mode should be in remote mode to enable control from the station level or remote control level (SCADA).
- *State of the controlled item*: The control should lead the controlled item into an authorized state (for example, it is impossible to open an open disconnecter). When the controlled item is in an unknown state (for example, double point status have the same value), this filter is optionally suppressed.

Control is canceled if one of these filters is not verified or if a cancel order is received from the control point.

6.4.6 MMS

Part 8-1 of the protocol specification details the Specific Communication Service Mapping (SCSM), which is mapping of data to MMS (ISO 9506-1 and ISO 9506-2). The IEC-61850 driver is fully compliant to the MMS requirement.

In terms of the seven-layer OSI model, the new MMS stack looks like this:

Application	Association Control Service Element (ACSE)- ISO 8649/8650
Presentation	Connection Oriented Presentation - ISO 8822/8823 Abstract Syntax Notation (ASN)- ISO 8824/8825
Session	Connection Oriented Session - ISO 8326/8327
Transport	ISO transport over TCP - RFC 1006 Transmission Control Protocol (TCP) - RFC 793
Network	Internet Control Message Protocol (ICMP) - RFC 792 Internet Protocol (IP)- Address Resolution Protocol (ARP)- RFC 826
Link	IP datagrams over Ethernet - RFC 894 MAC - ISO 8802-3 [Ethernet]
Physical	Ethernet

Data Types

Understanding the data types used by the PLX8X-MNET-61850 will be helpful for understanding data transfer for IEC-61850-7-2 Clause 14 (BRCB & URCB), 15 (GOOSE), and 17 (CONTROL).

Basic data types

The **BasicTypes** shall be as listed in Table 2.

Table 2 – BasicTypes

BasicTypes			
Name	**Value range**	**Remark**	**Used by**
BOOLEAN			IEC 61850-7-3 IEC 61850-7-2
INT8	-128 to 127		IEC 61850-7-3 IEC 61850-7-2
INT16	-32 768 to 32 767		IEC 61850-7-3 IEC 61850-7-2
INT24	-8 388 608 to 8 388 607	for TimeStamp type	IEC 61850-7-2
INT32	-2 147 483 648 to 2 147 483 647		IEC 61850-7-3 IEC 61850-7-2
INT128	-2**127 to (2**127)-1	Required for counters	IEC 61850-7-3
INT8U	Unsigned integer, 0 to 255		IEC 61850-7-3 IEC 61850-7-2
INT16U	Unsigned integer, 0 to 65 535		IEC 61850-7-3 IEC 61850-7-2
INT24U	Unsigned integer, 0 to 16 777 215		IEC 61850-7-2
INT32U	Unsigned integer, 0 to 4 294 967 295		IEC 61850-7-3 IEC 61850-7-2
FLOAT32	Range of values and precision as specified by IEEE 754 single-precision floating point		IEC 61850-7-3
FLOAT64	Range of values and precision as specified by IEEE 754 double-precision floating point		IEC 61850-7-3
ENUMERATED	Ordered set of values, defined where type is used	Custom extensions are allowed	IEC 61850-7-3 IEC 61850-7-2
CODED ENUM	Ordered set of values, defined where type is used	Custom extensions shall not be allowed. Type shall be mapped to an efficient encoding in a SCSM	IEC 61850-7-3 IEC 61850-7-2
OCTET STRING	Max. length shall be defined where type is used [a]		IEC 61850-7-3 IEC 61850-7-2
VISIBLE STRING	Max. length shall be defined where type is used [a]		IEC 61850-7-3 IEC 61850-7-2
UNICODE STRING	Max. length shall be defined where type is used [a]		IEC 61850-7-3
[a] The length suffix shall have the format "...STRINGnn" where "nn" is the length in characters.			

(This table has been taken directly from the IEC 61850 Standard document)

EntryID

EntryID is 8 octet fixed length MMS *OCTET STRING*.

PACKED LIST

PACKED LIST is MMS Bit-string of variable length. Bit 0 is the leftmost (most significant) bit of the first octet. Bit 7 is the rightmost (least significant) bit of the first octet. Bit 8 is the leftmost (most significant) bit of the second octet. Bit 15 is the rightmost (least significant) bit of the second octet, etc. Exceptions to this are time and quality:

Table 15 – Encoding of IEC 61850-7-2 TimeQuality

Bit	Value	Meaning
0		Leap Second Known
1		ClockFailure
2		Clock not synchronized
3-7		Time accuracy of fractions of second
	00000	0 bit of accuracy
	00001	1 bit of accuracy
	00010	2 bits of accuracy
	00011	3 bits of accuracy
	00100 - 11000	Integer value of number of bits of accuracy
	11000- 11110	Invalid
	11111	unspecified

(This table has been taken directly from the IEC 61850 Standard document)

Bit 0 will be the most significant bit of octet 7. Bit 7 will be the least significant bit of octet 7. The octet format will be (using ASN.1 bstring notation)

EntryTime

EntryTime is mapped as BINARY-TIME, and it will be six octets.

TriggerConditions

TriggerConditions, such as those used in BRCB, are encoded as a PACKED LIST, yet bit 0 is reserved.

Bit 0 Reserved (reserved to provide backward compatibility with UCA 2.0)
Bit 1 data-change
Bit 2 quality-change
Bit 3 data-update
Bit 4 integrity
Bit 5 general-interrogation

Quality

Quality is packed as 13 bits.

Table 16 – Encoding of IEC 61850-7-3 quality

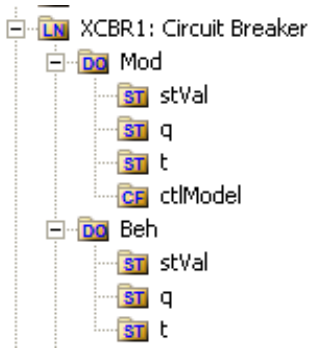
Bit(s)	IEC 61850-7-3		Bit-String	
	Attribute name	Attribute value	Value	Default
0-1	Validity	Good	0 0	0 0
		Invalid	0 1	
		Reserved	1 0	
		Questionable	1 1	
2	Overflow		TRUE	FALSE
3	OutofRange		TRUE	FALSE
4	BadReference		TRUE	FALSE
5	Oscillatory		TRUE	FALSE
6	Failure		TRUE	FALSE
7	OldData		TRUE	FALSE
8	Inconsistent		TRUE	FALSE
9	Inaccurate		TRUE	FALSE
10	Source	Process	0	0
		Substituted	1	
11	Test		TRUE	FALSE
12	OperatorBlocked		TRUE	FALSE

(This table has been taken directly from the IEC 61850 Standard document)

Functional Constraints

Each IEC 61850 Data Attribute has a Functional Constraint (FC), which shows what the data is or how it is used. For example, Data Attributes with FC=ST are status data. Data Attributes with FC=CO can be controlled.

The Data Attributes Functional Constraints can be seen in the IEC Mapping Tool window, for example:



Note: the little icons provide information. *DO* is for Data Object. Within the DO, there may be multiple levels of data. When we get down to the Data Attribute level, the functional constraint of the Data Attribute is shown in the icon, e.g. *CO* for Control, *ST* for Status Information, and *CF* for Configuration.

List of IEC 61850 Functional Constraints:

Functional Constraint	Description
ST	Status information
MX	Measurands (analog values)
CO	Control
SP	Setpoint
SV	Substitution
CF	Configuration
DC	Description
SG	Setting Group
SE	Setting group editable
EX	Extended definition
BR	Buffered report
RP	Unbuffered report
LG	Logging
GO	GOOSE Control
GS	GSSE Control
MS	Multicast sampled value control
US	Unicast sampled value control
XX	Represents data attributes as a service parameter. XX is a wildcard.

6.4.7 Modbus TCP/IP Server

Modbus TCP/IP Server Startup Sequence:

- **a** Connect to Event Logger
- **b** Connect to tag database – Error message in event log on fail
- **c** Parse configuration file – Error message if cannot create configuration object
- **d** Connect to system tag database
- **e** Initialize diagnostics
- **f** Connect to MCP – Error message in event log on fail
- **g** Create server pool
- **h** Server pool creates a server thread for each configured server
- **i** Inform MCP that driver is ready to run
- **j** Wait for run signal from MCP
- **k** Run server communications: wait for Client to connect
- **l** If receives quit signal from MCP clean up threads and exit process

Each Client will try to connect in a loop until the connection is made. If the attempt to connect fails, it will wait 100ms and try again. If a connection is lost it start trying to connect the same as during startup.

The server will disconnect on connection loss or when there is no communication for a timeout period. It will then begin listening for a connection request from a Client.

6.4.8 IEC 61850 Client

IEC 61850 Client Startup Sequence:

- **a** Verify process arguments from MCP
- **b** Connect to the Event Log; upon success log Event.
- **c** Connect to System tag DB; upon failure log Event.
- **d** Initialize diagnostics.
- **e** Connect to User tag DB; upon failure log Event.
- **f** Connect to MCP Interface; upon failure log Event. Tell MCP Interface "not running", "not ready".
- **g** Parse configuration.
- **h** Verify all tag pointers from configuration for validity (tags all defined, all exist in User tag DB); upon first failure log Event.
- **i** Create internal file for configuration from our parsed configuration.
- **j** Initialize diagnostic tag pointers and diagnostic values.
- **k** Opens internal file and the GOOSE socket; upon failure of either log Event.
- **l** Prepare reportids; upon failure log Event.
- **m** Tell MCP Interface *ready.*
- **n** Start the Diagnostics thread.
- **o** Initialize global GOOSE management
- **p** Tell MCP Interface *running.*

All conditions causing the driver not to start are identified above by the log Event actions.

IEC 61850 Client firmware operating sequence:

- **a** If not connected to a configured IED, it will attempt to connect. Attempt every 5 seconds. Once connected, attempt identify with the IED. Attempt every 50 ms. If identify fails 10 times, disconnect from IED and attempt reconnect every 5000 ms.
- **b** Subscribe to any GOOSE messaging configured for this IED. Ensure match of each element's type id and the GOOSE confRev. Set failure flag if no match is found.
- **c** Enable any Reports configured for this IED. If the enable fails for whatever reason, such as a mismatch of confRev, then the Report is not enabled and not attempted again. Otherwise the Enable continues to be attempted every 60 seconds. Once connected, perform a General Interrogation to receive all data values of the Report, if that TrgOp was enabled for that Report. Once connected, perform a General Interrogation to receive all data values of the Report, if that TrgOp was enabled for that report.
- **d** Process MMS reads and MMS writes

The IEC 61850 Client driver attempts to reconnect to any disconnected IEDs every 5000 milliseconds.

Configured GOOSE messages for an IED are not re-subscribed upon a reconnect. There is no need, because GOOSE messages are of an EtherType packet, not an IP packet. GOOSE messages are addressed by MAC address, not IP address. (Essentially it is a broadcast message.)

Configured Reports for an IED return to a *Must try to Enable* state, and follow the startup sequence.

If MMS Reset (meaning the stream is out of step) is issued by the gateway or the IED, then the gateway issues a disconnect and reconnects to the IED. If the IEC-61850 driver receives a short packet (short MMS read) then it issues a MMS Reset.

6.5 Processing the Commands

The command processing options are:

Continuous polling

- Messages will be issued to the server each time the command is next on the polling list.

Timed polling

- Commands will issue a message when the time has expired and the command is the next command in the polling list.

Data change event

- Commands will be loaded into a queue when any value in a tag mapped to the command changes. The queue is always checked before processing the scan list giving event commands a higher priority. IEC 61850 GOOSE data has priority over any other command processing.

Client tag mapping is command based. Each command has one tag mapped to the Modbus registers being written or read by the Client. When reading registers from a server, the data returned in the response is placed in tags in the tag database. When writing registers to a server, the data is taken from tags in the tag database. This tag mapping is done at the individual command level. The tags are mapped within ProSoft 61850 Configuration Manager.

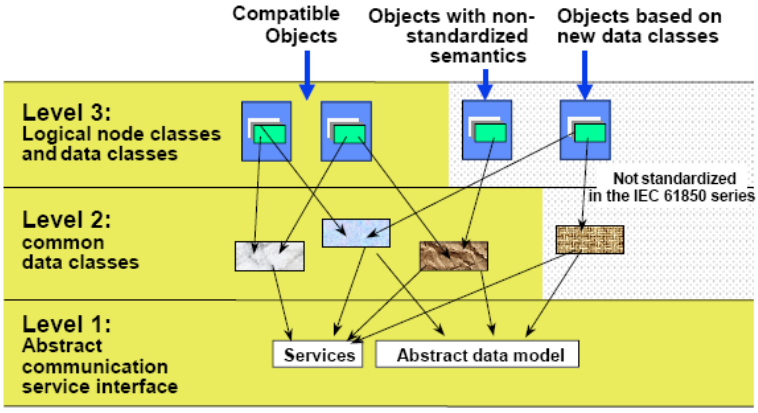
6.6 IEC 61850 Standard Introduction

IEC 61850 is primarily focused on electrical utility stations and substations. Substations can be categorized as distribution or transmission substations. Distribution substations generally have feeder equipment in the voltage range of 30 kV and under. The one or two incoming feeders are generally at a transmission voltage level. A transmission substation would have feeder equipment at a transmission voltage level, generally 100 kV and above.

Although IEC 61850 applications are primarily in electrical substations, there are applications in the oil and gas industries as well (co-gen sites).

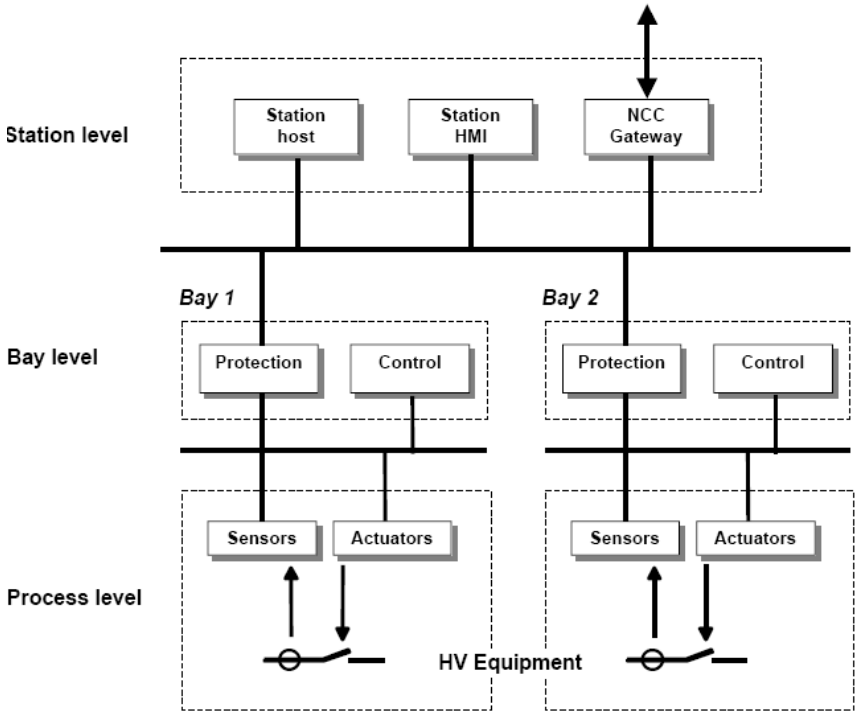
6.6.1 Integrating the Substation

The Logical nodes can inter-operate with other logical nodes by interpreting and processing compatible services and data classes.



(This table has been taken directly from the IEC 61850 Standard document)

Typical Substation Automation System:



(This table has been taken directly from the IEC 61850 Standard document)

- In a typical substation, all data attributes from each of the IEDs are desired at the PLC.
- Data is desired at the Station PLC (for decision making) and at the SCADA system
- Data gathered for Condition Based Monitoring purposes, to detect point of degradation of an aging mechanism
- Examples of data needs: checking SF_6 gas insulation temperature
- Alarm data with high precision of accuracy needed, to determine which IED alarmed (GOOSE'd) first
- Control of bay-level switchgear for interlocking and maintenance purposes

6.6.2 IEC 61850 Benefits

- Object-oriented data model
- Introduces *Logical Nodes* (*LNs)* for formally defining functions (for example *XCBR* = Circuit Breaker, *XSWI* = Isolator or earth switch)
- *LN* defines standardized access to its data
- Performance guidelines per *LN* strongly influence the communication system structure
- Communication technology based upon standardized rules, not rules stated by chance by customer specifications
- Strong formal description of automation system, which is key for specification, design, and engineering
- Self-describing (Example: vendor name plate information)

6.6.3 IEC 61850 Communication Features

- Specific Communication Service Mapping (SCSM) is done via MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3. This is part *IEC-61850-8-1* of the standard.
- Specific Communication Service Mapping (SCSM) for Sampled Values is over ISO/IEC 8802-3. This is part *IEC-61850-9-2* of the standard.

Ethernet has proven performance for the demands of IEC 61850. For best performance, it is recommended that Ethernet switches be used, rather than hubs.

6.6.4 SCL / Standardized Data Exchange

IEC-61850's SCL (Substation Configuration Description Language) introduces a powerful feature for substation automation. It provides a *vendor-independent* representation of the substation's configuration. For example, XCBR is a circuit breaker, no matter who the vendor is, what the country the vendor is from, what country the system integrator is from, where the installation is.

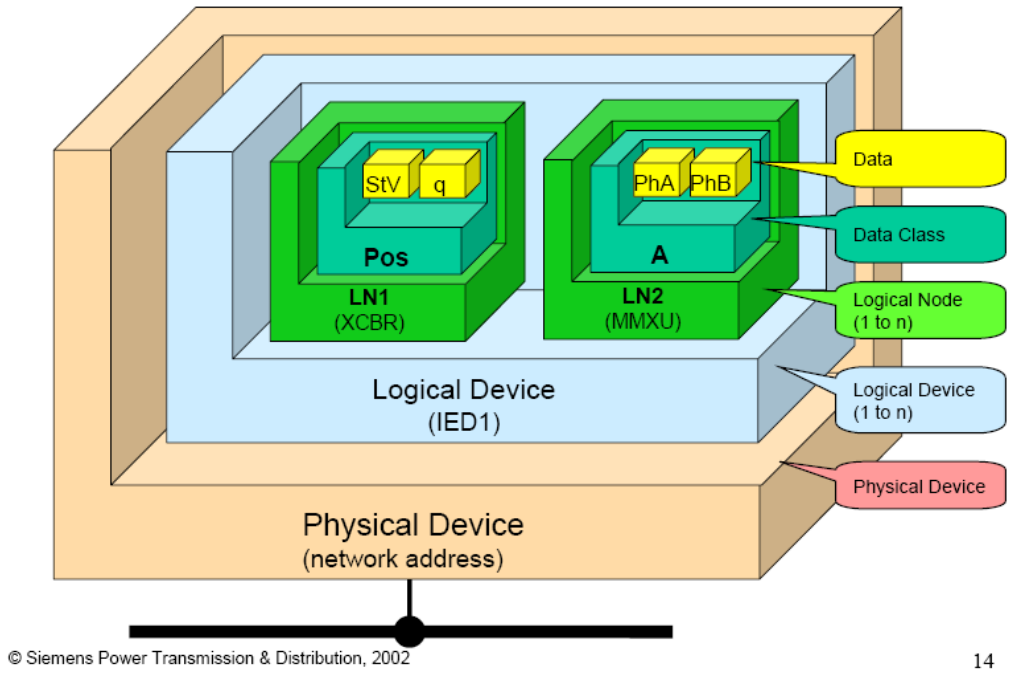
IEC-61850 has a number of SCL-type files:

- SSD for substation specification description
- SCD for the substation configuration description
- ICD for IED capability description (like a configuration template for the IED)
- CID for the configured IED description

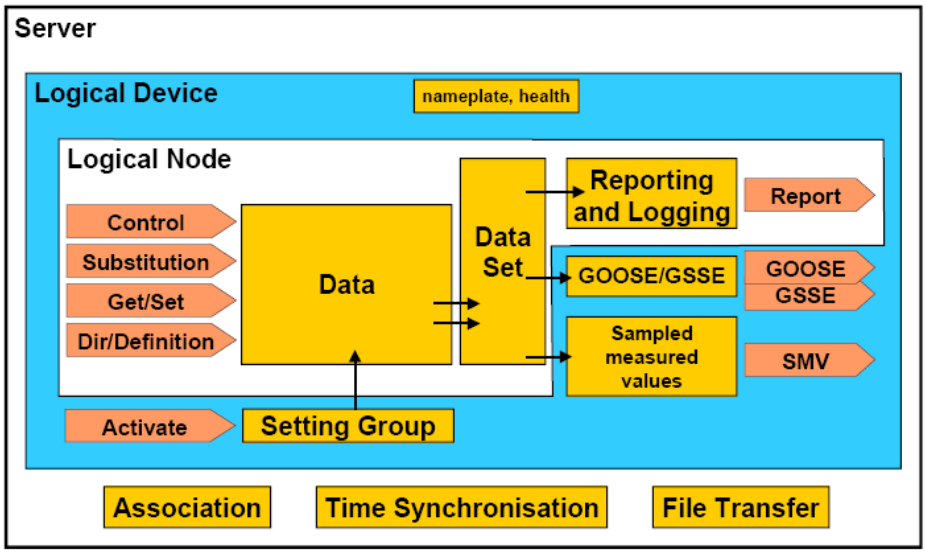
Note: This concept is key for meeting engineering challenges.

6.6.5 Additional Advantages to Substation Configuration Description Language (SCL)

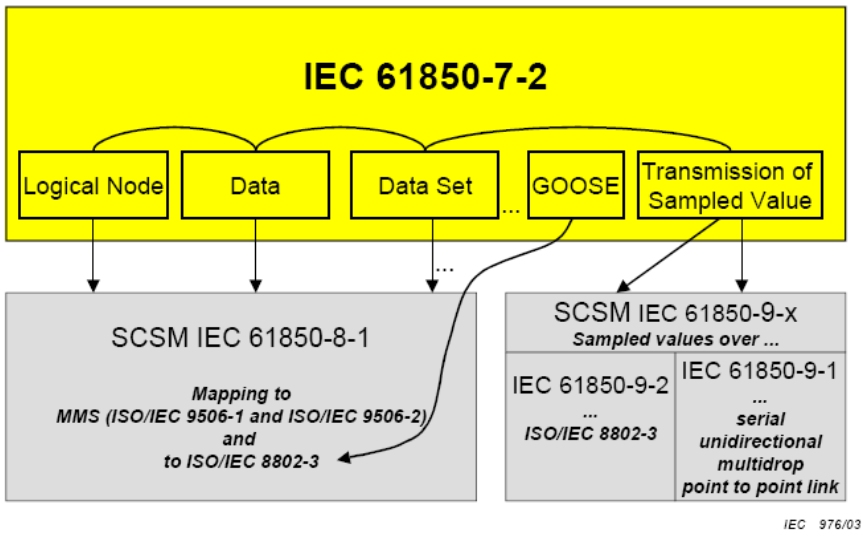
- ICD files list the functionality (via Logical Nodes) and data objects (Data Attributes) available for the IED
- The device's ICD files list the communication service capabilities of the IED, e.g. is File Transfer supported
- The ICD tells what's in the DATA-SETs.
- It lists the Report Control Blocks, and if the DATA-SET for it can by dynamically assigned.
- When gathering data from the IED for archiving purposes, the database is simply built because of the descriptive names coming from the devices.



IEC-61850-7-2 Overview Diagram



Information Exchange Diagram



(These diagrams have been taken directly from the IEC 61850 Standard document)

6.6.6 Report Control Block BRCB (Clause 14)

Buffered Report Control Block (BRCB)

A Buffered Report Control Block (BRCB) is associated with a DATA-SET. BRCB data is queued up, or buffered, in the IED, and sent sequentially to the connected IEC-61850 Client. The size of the buffer is defined by the IED. BRCB is used so that data will not be lost due to communication control or loss of connection. There are procedures required around the reporting, and the IED may only report to one Client.

Unbuffered Report Control Block (URCB)

An Unbuffered Report Control Block (URCB) is associated with a DATA-SET. URCB data is sent immediately to the connected IEC-61850 Client. If the transport data flow is not fast enough to support the movement of this data, some may be lost. The IED can have multiple instances of the URCB data, and manages the separation of the instances to the IEC-61850 Clients.

6.6.7 Control (Clause 17)

There are 5 types of control models defined:

- *Status-only*
- *Direct-with-normal-security*
- *Select Before Operate SBO-with-normal-security*
- *Direct-with-enhanced-security*
- *Select Before Operate SBO-with-enhanced-security*

Enhanced Security tends to be used only for high-voltage sites.

SBO includes a *Select* step, used to check that the control may be valid and to eventually lock a resource.

Direct Control with Normal Security

Direct control with normal security is commonly used for operations that act on local data (such as a LED test) or on data for which return information is not supervised (for example switch on a heating). It uses the *Operate* and *TimeActivatedOperate* services.

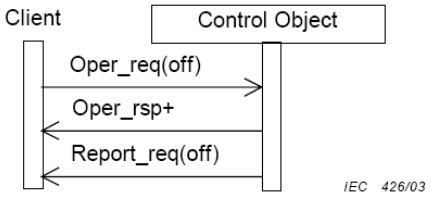


Figure 31 – Direct control with normal security

Procedure

On receipt of an **Operate** request, the control object shall check validation of the control execution.

- If not successful, the control object shall issue a negative response to the requesting client.
- If successful, the control object shall issue a positive response to the requesting client and causes the requested action.

The new status may be reported by the **Report** service (see reporting model).

(This diagram and text has been taken directly from the IEC 61850 Standard document)

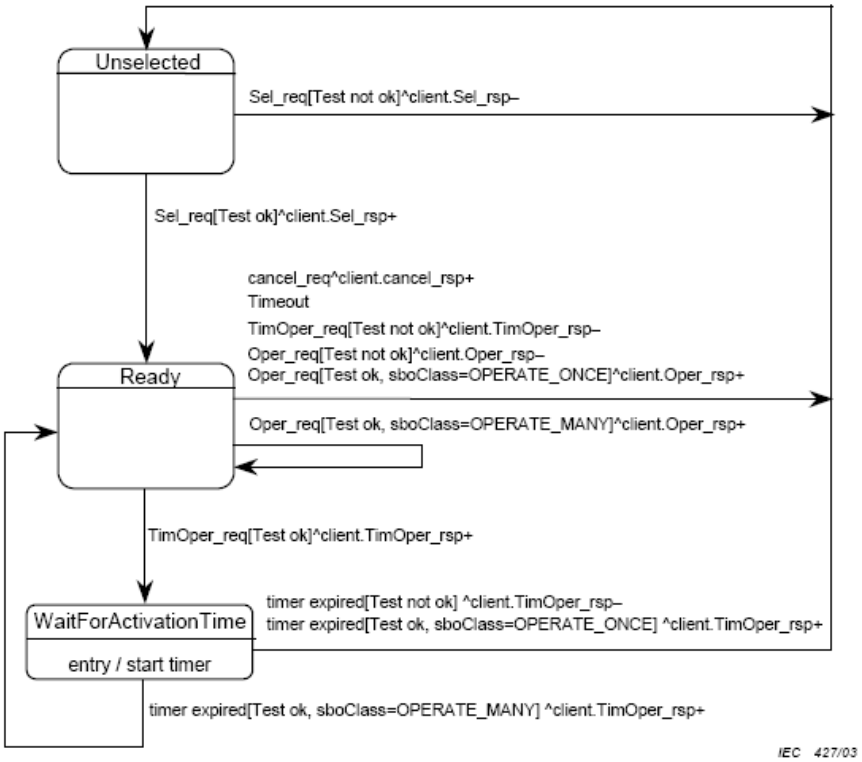
SBO (Select Before Operate) with Normal Security

SBO control with normal security first verifies that the data attribute is not currently selected by a different Client; that it is operable; and that the operation is not restricted. If this is verified, then the Operate request should proceed. It uses these services:

- **SELECT**
- **CANCEL**
- **OPERATE**
- **TIMEACTIVATEDOPERATE**

SBO with normal security data attributes are generally controllable single point (SPC) attribute types. These are things such as:

- **RUN DIAGNOSTICS**
- **TRIGGER RECORDER**
- **RESET RECORDER MEMORY**
- **CLEAR MEMORY**



NOTE This state machine is compatible to the SBO control model defined in UCA™.2.

Figure 32 – State machine of SBO control with normal security

Procedure

a) On receipt of a **Select** request, the control object shall determine if the client has appropriate access authority, that the control object is not currently selected by a different client, and that the device represented by the associated **LOGICAL-NODE** is operable and is not tagged so as to restrict operation.
   - If the **Select** operation is not valid, the control object shall issue a negative response to the requesting client.
   - If the **Select** operation is valid, the control object shall issue a positive response to the requesting client, shall change the state to ready and starts a deselect timer for either the interval defined by the SelTimOut attribute or, if unimplemented, some locally determined duration.

b) If the deselect timer expires before an **Operate** request on one or more of the other control components shall be requested by the selecting client, the control object shall change the state to unselected.

c) If an **Operate** request is received from the selecting client while the state is not Ready for that client, the operation shall be denied.

d) On receipt of an **Operate** request, the control object shall check validation of the control execution.
   - If not successful, the control object shall issue a negative response to the requesting client.
   - If successful, the control object shall issue a positive response to the requesting client and shall cause the requested action by activating a binary output (or sending an equivalent signal on a process bus). The control object shall turn to the state WaitForActivationTime.

(This diagram and text has been taken directly from the IEC 61850 Standard document)

Direct Control with Enhanced Security

Direct control with enhanced security uses these services:

- **OPERATE**
- **TIMEACTIVATEDOPERATE**
- **COMMAND-TERMINATION**

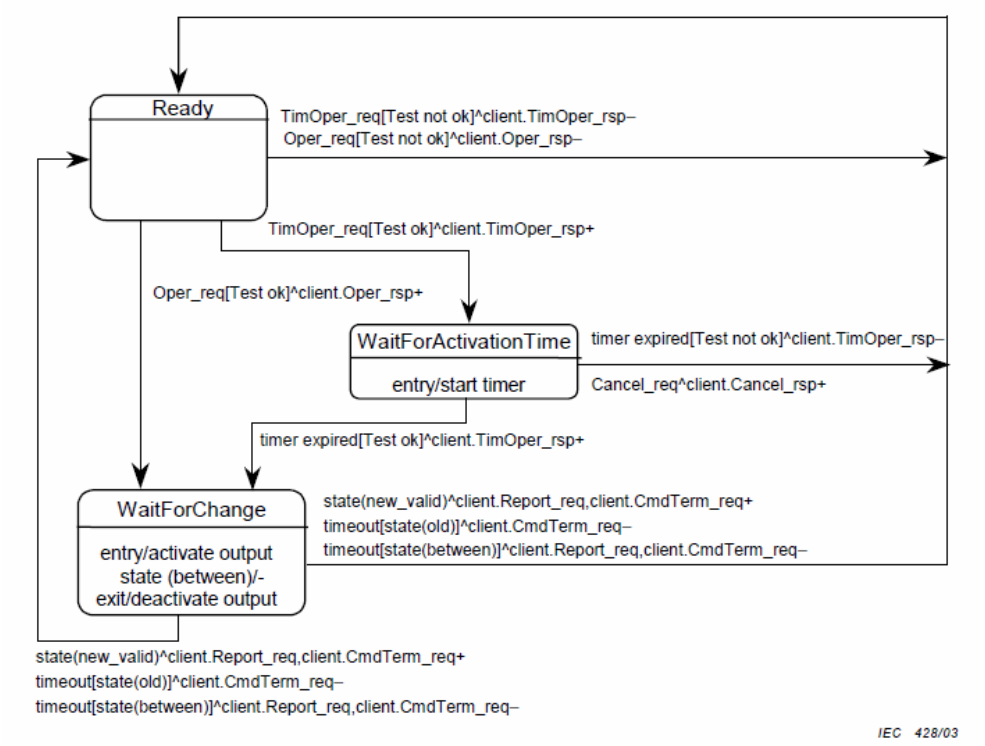


Figure 33 – State machine of direct control with enhanced security

(This diagram has been taken directly from the IEC 61850 Standard document)

SBO (Select Before Operate) with Enhanced Security

SBO control with enhanced security uses these services:

- **SELECTWITHVALUE**
- **CANCEL**
- **OPERATE**
- **TIMEACTIVATEDOPERATE**
- **COMMAND-TERMINATION**

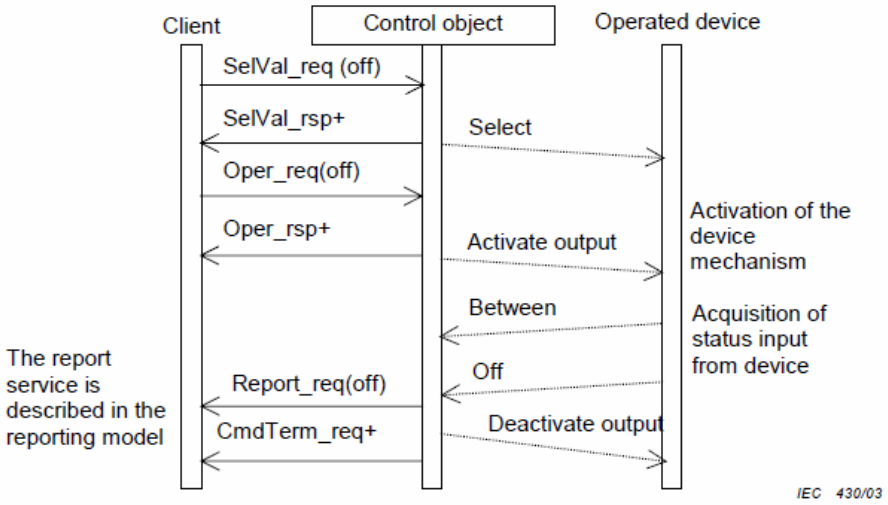


Figure 35 – Select before operate with enhanced security – positive case

NOTE The dashed lines in Figures 35 and 36 indicate that these "services" are local and not visible at the communication level.

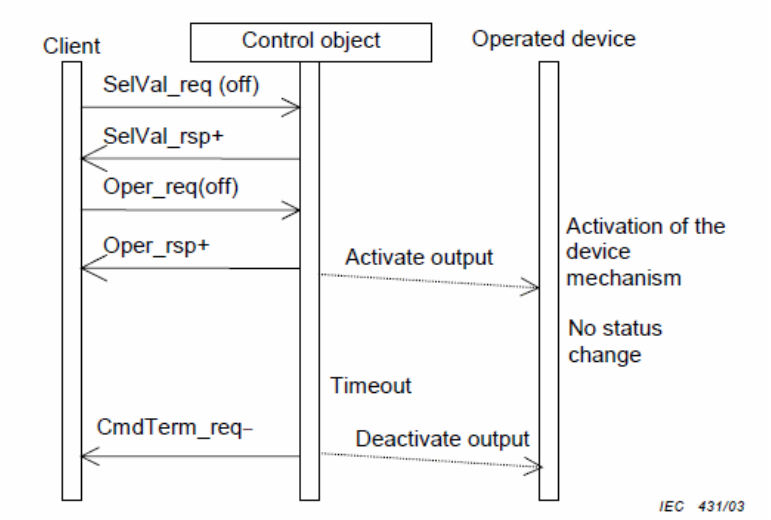


Figure 36 – Select before operate with enhanced security – negative case (no status change)

Procedure

a) On receipt of a **SelectWithValue** request, the control object shall determine if the client has appropriate access authority, that the control object is not currently selected by a different client, and that the device represented by the associated **LOGICAL-NODE** is operable and is not tagged so as to restrict operation.

   – If the **SelectWithValue** operation is not valid, the control object shall issue a negative response to the requesting client.

   – If the **SelectWithValue** operation is valid, the control object shall issue a positive response to the requesting client, shall change the state to ready and starts a deselect timer for either the interval defined by the **sboTimOut** attribute or, if unimplemented, some locally determined duration.

b) If the deselect timer expires before an **Operate** request on one or more of the other control components shall be requested by the selecting client, the control object shall change the state to unselected.

c) If an **Operate** request is received from the selecting client while the state is not Ready for that client, the operation shall be denied.

d) On receipt of an **Operate** request, the control object shall check validation of the control execution.

   – If not successful, the control object shall issue a negative response to the requesting client.

   – If successful, the control object shall issue a positive response to the requesting client and shall cause the requested action by activating a binary output (or sending an equivalent signal on a process bus). The control object shall turn to the state WaitForChange.

   – The control object supervises the change of the device status.

   – As soon as the status of the controlled device has changed, the control object shall report the new status using the report service of the reporting model.

   – If the status has not changed to the wanted value after a certain time, the control object shall issue a CommandTermination negative as soon as the output is deactivated.

   – When the object indicates the wanted position before expiration of a timer, the control object shall issues a CommandTermination positive as soon as the output is deactivated.

e) When leaving the **WaitForChange** state, one of the following procedures shall be performed based on the SBO-Select Class.

   – If the value of the **sboClass** attribute is **operate-once**, the new state shall be unselected.

   – If the value of the **sboClass** attribute is **operate-many**, the new state shall be Ready.

The last action shall be the command termination (**CmdTerm**) service.

{These diagrams and text have been taken directly from the IEC 61850 Standard document.}

6.6.8 Time and Time Synchronization (Clause 18)

NTP provides for UTC synchronized time.

6.6.9 Naming Conventions (Clause 19)

This section discusses the gateway's implementation of IEC 61850-7-2 Clause 19: Naming Conventions.

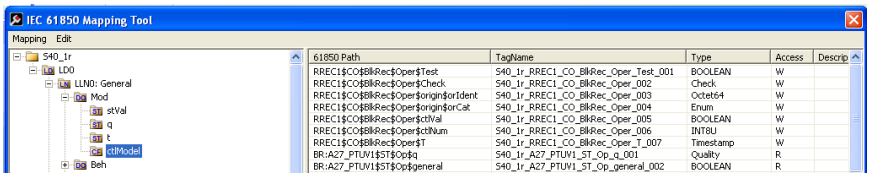
ProSoft 61850 Configuration Manager follows the naming conventions in accordance with the IEC-61850 standards, and they are also transferred into Modbus.

Here on the *IEC 61850 Mapping Tool* window, we see the use of standard naming conventions:

- *Logical Node*
- *Data Object*
- *Data Attribute*
- *Functional Constraint*
- *61850 Path*

Extended into:

Tag name



References to data for class naming and class specialization are as defined in the IEC 61850 Standard.

The classes for **DATA**, **common DATA**, **compatible DATA**, and **compatible LOGICAL-NODE** defined in IEC 61850-7-x make use of the following specializations:

IEC 61850-7-3	common **DATA** classes (for example, **DPC**) are specializations of the class **DATA** of IEC 61850-7-2
IEC 61850-7-4	compatible **DATA** classes (for example, **Pos** – position) are specializations of IEC 61850-7-3 common **DATA** classes (for example, **DPC** – controllable double point)
IEC 61850-7-4	compatible **LOGICAL-NODE** classes (for example, XCBR) are specializations of the **LOGICAL-NODE** class of IEC 61850-7-2

(This diagram and text has been taken directly from the IEC 61850 Standard document)

6.7 Usage Examples

The PLX8X-MNET-61850 is intended to work with and be highly integrated with Schneider Electric Quantum and Premium PLCs, as well as M340 PACs. The gateway creates files for the user to import into Unity Pro, Schneider Electric's PLC configuration software, to simplify setup and integration of the PLX8X-MNET-61850 into Unity Pro.

The function block created by ProSoft 61850 Configuration Manager requires Quantum processor firmware version 2.6 or later. However, if the customer is using an NOE card for their Ethernet connection to the ProSoft gateway, then the processor firmware version does not matter.

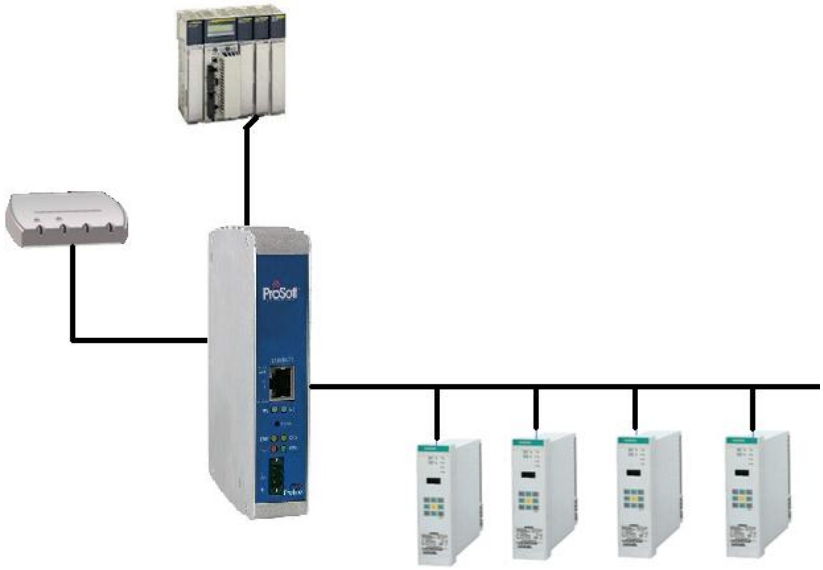
6.7.1 Example: Energy Application:

- The IEC 61850 protocol specification was written with electrical substations in mind.
- The PLC wants ALL DATA, including time stamp and quality bits from all IEDs. It will send this data to a dispatching system. In this case, the PLC is like a data concentrator from the substation to the dispatching center.
- User wants Open and Close control with tight time constraints. The controls need to be as fast as possible.

One typical example for this kind of application might be 20 IEDs, where the ProSoft gateway needs to send all the data from all 20 IEDs to the PLC. Typically, this would be approximately 50 data points per IED.

6.7.2 Example: Oil & Gas Application

- There is not much data that typically needs to be moved from each IED to the PLC in this type of application.
- In this example, the user may want to send commands from a process DCS system to control breakers.
- The PLC needs to transfer five to ten Data Attributes through the ProSoft gateway to each of many IEDs.



6.7.3 Monitoring

In a typical monitoring application, several types of actions may be needed:

- Automatic action required: Monitoring the currents and voltages and the system taking an immediate automatic action, like tripping a circuit breaker.
- Operator action required: Monitoring of the current temperature of gas in a gas insulator around a circuit breaker. This could result in actions initiated by an operator, such as sending maintenance people on-site.
- Post mortem analysis: Monitoring and collecting information about equipment condition, to be analyzed by a specific tool, resulting in recommendations for maintenance.

6.7.4 Measuring and Metering

Statistical evaluation of measured quantities, determining minimum and maximum values over a period of time, and creating history of this information, such as:

- currents, voltage, power and impedance in a three phase system (MMXU)
- calculation of energy in a three phase system (MMTR)
- calculation of harmonics and interharmonics (MHAI)

6.7.5 Supervision and Protection

Evaluating measured quantities for the purpose of detecting dangerous situations, such as

- Supervision of the quantities of an insulation medium in Sxxx logical nodes (Sxxx = logical nodes for monitoring by sensors = *SIMS, SARC,* and *SPDC*)
- Processing of quantities in Pxxx logical nodes (Pxxx = logical nodes for protection = *PTEF, PZSU, PDIS, PVPH, PTUV, PDPR, PWDE, PUCP, PUEX, PPBR, PPBV, PMSU, PTTR, PROL, PSOL, PIOC, PTOC, PVOC, PPFR, PTOV, PDOV, PVCB, PHIZ, PREF, PSEF, PITF, PDOC, PDEF, PDCO, PPAM, PFRQ, PDIF, PPDF, PLDF, PNDF, PTDF, PBDF, PMDF*, and *PGDF*)

Upon detection of a dangerous situation, the system then initiates action.

7 Support, Service & Warranty

In This Chapter

- Contacting Technical Support 185
- Warranty Information 186

7.1 Contacting Technical Support

ProSoft Technology, Inc. (ProSoft) is committed to providing the most efficient and effective support possible. Before calling, please gather the following information to assist in expediting this process:

1 Product Version Number
2 System architecture
3 Network details

If the issue is hardware related, we will also need information regarding:

1 Module configuration and associated ladder files, if any
2 Module operation and any unusual behavior
3 Configuration/Debug status information
4 LED patterns
5 Details about the serial, Ethernet or fieldbus devices interfaced to the module, if any.

Note: *For technical support calls within the United States, an after-hours answering system allows 24-hour/7-days-a-week pager access to one of our qualified Technical and/or Application Support Engineers. Detailed contact information for all our worldwide locations is available on the following page.*

Internet	Web Site: www.prosoft-technology.com/support E-mail address: support@prosoft-technology.com
Asia Pacific (location in Malaysia)	Tel: +603.7724.2080, E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Asia Pacific (location in China)	Tel: +86.21.5187.7337 x888, E-mail: asiapc@prosoft-technology.com Languages spoken include: Chinese, English
Europe (location in Toulouse, France)	Tel: +33 (0) 5.34.36.87.20, E-mail: support.EMEA@prosoft-technology.com Languages spoken include: French, English
Europe (location in Dubai, UAE)	Tel: +971-4-214-6911, E-mail: mea@prosoft-technology.com Languages spoken include: English, Hindi
North America (location in California)	Tel: +1.661.716.5100, E-mail: support@prosoft-technology.com Languages spoken include: English, Spanish
Latin America (Oficina Regional)	Tel: +1-281-2989109, E-Mail: latinam@prosoft-technology.com Languages spoken include: Spanish, English
Latin America (location in Puebla, Mexico)	Tel: +52-222-3-99-6565, E-mail: soporte@prosoft-technology.com Languages spoken include: Spanish
Brasil (location in Sao Paulo)	Tel: +55-11-5083-3776, E-mail: brasil@prosoft-technology.com Languages spoken include: Portuguese, English

7.2 Warranty Information

For complete details regarding ProSoft Technology's TERMS & CONDITIONS OF SALE, WARRANTY, SUPPORT, SERVICE AND RETURN MATERIAL AUTHORIZATION INSTRUCTIONS please see the documents on the Product DVD or go to www.prosoft-technology.com/warranty

Documentation is subject to change without notice.

8 List of Abbreviations

Note: Some abbreviations have more than one meaning in the IEC 61850 specification. These are marked with an asterisk (*).

A	Current in Amperes (Amps) *	IEC 61850-7-4
A	Application (p. 983) *	IEC 61850-8-1
a.c.	alternating current	IEC 61850-3
AA	Application Association	IEC 61850-7-1
ACD	ACtivation information of Directional protection	IEC 61850-7-3
acs	Access	IEC 61850-7-4
ACSE	Application Common Service Element	IEC 61850-8-1
ACSI	Abstract Communication Service Interface	IEC 61850-1
ACT	Protection ACTivation information	IEC 61850-7-3
Acu	Acoustic	IEC 61850-7-4
Age	Ageing	IEC 61850-7-4
AIS	Air Insulated Switchgear	IEC 61850-1
Alm	Alarm	IEC 61850-7-4
ALPDU	Application Layer Protocol Data Unit	IEC 61850-9-1
Amp	Current – non phase related	IEC 61850-7-4
An	Analog	IEC 61850-7-4
ANCR	Logical node - Earth fault neutralizer control (control of Petersen coil)	IEC 61850-5
Ang	Angle	IEC 61850-7-4
APCI	Application Protocol Control Information	IEC 61850-9-2
APDU	Application Protocol Data Unit	IEC 61850-9-2
API	Application Program Interface	IEC 61850-7-1
APPID or AppID	Application Identification	IEC 61850-7-1, IEC 61850-8-1
A-Profile	Application Profile	IEC 61850-8-1
ARCO	Logical node - Reactive control	IEC 61850-5
ASDU	Application Service Data Unit	IEC 61850-1
ASG	Analog SettinG	IEC 61850-7-3
ASN.1	Abstract Syntax Notation One	IEC 61850-7-1
ATCC	Logical node - Automatic tap changer control	IEC 61850-5
AUI	Attachment Unit Interface, Transceiver, or connecting cable	IEC 61850-9-1
Auth	Authorization	IEC 61850-7-4
Auto	Automatic	IEC 61850-7-4
Aux	Auxiliary	IEC 61850-7-4

Av	Average	IEC 61850-7-4
AVCO	Logical node - Automatic voltage contol	IEC 61850-5
AZVT	Logical node - Zero-voltage tripping	IEC 61850-5
B	Bushing	IEC 61850-7-4
Bat	Battery	IEC 61850-7-4
BDA	Basic Data Attribute, that is not structured	IEC 61850-6
Beh	Behavior	IEC 61850-7-4
BER	Basic Encoding Rules ASN.1	IEC 61850-9-1
Bin	Binary	IEC 61850-7-4
Blk	Block, or Blocked	IEC 61850-7-4
Bnd	Band	IEC 61850-7-4
Bo	Bottom	IEC 61850-7-4
BOOLEAN		IEC 61850-7-3, IEC 61850-7-2
BR	Functional constraint - Buffered report	IEC 61850-7-2
BRC	Buffered Report Control class	IEC 61850-7-2
BRCB	Buffered Report Control Block	IEC 61850-7-2
BS	Bitstring	IEC 61850-9-2
BufTm		IEC 61850-7-1
c	Conditional support. The item shall be implemented if the stated condition exists	IEC 61850-9-2
CAD	Computer Aided Design	IEC 61850-4
CALH	Logical node - Alarm handling (creation of group alarms and group events)	IEC 61850-5
Cap	Capability	IEC 61850-7-4
Capac	Capacitance	IEC 61850-7-4
Car	Carrier	IEC 61850-7-4
CB	Circuit Breaker	IEC 61850-1
CBB	Conformance Building Block	IEC 61850-8-1
CDC	Common Data Class	IEC 61850-1
CDCAName	Common Data Class Attribute Name	IEC 61850-8-1
cdcNs	common data class Name space	IEC 61850-7-3
CDCNSpace	Common Data Class Name Space	IEC 61850-7-2
CE	Cooling Equipment	IEC 61850-7-4
Cf	Crest factor	IEC 61850-7-4
CF	Functional constraint - Configuration	IEC 61850-7-2
Cfg	Configuration	IEC 61850-7-4
CFI	Canonical Format Identifier	IEC 61850-9-2
CG	Core Ground	IEC 61850-7-4
Ch	Channel	IEC 61850-7-4
Cha	Charger	IEC 61850-7-4
Chg	Change	IEC 61850-7-4

Chk	Check	IEC 61850-7-4
Chr	Characteristic	IEC 61850-7-4
CILO	Logical node - Interlocking function (at station level and/or bay level)	IEC 61850-5
CIM	Common Information Model of IEC 61970-301	IEC 61850-6
Cir	Circulating	IEC 61850-7-4
CL	Connectionless	IEC 61850-8-1
Clc	Calculate	IEC 61850-7-4
Client-CR	Client Conformance Requirement	IEC 61850-8-1
Clk	Clock or Clockwise	IEC 61850-7-2
Cls	Close	IEC 61850-7-4
Cnt	Counter	IEC 61850-7-4
CO	Functional constraint - Control *	IEC 61850-7-2
CO	Connection Oriented (p. 983) *	IEC 61850-8-1
CODED ENUM	Ordered set of values, defined where type is used (custom extensions not allowed)	IEC 61850-7-3, IEC 61850-7-2
Col	Coil	IEC 61850-7-4
ConfRev	Configuration revision	IEC 61850-7-1
ConNode	Connectivity Node	IEC 61850-6
Cor	Correction	IEC 61850-7-4
CPOW	Logical node - Point-on-wave breaker controller (controls a circuit breaker with point-on-wave switching capacity)	IEC 61850-5
CRC	Cyclic Redundancy Check	IEC 61850-2
Crd	Coordination	IEC 61850-7-4
Crv	Curve	IEC 61850-7-4
CSMA/CD	Carrier Sense Multiple Access/Collision Detection	IEC 61850-9-1
CSWI	Logical node - Switch controller (controls any switchgear, i.e. the devices described by XCBR and XSWI)	IEC 61850-5
CT	Current Transformer/Transducer	IEC 61850-4
Ctl	Control	IEC 61850-7-4
Ctr	Center	IEC 61850-7-4
Cyc	Cycle	IEC 61850-7-4
d.c.	direct current	IEC 61850-3
DA	Data Attribute	IEC 61850-7-2
DAI	Instantiated Data Attribute	IEC 61850-6
DAT	Data Attribute Type	IEC 61850-7-2
dataNs	Data Name Space	IEC 61850-7-3
DataRef	Data Reference	IEC 61850-7-2
DatAttrRef	Data Attribute Reference	IEC 61850-7-2
DatSet	Data set	IEC 61850-7-1
DAType	data attribute type	IEC 61850-7-1
DC	Functional constraint - Description	IEC 61850-7-2

dchg	Trigger option for data-change	IEC 61850-7-1
Dea	Dead	IEC 61850-7-4
Den	Density	IEC 61850-7-4
Det	Detected	IEC 61850-7-4
DEX or DExt	De-Excitation	IEC 61850-7-4
DF	Data Frame	IEC 61850-9-1
Diag	Diagnostics	IEC 61850-7-4
Dif	Differential/Difference	IEC 61850-7-4
Dir	Directional	IEC 61850-7-4
Dis	Distance	IEC 61850-7-4
Dl	Delay	IEC 61850-7-4
Dlt	Delete	IEC 61850-7-4
Dmd	Demand	IEC 61850-7-4
Dn	Down	IEC 61850-7-4
DNA	Dynamic Namespace Attribute	IEC 61850-8-1
DO	Data Object	IEC 61850-1
DOI	Instantiated Data Object	IEC 61850-6
DORef	Data Object Reference	IEC 61850-6
DPC	Double Point Control	IEC 61850-7-2
DPS	Double Point Status information	IEC 61850-7-1
DPSCO	Double Point Controllable Status Output	IEC 61850-7-4
DQ0	Direct, Quadrature and Zero (0) axis quantities	IEC 61850-7-4
Drag	Drag Hand	IEC 61850-7-4
Drv	Drive	IEC 61850-7-4
DS	Data Set *	IEC 61850-7-2
DS	Device State (p. 867) *	IEC 61850-7-4
Dsch	Discharge	IEC 61850-7-4
DSG	Data Set Group	IEC 61850-9-1
DTD	Document Type Definition	IEC 61850-6
dupd	trigger option for data update	IEC 61850-7-2
Dur	Duration	IEC 61850-7-4
DUT	Device Under Test	IEC 61850-10
EC	Earth Coil	IEC 61850-7-4
ECT	Electronic Current Transformer or transducer	IEC 61850-9-1
EE	External Equipment	IEC 61850-7-4
EF	Earth Fault	IEC 61850-7-4
EMC	Electro Magnetic Compatibility	IEC 61850-1
EMI	Electro Magnetic Interference	IEC 61850-1
Ena	Enabled	IEC 61850-7-4
ENUMERATED	Ordered set of values, defined where type is used (custom extensions allowed)	IEC 61850-7-3, IEC 61850-7-2

EPRI	Electric Power Research Institute	IEC 61850-1
Eq	Equalization or Equal	IEC 61850-7-4
Ev	Evaluation	IEC 61850-7-4
EVT	Electronic Voltage Transformer or transducer	IEC 61850-9-1
Ex or Ext	Excitation *	IEC 61850-7-4
EX	Functional constraint - Extended definition *	IEC 61850-7-2
Ex	External (p. 867) *	IEC 61850-7-4
Exc	Exceeded	IEC 61850-7-4
Excl	Exclusion	IEC 61850-7-4
F/S	Functional Standard	IEC 61850-8-1
FA	Fault Arc	IEC 61850-7-4
Fact	Factor	IEC 61850-7-4
Fan	Fan	IEC 61850-7-4
FAT	Factory Acceptance Test	IEC 61850-4
FC	Functional Constraint	IEC 61850-7-1
FCD	Functionally Constrained Data	IEC 61850-7-2
FCDA	Functionally Constrained Data Attribute	IEC 61850-7-2
fchg	Trigger option for filtered-data change	IEC 61850-7-2
FD	Fault Distance	IEC 61850-7-4
FLOAT32	Range of values and precision as specified by IEEE 754 single-precision floating point	IEC 61850-7-3
FLOAT64	Not Supported	Not Supported
Flt	Fault	IEC 61850-7-4
Flw	Flow	IEC 61850-7-4
FPF	Forward Power Flow	IEC 61850-7-2
Fu	Fuse	IEC 61850-7-4
Fwd	Forward	IEC 61850-7-4
GAPC	Logical node - Automatic process control (a generic, programmable LN for sequences, unknown functions, etc.)	IEC 61850-5
Gen	General	IEC 61850-7-4
GGIO	Logical node - Generic I/O	IEC 61850-5
GI	General interrogation	IEC 61850-7-1, IEC 61850-7-2
GIS	Gas Insulated Switchgear	IEC 61850-1
Gn	Generator	IEC 61850-7-4
Gnd	Ground	IEC 61850-7-4
GO	Functional constraint - Goose control	IEC 61850-7-2
GoCB	Goose Control Block	IEC 61850-7-2
GoEna		IEC 61850-7-1
GOMSFE	Generic Object Models for Substation and Feeder Equipment	IEC 61850-1
GOOSE	Generic Object Oriented Substation Events	IEC 61850-5
GPS	Global Positioning System (time source)	IEC 61850-5

Gr	Group	IEC 61850-7-4
Grd	Guard	IEC 61850-7-4
Gri	Grid	IEC 61850-7-4
GS	Functional constraint - GSSE control	IEC 61850-7-2
GSAL	Logical node - General security application	IEC 61850-5
GsCB	GSSE Control Block	IEC 61850-7-2
GSSE	Generic Substation Status Event	IEC 61850-7-2
GTES	Logical node - Test generator	IEC 61850-5
H	Harmonics (phase related)	IEC 61850-7-4
H2	Hydrogen	IEC 61850-7-4
H2O	Water	IEC 61850-7-4
Ha	Harmonics (non-phase related)	IEC 61850-7-4
Hi	High or Highest	IEC 61850-7-4
HMI	Human Machine Interface	IEC 61850-3
HP	Hot Point	IEC 61850-7-4
Hz	Hertz – frequency cycles/second	IEC 61850-7-4
i	Out-of-scope: The implementation of the item is not within the scope of this standard	IEC 61850-9-2
I/O	Status Inputs/Output contacts, or channels	IEC 61850-5
IARC	Logical node - Archiving	IEC 61850-5
ICD	IED Configuration Description	IEC 61850-10
ID	Identifier	IEC 61850-6
IEC	International Electrotechnical Commission	IEC 61850-1
IED	Intelligent Electronic Device	IEC 61850-1
IEEE	Institute of Electrical and Electronic Engineers	IEC 61850-1
IETF	Internet Engineering Task Force	IEC 61850-8-1
IF	Interface (serial)	IEC 61850-5
IHMI	Logical node - Operator interface (control local at bay level/control at station level)	IEC 61850-5
Imb	Imbalance	IEC 61850-7-4
Imp	Impedance (non-phase related)	IEC 61850-7-4
In	Input	IEC 61850-7-4
Ina	Inactivity	IEC 61850-7-4
INC	INteger status – Controllable	IEC 61850-7-3
Incr	Increment	IEC 61850-7-4
Ind	Indication	IEC 61850-7-4
Inh	Inhibit	IEC 61850-7-4
Ins	Insulation	IEC 61850-7-4
Int	Integer	IEC 61850-7-4
INT128	Not Supported	Not Supported
INT16	-32 768 to 32 767	IEC 61850-7-2

INT16U	Unsigned integer, 0 to 65 535	IEC 61850-7-3, IEC 61850-7-2
INT24	-8 388 608 to 8 388 607 (for TimeStamp type)	IEC 61850-7-3, IEC 61850-7-2
INT24U	Unsigned integer, 0 to 16 777 215	IEC 61850-7-2
INT32	-2 147 483 648 to 2 147 483 647	IEC 61850-7-3, IEC 61850-7-2
INT32U	Unsigned integer, 0 to 4 294 967 295	IEC 61850-7-3, IEC 61850-7-2
INT8	-128 to 127	IEC 61850-7-3, IEC 61850-7-2
INT8U	Unsigned integer, 0 to 255	IEC 61850-7-3, IEC 61850-7-2
IntgPd	Integrity Period	IEC 61850-7-1, IEC 61850-7-2
IP	Internet Protocol	IEC 61850-3
ISC	Integer Step Controlled position information	IEC 61850-7-3
ISCSO	Integer Status Controllable Status Output	IEC 61850-7-4
ISI	Integer Status Information	IEC 61850-7-3
ISO	International Organization for Standardization	IEC 61850-1
IT	Current x Time product	IEC 61850-7-4
ITCI	Logical node - Remote control interface or telecontrol interface	IEC 61850-5
ITMI	Logical node - Remote monitoring interface or telemonitoring interface	IEC 61850-5
km	Kilometer	IEC 61850-7-4
L	Lower	IEC 61850-7-4
LAN	Local Area Network	IEC 61850-5
LC	LOG CONTROL Class *	IEC 61850-7-2
LC	Logical Connection (p. 217) *	IEC 61850-5
LCB	Log Control Block	IEC 61850-7-2
LD	Logical Device	IEC 61850-7-1
Ld	Lead	IEC 61850-7-4
LD0	Logical Device Zero (0)	IEC 61850-7-2
LDC	Line Drop Compensation	IEC 61850-7-4
LDCR	Line Drop Compensation Resistance	IEC 61850-7-4
LDCX	Line Drop Compensation Reactance (X)	IEC 61850-7-4
LDCZ	Line Drop Compensation Impedance (Z)	IEC 61850-7-4
LDInst	Instantiated Logical Device	IEC 61850-6
ldNs	logical device Name space	IEC 61850-7-3
LED	Light Emitting Diode	IEC 61850-7-4
Len	Length	IEC 61850-7-4
Lev	Level	IEC 61850-7-4
Lg	Lag	IEC 61850-7-4

LG	Functional constraint - Logging	IEC 61850-7-2
Lim	Limit	IEC 61850-7-4
Lin	Line	IEC 61850-7-4
Liv	Live	IEC 61850-7-4
LLC	Logical Link Control	IEC 61850-9-1
LLN0	Logical Node Zero (0)	IEC 61850-7-1
LLN0	Logical node device	IEC 61850-5
LN	Logical Node	IEC 61850-1
LN Name	Logical Node Name	IEC 61850-7-2
LNC	Logical Node Class	IEC 61850-7-2
LNData	Logical Node Data	IEC 61850-8-1
LNG	Logical Node Group	IEC 61850-7-4
LNInst	Instantiated Logical Node	IEC 61850-6
lnNs	logical node Name space	IEC 61850-7-3
Lo	Low	IEC 61850-7-4
LO	LockOut	IEC 61850-7-4
Loc	Local	IEC 61850-7-4
Lod	Load or Loading	IEC 61850-7-4
LogEna		IEC 61850-7-1
LogRef	Log reference	IEC 61850-7-1
Lok	Locked	IEC 61850-7-4
Los	Loss	IEC 61850-7-4
LPDU	Link Protocol Data Unit	IEC 61850-8-1
LPHD	Logical Node PHysical Device	IEC 61850-7-1
LSAP	Link Service Access Point	IEC 61850-9-2
LSDU	Link layer Service Data Unit	IEC 61850-9-1
Lst	List	IEC 61850-7-4
LTC	Load Tap Changer	IEC 61850-7-4
m	Minutes *	IEC 61850-7-4
M or m	Mandatory (p. 983) *	IEC 61850-7-2, IEC 61850-8-1
M/O	Data Object is Mandatory or Optional	IEC 61850-7-4
M= or m=	Mandatory information that shall be equal the original information supplied in the request	IEC 61850-8-1
MAC	Media Access Control	IEC 61850-9-1
MAU	Medium Attachment Unit (Transceiver)	IEC 61850-9-1
Max	Maximum	IEC 61850-7-4
MC	multicast	IEC 61850-7-1
MCAA	MultiCast Application Association	IEC 61850-7-2
Mem	Memory	IEC 61850-7-4
MHAI	Logical node - Harmonics and interharmonics (for example for power quality purpose)	IEC 61850-5

MICS	Model Implementation Conformance Statement	IEC 61850-10
Min	Minimum	IEC 61850-7-4
MJD	Modified Julian Day	IEC 61850-8-1
MMS	Manufacturing Message Specification (ISO 9506)	IEC 61850-5
MMTR	Logical node - Metering (for commercial purpose)	IEC 61850-5
MMXU	Logical node - Measuring (for operative purpose)	IEC 61850-5
Mod	Mode	IEC 61850-7-4
Mot	Motor	IEC 61850-7-4
ms	Milliseconds	IEC 61850-7-4
MS	Functional constraint - Multicast sampled value control	IEC 61850-7-2
MSQI	Logical node - Sequences and imbalances (for example for stability purpose)	IEC 61850-5
Mst	Moisture	IEC 61850-7-4
MSV	Multicast Sampled Value	IEC 61850-6
MSVC	Multicast Sampled Value Control	IEC 61850-7-2
MSVCB	Multicast Sampled Value Control Block	IEC 61850-7-2
MsvID	ID for MSV (Multicast Sampled Value	IEC 61850-6, IEC 61850-7-1
MT	Main Tank	IEC 61850-7-4
MTTF	Mean Time To Failure	IEC 61850-3
MTTR	Mean Time To Repair	IEC 61850-3
MU	Merging Unit	IEC 61850-9-1
MX	Functional constraint - Measurands (analog values)	IEC 61850-7-2
N	Neutral	IEC 61850-7-4
Nam	Name	IEC 61850-7-4
NCC	Network Control Center	IEC 61850-5
NdsCom		IEC 61850-7-1
Net	Net sum	IEC 61850-7-4
Ng	Negative	IEC 61850-7-4
Nom	Nominal, Normalizing	IEC 61850-7-4
NPL	Name PLate	IEC 61850-7-2
Num	Number	IEC 61850-7-4
O	Optional	IEC 61850-7-2
OCTET STRING	Max. length defined where type is used	IEC 61850-7-3, IEC 61850-7-2
Ofs	Offset	IEC 61850-7-4
Op	Operate/Operating	IEC 61850-7-4
Opn	Open	IEC 61850-7-4
OptFlds	Optional fields	IEC 61850-7-1
OSI	Open Systems Interconnection	IEC 61850-1
Out	Output	IEC 61850-7-4
Ov	Over/Override/Overflow	IEC 61850-7-4

Pa	Partial	IEC 61850-7-4
Par	Parallel	IEC 61850-7-4
PBDF	Logical node - Busbar protection	IEC 61850-5
PC	Physical Connection	IEC 61850-5
Pct	Percent	IEC 61850-7-4
PD	Physical Device	IEC 61850-1
PDCO	Logical node - DC time overcurrent protection	IEC 61850-5
PDEF	Logical node - Directional earth fault protection	IEC 61850-5
PDIF	Logical node - Differential protection	IEC 61850-5
PDIS	Logical node - Distance protection	IEC 61850-5
PDOC	Logical node - AC directional overcurrent protection	IEC 61850-5
PDOV	Logical node - DC overvoltage protection	IEC 61850-5
PDPR	Logical node - Directional power/reverse power protection	IEC 61850-5
PDU	Protocol Data Unit	IEC 61850-7-2
PE	Process Environment	IEC 61850-4
Per	Periodic	IEC 61850-7-4
PF	Power Factor	IEC 61850-7-4
PFRQ	Logical node - Frequency protection	IEC 61850-5
PGDF	Logical node - Generator differential protection	IEC 61850-5
Ph	Phase	IEC 61850-7-4
PHD	Physical Device	IEC 61850-7-1
PHIZ	Logical node - Earth fault protection/Ground detection	IEC 61850-5
PhPh	Phase to Phase	IEC 61850-7-4
Phy	Physical	IEC 61850-7-4
PICOM	Piece of Information for communication	IEC 61850-1
PICS	Protocol Implementation Conformance Statement (ISO/IEC 8823-2:1994)	IEC 61850-7-2
PIOC	Logical node - Instantaneous overcurrent or rate of rise protection	IEC 61850-5
PITF	Logical node - Interturn fault protection	IEC 61850-5
PIXIT	Protocol Implementation extra Information for Testing	IEC 61850-7-2
PLDF	Logical node - Differential line protection	IEC 61850-5
Pls	Pulse	IEC 61850-7-4
Plt	Plate	IEC 61850-7-4
PMDF	Logical node - Motor differential protection	IEC 61850-5
Pmp	Pump	IEC 61850-7-4
PMSU	Logical node - Motor start-up protection	IEC 61850-5
PNDF	Logical node - Restricted earth fault protection	IEC 61850-5
Po	Polar	IEC 61850-7-4
Pol	Polarizing	IEC 61850-7-4
pos	Position	IEC 61850-7-4

POW	Point On Wave Switching	IEC 61850-7-4
PP	Phase to Phase	IEC 61850-7-4
PPAM	Logical node - Phase angle or out-of-step protection	IEC 61850-5
PPBR	Logical node - Reverse phase or phase balance current protection	IEC 61850-5
PPBV	Logical node - Phase sequence or phase-balance voltage protection	IEC 61850-5
PPDF	Logical node - Phase comparison protection	IEC 61850-5
PpdID		IEC 61850-7-1
PPFR	Logical node - Power factor protection	IEC 61850-5
PPV	Phase to Phase Voltage	IEC 61850-7-4
PREF	Logical node - Rotor earth fault protection	IEC 61850-5
Pres	Pressure	IEC 61850-7-4
Prg	Progress	IEC 61850-7-4
Pri	Primary	IEC 61850-7-4
Pro	Protection	IEC 61850-7-4
PROL	Logical node - Rotor thermal overload protection	IEC 61850-5
Ps	Positive	IEC 61850-7-4
PSEF	Logical node - Stator earth fault protection	IEC 61850-5
PSOL	Logical node - Stator thermal overload protection	IEC 61850-5
Pst	Post	IEC 61850-7-4
PTDF	Logical node - Differential transformer protection	IEC 61850-5
PTEF	Logical node - Transient earthfault protection	IEC 61850-5
PTOC	Logical node - AC time overcurrent protection	IEC 61850-5
PTOV	Logical node - (Time) Overvoltage protection	IEC 61850-5
PTTR	Logical node - Thermal overload protection	IEC 61850-5
PTUV	Logical node - (Time) Undervoltage protection	IEC 61850-5
PUCP	Logical node - Undercurrent/underpower protection	IEC 61850-5
PUEX	Logical node - Loss of field/Underexcitation protection	IEC 61850-5
PurgeBuf		IEC 61850-7-1
PVCB	Logical node - Voltage or current balance protection	IEC 61850-5
PVOC	Logical node - Voltage controlled/dependent time overcurrent protection	IEC 61850-5
PVPH	Logical node - Volt per Hz protection	IEC 61850-5
PWDE	Logcial node - Directional earth fault protection for compensated networks based on wattmetric principle	IEC 61850-5
Pwr	Power	IEC 61850-7-4
PZSU	Logical node - Zero speed and underspeed protection	IEC 61850-5
qchg	Trigger option for quality-change	IEC 61850-7-2
Qty	Quantity	IEC 61850-7-4
R or Ra	Rais	IEC 61850-7-4
r	readable	IEC 61850-8-1

R0	Zero Sequence Resistance	IEC 61850-7-4
R1	Positive Sequence Resistance	IEC 61850-7-4
Rat	Ratio *	IEC 61850-7-4
Rat	Winding ration (p. 868) *	IEC 61850-7-4
RBRF	Logical node - Breaker failure	IEC 61850-5
RCB	Report Control Block	IEC 61850-6
Rcd	Record or Recording	IEC 61850-7-4
Rch	Reach	IEC 61850-7-4
Rcl	Reclaim	IEC 61850-7-4
RCPW	Logical node - Carrier or pilot wire protection	IEC 61850-5
RDRE	Logical node - Disturbance recording (bay/process level: acquisition)	IEC 61850-5
RDRS	Logical node - Disturbance recording (station level: evaluation)	IEC 61850-5
Re	Retry	IEC 61850-7-4
React	Reactance	IEC 61850-7-4
Rec	Reclose	IEC 61850-7-4
Red	Reduction	IEC 61850-7-4
Rel	Release	IEC 61850-7-4
Rem	Remote	IEC 61850-7-4
Res	Residual	IEC 61850-7-4
Rest	Resistance	IEC 61850-7-4
RFC	Request For Comments	IEC 61850-8-1
RFLO	Logical node - Fault locator	IEC 61850-5
RIF	Routing Information Field (ISO/IEC 8802-5)	IEC 61850-9-2
Ris	Resistance	IEC 61850-7-4
Rl	Relation, relative	IEC 61850-7-4
Rms	Root mean square	IEC 61850-7-4
Rot	Rotation, rotor	IEC 61850-7-4
RP	Functional constraint - Unbuffered report	IEC 61850-7-2
RPF	Reverse Power Flow	IEC 61850-7-4
RPSB	Logical node - Power swing blocking	IEC 61850-5
RptEna	Report enable	IEC 61850-7-1
RREC	Logical node - Automatic reclosing	IEC 61850-5
Rs	Reset, Resetable	IEC 61850-7-4
Rsl	Result	IEC 61850-7-4
Rst	Restraint	IEC 61850-7-4
Rsv	Reserve	IEC 61850-7-4
RSYN	Logical node - Synchrocheck/synchronizing or synchronism check	IEC 61850-5
Rte	Rate	IEC 61850-7-4
Rtg	Rating	IEC 61850-7-4

RTU	Remote Terminal Unit	IEC 61850-4
Rv	Reverse	IEC 61850-7-4
Rx	Receive/Received	IEC 61850-7-4
S	Server specified parameter	IEC 61850-8-1
S1	Step one	IEC 61850-7-4
S2	Step two	IEC 61850-7-4
SA	Substation Automation	IEC 61850-1
SAP	Service Access Point	IEC 61850-8-1
SARC	Logical node - Monitoring and diagnostics for arcs	IEC 61850-5
SAS	Substation Automation System	IEC 61850-1
SAT	Site Acceptance Test	IEC 61850-4
SAV	Sampled Analog Value	IEC 61850-9
SBO	Select Before Operate	IEC 61850-9-1
SC	Secondary Converter	IEC 61850-9-1
SCADA	Supervisory Control And Data Acquisition	IEC 61850-3
SCD	Substation Configuration Description	IEC 61850-10
Sch	Scheme	IEC 61850-7-4
SCL	Substation Configuration description Language	IEC 61850-1, IEC 61850 -8-1
SCO	Supply Change Over	IEC 61850-7-4
SCSM	Specific Communication Service Mapping	IEC 61850-1
SDI	Instantiated Sub DATA; middle name part of a structured DATA name	IEC 61850-6
SE	Functional constraint - Setting group editable	IEC 61850-7-2
Sec	Security	IEC 61850-7-3
Seq	Sequence	IEC 61850-7-4
SeqNum	Sequence number	IEC 61850-7-1
Server-CR	Server-Conformance Requirement	IEC 61850-8-1
Set	Setting	IEC 61850-7-4
SF6	Sulphur HexaFluoride gas	IEC 61850-3
SG	Functional constraint - Setting group	IEC 61850-7-2
SGC	Setting Group Control class	IEC 61850-6
SGCB	Setting Group Control Block	IEC 61850-7-2
Sh	Shunt	IEC 61850-7-4
SIG	Status Indication Group	IEC 61850-9-1
SIMS	Logical node - Insulation medium supervision	IEC 61850-5
SmpRate	Sample rate	IEC 61850-7-1
SMV	Sampled Measured Value	IEC 61850-6
SMVC	Sampled Measured Value Control	IEC 61850-7-2
NTP	Network Time Protocol	IEC 61850-8-1
SoE	Sequence of Events	IEC 61850-7-1

Sp	Speed	IEC 61850-7-4
SP	Functional constraint - Setpoint	IEC 61850-7-2
SPC	Single Point Control	IEC 61850-7-4
SPCSO	Single Point Controllable Status Output	IEC 61850-7-4
Spd	Speed	IEC 61850-7-4
SPDC	Logical node - Monitoring and diagnostics for partial discharge	IEC 61850-5
SPI	Single Pole	IEC 61850-7-4
SPS	Single Point Status information	IEC 61850-7-1
Src	Source	IEC 61850-7-4
SSYS	Logical node - System supervision	IEC 61850-5
ST	Functional constraint - Status information	IEC 61850-7-2
St	Status	IEC 61850-7-4
Stat	Statistics	IEC 61850-7-4
Std	Standard	IEC 61850-7-4
STIM	Logical node - Time master	IEC 61850-5
Stop	Stop	IEC 61850-7-4
Str	Start	IEC 61850-7-4
Sts	Stress	IEC 61850-7-4
Sup	Supply	IEC 61850-7-4
SUT	System Under Test	IEC 61850-10
SV	Functional constraint - Sampled Value Substitution	IEC 61850-7-2
Svc	Service	IEC 61850-7-4
SVC	Sampled Value Control	IEC 61850-6
SvEna		IEC 61850-7-1
Sw	Switch	IEC 61850-7-4
Swg	Swing	IEC 61850-7-4
Syn or Sync	Synchronization	IIEC 61850-7-4, IEC 61850-8-1
T	Transient data *	IEC 61850-7-4
T	Transport or Timestamp (p. 983) *	IEC 61850-8-1
TAI	Temps Atomique International	IEC 61850-8-1
Tap	Tap	IEC 61850-7-4
TCI	TeleControl Interface *	IEC 61850-5
TCI	Tag Control Information (p. 1114, 1152) *	IEC 61850-9-2
TCP	Transmission Control Protocol	IEC 61850-3
TCP/IP	Transmission Control Protocol / Internet Protocol	IEC 61850-3
TCTR	Logical node - Current transformer	IEC 61850-5
Td	Total distortion	IEC 61850-7-4
Tdf	Transformer derating factor	IEC 61850-7-4
TE	Telecommunication Environment	IEC 61850-4
Test	Test	IEC 61850-7-4

Thd	Total harmonic distortion	IEC 61850-7-4
Thm	Thermal	IEC 61850-7-4
Tif	Telephone influence factor	IEC 61850-7-4
Tm	Time	IEC 61850-7-4
Tmh	Time in hours	IEC 61850-7-4
TMI	TeleMonitoring Interface (for example to engineer's work-station)	IEC 61850-5
Tmm	Time in minutes	IEC 61850-7-4
Tmms	Time in milliseconds	IEC 61850-7-4
Tmp	Temperature	IEC 61850-7-4
Tms	Time in seconds	IEC 61850-7-4
To	Top	IEC 61850-7-4
Tot	Total	IEC 61850-7-4
TP	Three Pole *	IEC 61850-7-4
TP	Two-party (p. 621) *	IEC 61850-7-3, IEC 61850-7-2
TPAA	Two Party Application Association	IEC 61850-7-2
TPID	Tag Protocol Identifier *	IEC 61850-9-2
TPID	Priority Tagging Identification (for IEEE 802.1Q networks) = 0x8100 (p. 983) *	IEC 61850-8-1
T-Profile	Transport Profile	IEC 61850-8-1
Tr	Trip	IEC 61850-7-4
Trg	Trigger	IEC 61850-7-4
TrgOp	Trigger Option	IEC 61850-7-2
TrgOpEna	Trigger Option Enabled	IEC 61850-7-2
TrgOps	Trigger options	IEC 61850-7-1
Ts	Total signed	IEC 61850-7-4
Tu	Total unsigned	IEC 61850-7-4
TVTR	Logical node - Voltage transformer	IEC 61850-5
Tx	Transmit/Transmitted	IEC 61850-7-4
Typ	Type	IEC 61850-7-4
U or u	User-specific: Indicates that the service, parameter, or attribute can be defined by an implementation	IEC 61850-8-1
U= or u=	User-specific information that shall be equal the original information supplied in the request	IEC 61850-8-1
UCA ™	Utility Communications Architecture	IEC 61850-7-2
UML	Unified Modeling Language	IEC 61850-7-1
Un	Under	IEC 61850-7-4
UNICODE STRING	Max. length defined where type is used	IEC 61850-7-3
URC	Unbuffered Report Control	IEC 61850-7-2
URCB	Unbuffered Report Control Block	IEC 61850-7-2
URI	Universal Resource Identifier	IEC 61850-6

US	Functional constraint - Unicast sampled value control	IEC 61850-7-2
USMVC	Unicast Sampled Measured Value Control	IEC 61850-7-2
USV	Unicast Sampled Value	IEC 61850-6
USVC	Unicast Sampled Value Control	IEC 61850-7-2
USVCB	Unicast Sampled Value Control Block	IEC 61850-7-2
UsvID	ID for USV (Unicast Sampled Value)	IEC 61850-6
UTC	Co-ordinated Universal Time	IEC 61850-7-2
V	Voltage	IEC 61850-7-4
VA	Volt Amperes	IEC 61850-7-4
Vac	Vacuum	IEC 61850-7-4
Val	Value	IEC 61850-7-4
Var	Volt Amperes reactive	IEC 61850-7-4
VARSPEC	Variable Specification	IEC 61850-8-1
V-Get	Virtual Get function (ISO 9506-1)	IEC 61850-8-1
VID	VLAN Identifier	IEC 61850-9-2
VISIBLE STRING	Max. length defined where type is used	IEC 61850-7-3, IEC 61850-7-2
VLAN	Virtual Local Area Network	IEC 61850-9-2
Vlv	Valve	IEC 61850-7-4
VMD	Virtual Manufacturing Device	IEC 61850-8-1
Vol	Voltage (non-phase related)	IEC 61850-7-4
V-Put	Virtual Put function (ISO 9506-1)	IEC 61850-8-1
VT	Voltage Transformer/Transducer	IEC 61850-4
W	Watts active power	IEC 61850-7-4
w	Writeable	IEC 61850-8-1
Wac	Watchdog	IEC 61850-7-4
Watt	Active power (non-phase related)	IEC 61850-7-4
Wei	Week end infeed	IEC 61850-7-4
Wh	Watt hours	IEC 61850-7-4
Wid	Width	IEC 61850-7-4
Win	Window	IEC 61850-7-4
Wrm	Warm	IEC 61850-7-4
X	Excluded: The user shall not implement this item	IEC 61850-9-2
X0	Zero sequence reactance	IEC 61850-7-4
X1	Positive sequence reactance	IEC 61850-7-4
XCBR	Logical node - The LN 'circuit breaker' covers all kinds of circuit breakers, i.e. switches able to interrupt short circuits	IEC 61850-5
XML	extensible Mark-up Language	IEC 61850-1
XSWI	Logical node - The LN 'switch' covers all kinds of switching devices not able to switch short circuits	IEC 61850-5
XX	Functional constraint - Wildcard representing all DataAttributes as a service parameter	IEC 61850-7-2

YEFN	Logical node - Earth fault neutralizer (Petersen coil)	IEC 61850-5
YLTC	Logical node - Tap changer	IEC 61850-5
YPSH	Logical node - Power shunt	IEC 61850-5
YPTR	Logical node - Power transformer	IEC 61850-5
Z	impedance	IEC 61850-7-4
Z0	Zero sequence impedance	IEC 61850-7-4
Z1	Positive sequence impedance	IEC 61850-7-4
ZAXN	Logical node - Auxiliary network	IEC 61850-5
ZBAT	Logical node - Battery	IEC 61850-5
ZBSH	Logical node - Bushing	IEC 61850-5
ZCAB	Logical node - Power cable	IEC 61850-5
ZCAP	Logical node - Capacitor bank	IEC 61850-5
ZCON	Logical node - Converter	IEC 61850-5
Zer	Zero	IEC 61850-7-4
ZGEN	Logical node - Generator	IEC 61850-5
ZGIL	Logical node - Gas isolated Line (GIL)	IEC 61850-5
ZLIN	Logical node - Power overhead line	IEC 61850-5
ZMOT	Logical node - Motor	IEC 61850-5
Zn	Zone	IEC 61850-7-4
ZREA	Logical node - Reactor	IEC 61850-5
Zro	Zero sequence method	IEC 61850-7-4
ZRRC	Logical node - Rotating reactive component	IEC 61850-5
ZSAR	Logical node - Surge arrestor	IEC 61850-5
ZTCF	Logical node - (Thyristor controlled) frequency converter	IEC 61850-5
ZTCR	Logical node - Thyristor controlled reactive component	IEC 61850-5

Glossary of Terms

Symbols & Numeric

(n)-Layer

Any specific layer.

(n)-Protocol

Set of rules and formats (semantic and syntactic) which determines the communication behavior of (N)-entities in the performance of (*n*)-functions.

(n)-Protocol Data Unit

Unit of data specified in an (*n*)-protocol and consisting of (*n*)-protocol-control-information and possibly (*n*)-user-data.

A

Access Point

Communication access point to an IED. This may be a serial port, an Ethernet connection, or a Client or server address dependent on the stack being used. Each access point of an IED to a communication bus is uniquely identified. Each server has only one logical access point.

Active master

Interface allowing communication with IEDs (Intelligent Electronic Devices) that use any protocol. The interface works by standardizing attributes of all possible functions, so that these can be mapped to functions used by the IED.

Application and Transport Profiles (A-Profile and T-Profile)

Set of protocols for a specific purpose.

Application Layer

Layer 7 in the OSI reference model. It is the OSI layer closest to the end user, providing an interface between the Open Systems Interconnection environment and the end user's application.

Association

Conveyance path established between a Client and a server for the exchange of messages.

Attribute

Named element of data which has a specific type.

B

Bay

Collection of components of a substation with common functionality.

Bay Level Functions

Functions that pertain to a bay. The bay level represents an additional layer of control below the overall substation level. These functions communicate via the logical interface 3 within the bay level and via the logical interfaces 4 and 5 to the process level, i.e. with any kind of remote I/Os or intelligent sensors and actuators. Interfaces 4 and 5 may be hardwired also but hardwired interfaces are beyond the scope of the IEC-61850 series.

Broadcast

Message sent to all nodes on a network.

Bus

Communication system connection between IEDs with communication facilities.

C

Class

Description of a set of objects that share the same attributes, services, relationships and semantics.

Client

A workstation on a network that requests services from a server and that receives unsolicited messages from a server.

Communication Connection

Connection which utilizes the communication mapping function of one or more resources for the conveyance of information.

Communication Stack

Also called protocol stack. Multi-layer stack. In the 7-layer OSI reference model for Open Systems Interconnection, each layer performs specific functions related to Open Systems Interconnection communication.

Communication System

Interconnected set of all communication links.

Configuration

The assignment of values to parameters of a system or device that determine its function and operation.

Configuration List

Overview of all compatible hardware and software versions of components and IEDs, including the software versions of relevant supporting tools, operating together in a SAS product family. Additionally, the configuration list details the supported transmission protocols for communication with IEDs of other manufacturers.

Conformance Test

Check of data flow on communication channels in accordance with the standard conditions concerning access organization, formats and bit sequences, time synchronization, timing, signal form and level, and reaction to errors. The conformance test can be carried out and certified to the standard or to specifically described parts of the standard. The conformance test should be carried out by an ISO 9001 certified organization or system integrator.

Connection

Association established between functional units for conveying information.

Connectivity Node

An identifiable, named, common connection point between terminals of primary devices whose only function is to connect them electrically with minimum resistance; for example, a bus bar as a connectivity node connects bus bar disconnectors. The connection to a device is done at a device terminal. A connectivity node can connect an arbitrary number of terminals (devices).

Cyclic Redundancy Check (CRC)

A check for transit damage in frames. It is calculated and included in each frame transmitted by the sending device, and recalculated by the receiving device.

D

Data

Meaningful, structured, information of applications, located in an IED, it can be read or written.

Data Attribute

Property of data that defines its name (semantic), format, range of possible values, and representation of values while being communicated.

Data Class

Class that aggregates data classes or data attributes. Specific data classes carry the semantic within a logical node.

Data Link Layer

Layer 2 of the OSI reference model for Open Systems Interconnection, responsible for the transmission of data over a physical medium. After establishment of a link, layer 2 performs data rate control, error detection, contention/collision detection, quality of service monitoring and error recovery.

Data Object

A data structure that is part of a logical node and represents specific information.

Data Set Class

Named list of ordered references to one or more Functionally Constrained Data (FCD) or Functionally Constrained Data Attributes (FCDA). Used to group commonly used data objects for easy retrieval.

Device

Piece of equipment or tool designed to perform one or more specific tasks.

Diameter

Refers to a 1 1/2 breaker arrangement and comprises the complete switchgear between the two busbars, i.e. the 2 lines and the 3 circuit breakers with all related isolators, earth switches, CTs and VTs. It has some common functionality and relationship both for operation, maintenance and extensions.

Distributed Functions

Functions performed by collaboration of two or more logical nodes that are located in different physical devices. Since all functions communicate in some way, the definition of a local or distributed function is not unique but depends on the definition of the functional steps to be performed until the function is completed. In the case of loss of one LN or one included communication link, the function may be blocked completely or show a graceful degradation, as applicable.

Distribution

The part of the power system operating at voltages typically up to 69 kV.

E

Electronic Current Transducer

Transducer in the primary plant that measures system current and provides low-level analog and/or digital output(s).

Electronic Voltage Transducer

Transducer in the primary plant that measures system voltage(s) and provides low-level analog and/or digital output(s).

Engineering

First phase of a project, i.e. detail design.

Engineering Tools

These support the creation and documentation of the conditions for adapting the SAS to the specific substation and customer requirements. The engineering tools are divided into project management, parameterization and documentation tools.

Equipment

Entity that performs an energy transport function, for example: transformer, circuit breaker, line. It may be stand-alone or interfaced to an automation system via an integral device or associated external device.

Expandability

The ability of a system to rapidly and efficiently extend to accommodate new hardware and/or software.

Extensible Mark-up Language (XML)

High-level language that can be used to construct plain-text file formats describing application-specific structured data. This enables data files to be generated and read by a computer, and which are also human legible.

XML is independent of platform, for example, hardware, software, and application, and provides free-extensibility. XML file readers (browsers) are available that are non-proprietary.

F

Factory Acceptance Test

Customer-agreed functional tests of the specifically manufactured SAS installation or its parts, using the parameter set for the planned application. This test should be carried out in the factory of the system integrator by use of process-simulating test equipment.

Flexibility

Ability of a system to rapidly and efficiently implement functional changes, including hardware adaptation.

Freeze

To lock and hold a value at that instant. Typically used with measurands and counters.

Functional Constraint

Property of a data attribute that indicates the services that may be applied to that data attribute, for example: read value, write value, substitute value, etc.

Functionally Constrained Data

An ordered collection of data having the same functional constraint, for example: all MX (measurands).

Functionally Constrained Data Attribute

A data attribute to which a specific functional constraint applies.

Functions

Tasks performed by automation systems and their components.

G

Gateway

Network interconnection device that supports the full stack of the relevant protocol which it can convert to a non-7-layer protocol for asynchronous transmission over wide area networks.

Generic Object Oriented Substation Event

A report by exception multicast sent by an IED in response to a change of state in the system. It is high-speed binary object, typically containing the double command state of each of its status inputs, starters, output elements and relays, actual and virtual. A GOOSE report enables high speed trip signals to be issued with a high probability of delivery.

Generic Substation Event Model

Defines two classes of multicast/broadcast data, i.e. GOOSE and GSSE, for the fast transfer of input and output data values between IEDs.

Generic Substation State Event

Similar to GOOSE but restricts the contained-data to data values of a number of double-command (bit pairs) status values, for example: open, closed, in transition, or invalid states.

H

Hold Point

Point, defined in the appropriate document, beyond which an activity must not proceed without the written approval of the initiator of the conformance test. The test facility must provide a written notice to the initiator at an agreed time prior to the hold point. The initiator, or his representative, is obligated to verify the hold point and approve the resumption of the testing.

Hub

A central device that connects multiple computers on a single network. Each port of a hub links individual media segments together to create a larger network that operates as a single LAN. Collisions in the network are possible.

Human Machine Interface (HMI)

Display screen, either part of an IED or as a stand-alone device, presenting relevant process data to a human operator, with which the operator interacts. An HMI will typically present windows, icons, menus, pointers, and may include a keypad to enable user access and interaction.

I

IED Parameter Set

All the parameter values needed for the definition of the behavior of the IED and its adaptation to the substation conditions. Where the IED has to operate autonomously, the IED-parameter set can be generated without system parameters using an IED-specific parameterization tool. Where the IED is a part of the SAS, the IED-parameter set may include system parameters, which must be coordinated by a general parameterization tool at the SAS level.

Implementation

Development phase in which the hardware and software of a system become operational.

Information Model

Knowledge concerning substation functions (devices) made visible and accessible through the means of the IEC 61850 series. The model describes in an abstract way a simplified representation of a real function or device.

Inspection

Activity such as measuring, examining, testing or gauging of one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformity is achieved for each characteristic.

Instance

Entity that has a unique identity, with the attributes of a defined class, to which a set of services can be applied and which has a state that stores the effects of the services. 'Instance' is synonymous with 'object.'

Instance Name

Identifier associated with and designating an instance.

Instantiation

Creation of an instance of a specified class.

Intelligent Electronic Device (IED)

Device that contains at least one processor and that can exchange data with other Intelligent Electronic Devices.

Interchangeability

Ability to replace a device supplied by one manufacturer with a device supplied by another manufacturer, without making changes to the other elements in the system.

Interface

A boundary across which two systems communicate using common functional characteristics, for example: common physical interconnection or signal characteristics.

Interface Related Station Level Functions

Functions representing the interface of the SAS to the local station operator HMI (Human Machine Interface), to a remote control center TCI (Telecontrol Interface) or to the remote engineering workplace for monitoring and maintenance TMI (Telemonitoring Interface). These functions communicate via the logical interfaces 1 and 6 with the bay level, and via the logical interface 7 and the remote control interface to the outside world.

Interface Related Station Level Functions

Functions representing the interface of the SAS local station-operator HMI to a remote control center Tele-Control Interface (TCI) or to the remote engineering Tele-Monitoring Interface (TMI) for monitoring and maintenance purposes. These functions communicate via the logical interfaces 1 and 6 with the bay level and via logical interface 7 to technical services and via the remote control interface to the outside world. Logically, there is no difference if the HMI is local or remote. In the context of the substation, there exists at least a virtual interface for the SAS at the boundary of the substation. The same is true for both the TCI and TMI. These virtual interfaces may be realized in some implementations such as proxy servers.

Internet Protocol

TCP/IP standard internet protocol defines the datagram that provides the basis of connectionless packet delivery. It includes control and error message protocol providing the equivalent functions to network services, layer 3, of the OSI reference model for Open Systems Interconnection.

Interoperability

Ability of two or more IEDs from the same vendor, or different vendors, to exchange information and use that information for correct execution of specified functions.

ISO/IEC-8802-3

Communication technology according to ISO/IEC-8802-3.

L

Life Cycle

All phases from the feasibility/concept phase through to the final decommissioning phase.

Link Layer

See Data Link Layer.

Local Area Network (LAN)

Communications network which typically covers the area within a building or small industrial complex. In the context of the IEC-61850 standard, the area within the substation.

Log

Record of chronologically ordered data, for example: events with time tags and annotations.

Logical Connection

Communication link between logical nodes.

Logical Device

Entity that represents a set of typical substation functions.

Logical Device Class

Virtual device that exists to enable aggregation of related logical nodes and dataset(s) for communication purposes. In addition, logical devices contain convenient lists of frequently accessed, or referred to, information, for example: data sets.

Logical Device Object

Instance of the logical device class.

Logical Node

Smallest component of a function that exchanges data. A logical node is an object defined by its data and methods.

Logical Node Class

Aggregation of data, data sets, report controls, log controls, logs, GOOSE and GSSE controls and sampled measured values. Logical node classes represent typical functions of the substation system. IEC 61850-7-4 defines a list of compatible logical node classes for protection functions, supervisory control, metering, switchgear, power transformers, etc.

Logical Node Data

Information contained within a logical node. The term encompasses ACSI data, control blocks, etc.

Logical Node Object

Instance of a logical node class.

Logical System

Set of all application functions performing some overall task and communicating via its logical nodes, for example, 'management of a substation.' The boundary of a system is given by its logical or physical interfaces. Examples are industrial systems, management systems, information systems, etc.

M

Mapping

Defined association or linkage of two separate entities or sets of values by means of assigned correlation of individual elements from the first set to individual elements of the second set.

Merging unit

Physical unit performing the time-coherent combination of the current and/or voltage data coming from the secondary converters. The merging unit can be part of one of the transducers in the field or may be a separate unit, for example in the control room.

Message

Inherent attribute of a communication between IEDs, functions or instances, that conveys service-specific data or commands, on receipt of which it is expected that action will be taken.

Model

A simplified representation of some aspects of reality. The purpose of creating a model is to facilitate understanding, description, or prediction of something that is difficult or impossible to directly observe in the real world, by providing the opportunity for exploration of a simplified representation of a particular entity or phenomenon.

Model Implementation Conformance Statement

Details the standard data object models supported by the system or device.

Multicast

Uni-directional, connectionless communication between a server and a selected set of Clients.

N

Name Plate

Name for the set of data typically found on an item of a plant (for example, a power transformer) or on an IED (for example, a protection relay) that uniquely describes that device's identity and attributes.

Negative Test

Test to verify the correct response of a device or system to the following standards:

- IEC-61850-conformant information and services which are not implemented in the device or system under test
- Non-IEC-61850-conformant information and services sent to the device or system under test

Network Layer

Layer 3 of the OSI reference model for Open Systems Interconnection. It provides functional and procedural means of connectionless or connection-mode transmission, also independence from routing and communications-relaying considerations, enabling the transparent transfer of data between transport entities.

O

Object Attribute

Field or a category or value of data that, together with other attributes, specify the services or data values related to the function and performance of an object.

Object Name

Unique full reference identifier of a specific data object that is unique within the SAS domain, or within a specific domain. It is constructed by concatenation, using dot '.' deliminators, to as many hierarchical levels as required, for example, 'BasicDataClass.StructuredComponent.X.X.X.X.etc'

Object/Instance

Descriptor of an instance of a class of entity that is uniquely identifiable within the SAS domain, with defined boundaries and identity which encapsulates states and behavior. States are represented by attributes, behavior by services and state machines.

Open Protocol

Protocol whose stack is either standardized or publicly available.

P

Parameters

Variables which define the behavior of functions of the SAS and its IEDs within a given range of values.

Physical Connection

Communication link between physical devices.

Physical Device

Entity that represents the physical parts of a device (hardware and operating system, etc.). Physical devices host logical devices. Equivalent to an Intelligent Electronic Device (IED) as used in the context of the IEC-61850 Standard.

Physical Layer

Layer 1 of the OSI reference model for Open Systems Interconnection. It provides the mechanical, electrical, functional and procedural means to activate, maintain and de-activate physical connections for bit transmission between data-link entities. Physical layer entities are interconnected by means of a physical medium.

Physical Node

Point of connection on a physical device to a communication network. A physical node is a multi-functional unit providing both the communication server and the mapping to the real substation IED.

Physical System

A system composed of the IEDs and the interconnecting physical communication network (commonly fiber optics). The boundary of a system is given by its logical or physical interfaces. Examples are industrial systems, management systems, information systems, etc.

Piece of Information for Communication (PICOM)

PICOM is a description of an information transfer on a given logical connection with given communication attributes between two logical nodes. It also contains the information to be transmitted and required attributes, for example, performance. It does not represent the actual structure or format of the data that is transmitted over the communication network. The PICOM approach was adopted from the CIGRE working group 34.03.

Point to Point

One-to-one communication link between two nodes, used only for communication between those two nodes.

Positive Test

Test to ensure the correct implementation of the system capabilities as defined by the supplier. A positive test has a described and defined response.

Presentation Layer

Layer 6 of the OSI reference model for Open Systems Interconnection. It provides an interface between the concrete local syntax used by the Application layer and the negotiated abstract and transfer syntaxes to be used for the transfer of data during a communication session between the two communicating application entities.

Primary System

Common term for all power system equipment and switchgear.

Process Level Functions

All functions interfacing to the process, i.e. binary and analog input/output functions, for example: data acquisition (including sampling) and the issuing of commands. These functions communicate via the logical interfaces 4 and 5 to the bay level.

Process Related Station Level Functions

Functions that use data from more than one bay, or from the whole substation, and act on the primary equipment of more than one bay, or on the primary equipment of the whole substation. Examples of such functions are: station-wide interlocking, automatic sequencers, and busbar protection. These functions communicate mainly via the logical interface 8.

Process Related Station Level Functions

Functions using the data of more than one bay or of the complete substation, and acting on the primary equipment of more than one bay, or of the complete substation. Examples of such functions are station-wide interlocking, automatic sequencers or busbar protection. These functions communicate mainly via the logical interface 8.

Profile(s)

Defined format(s) used by a particular protocol to transmit data objects or commands, etc.

Protocol

Set of rules that determines the behavior of functional units in achieving communication.

Protocol Converter

Intelligent Electronic Device connected between two communication networks, that is capable of translating messages received in one protocol on one network to a second protocol for retransmission on the other network and vice versa.

Protocol Data Unit

Encoded message containing the service parameters.

Protocol Implementation Conformance Statement

Summary of the capabilities of the system to be tested.

Protocol Implementation Extra Information for Testing

Document (PIXIT) containing system-specific information regarding the capabilities of the system to be tested which are outside the scope of the IEC 61850 series. Provides information regarding the physical set-up that is not part of the ACSI. This could be information regarding the hardware, socket, and other information. The PIXIT shall not be subjected to standardization.

R

Redundant/Redundancy

Existence of more than one means for performing a required function. A spare or duplicate functionality that allows a system to continue to operate without degradation of performance in the event of a single failure, for example, a blown fuse.

Remote Terminal Unit

Typically an outstation in a SCADA system, a Remote Terminal Unit (RTU) may act as an interface between the communication network and the substation equipment. The function of an RTU may reside in one IED or may be distributed.

Report

Client-defined, set of data compiled by an IED for transmission to a Client at regular or specified time intervals, or on demand. A report may also be generated as a result of one or more trigger conditions that may be either pre-set or pre-defined by the Client.

Review

Systematic examination, as defined in the appropriate document, of the quality document(s) for an activity. The test facility must provide the documentation to be reviewed to the initiator of the conformance test at an agreed time prior to the associated hold or witness point. How the review is conducted is subject to agreement.

S

SAS Installation

Concrete instance of an SAS consisting of multiple, interoperable IEDs from one or more manufacturers.

SAS Parameter Set

All the parameters needed for the definition of the behavior of the overall SAS and its adaptation to the substation conditions. The SAS parameter set includes the IED parameter sets of all participating IEDs.

SAS Product Family

Range of different IEDs from one manufacturer, with various functionalities and with the ability to perform substation automation system functions. The IEDs of a product family are unified in relation to the design, the operational handling, the mounting and wiring requirements and they use common or coordinated supporting tools.

Scalability

Criterion for a cost-effective SAS, taking into account the various functionalities, IEDs, substation sizes and substation voltage ranges.

Secondary System

Interaction set of all components and systems in the substation for the operation, protection, and monitoring of the primary system. In case of full application of numerical technology, the secondary system is synonymous with the substation automation system (SAS).

Selector

Defines the references to a class instance for accessing the instance values.

Self-Description

Device contains information on its configuration. The representation of this information has to be standardized and has to be accessible via communication (in the context of the IEC-61850 series).

Server

On a communication network, a functional node that provides data to, or that allows access to its resources by, other functional nodes. A server may also be a logical subdivision, which has independent control of its operation, within the software algorithm (and/or possibly hardware) structure.

Server Class

External visible behavior of an IED or application process.

Service

Functional capability of a resource which can be modeled by a sequence of service primitives.

Service Access Point

Represents a logical construct through which a peer selects a communication protocol or access to an application. The selection of the entire seven layers of a service access point represents a communication profile.

Service Primitive

Abstract, implementation-independent representation of an interaction between the service user and the service provider.

Session Layer

Layer 5 of the OSI reference model for Open Systems Interconnection. It manages the establishment and release of session connections, and also the synchronization of data exchange between presentation entities.

SF6

Sulphur Hexafluoride gas, used as an insulating medium in gas-insulated circuit breakers and associated plant.

Site Acceptance Test

Verification of each data and control point and the correct functionality inside the SAS and between the SAS and its operating environment on the whole installed plant using the final parameter set. The site acceptance test is the pre-condition for the SAS being accepted and put into service.

Specific Communication Service Mapping

Standardized procedure which provides the concrete mapping of ACSI services and objects onto a particular protocol stack/communication profile.

To reach interoperability, it is intended to have a minimum number of profiles and corresponding Specific Communication Service Mapping (SCSM). Special application sub-domains such as 'station bus' and 'process bus' may result in more than one mapping. However, for the specific protocol stack selected, only one single SCSM and one single profile should be specified.

A SCSM shall detail the instantiation of abstract services into protocol-specific single service or sequence of services that achieve the service as specified in ACSI. Additionally, a SCSM shall detail the mapping of ACSI objects into objects supported by the application protocol.

SCSMs are specified in IEC-61850-8-x and IEC-61850-9-x.

State Machine

The functional behavior of any IED, logical node or object, can be defined and delineated by means of a state machine. This describes, normally by means of a state diagram, the functionality, responses, actions and reactions, as a series of discrete, linked states, together with the criteria governing the transition from one state to another specific state.

Station Level Functions

Functions applying to the whole substation. There are two classes of station-level functions, i.e. process-related station-level functions and interface-related station-level functions.

Subdevice

Part of a primary device, for example one phase of a three-phase device.

Subnetwork

Communication system connection between IEDs which have serial communication facilities. All devices connected to a subnetwork can directly communicate to each other, without an intervening router. Routers or gateways can connect subnetworks.

Subscribed Data

Data that a Client has requested to be supplied on a regular basis, or when trigger condition(s) are satisfied.

Substation Automation System (SAS)

System which operates, protects, and monitors the substation. It includes the IEDs and communication network infrastructure. It uses fully numerical technology and serial communication links.

Substation Master

IED that functions either as a RTU or provides a centralized function, for example time-synchronizing reference.

Supporting Tools

Support the user in the engineering, the operation and the management of the SAS and its IEDs. The supporting tools can perform the following tasks: engineering, project management, parameter change, diagnostics, testing, documentation, and other services.

Usually the supporting tools are part of the SAS and they run on an IED (for example, PC).

Switch

Active network component that connects two or more subnetworks, which themselves could be built of several segments connected by repeater. Switches establish the borders for so-called collision domains. Collisions cannot take place between networks divided by switches, as data packets destined to a specific subnetwork do not appear on the other subnetworks. To achieve this, switches must have knowledge of the hardware addresses of the connected stations. In cases where only one active network component is connected to a switch port, collisions on the network can be avoided.

System

Set of interacting entities which perform a common functionality. Its backbone is some communication mechanism.

System Integrator

Turnkey deliverer of SAS installations. The responsibility of system integration includes the engineering, the delivery and mounting of all participating IEDs, the factory and site acceptance tests and the trial operation. The quality assurance, maintenance and spares delivery obligations, and the warranty shall be agreed upon in the contract between the system integrator and the customer.

System Life Cycle

Two independent meanings:

A For the manufacturer - the time period between the start of the production of a newly developed SAS product family and the discontinuation of support for the IEDs.

B For the customer - the time period between the commissioning of an SAS installation mainly based on a SAS product family and the decommissioning of the latest SAS installation from the same family.

System Parameters

Data that defines the interaction of IEDs in the SAS. They are especially important in the definitions for configuration of the SAS, communication between IEDs, for marshaling of data between IEDs, for processing and visualization of data from other IEDs, for example at the station level, and for parameterization.

System Test

Check of correct behavior of the IEDs and of the overall SAS under various application conditions. The system test marks the final stage of the development of IEDs as part of a SAS product family.

T

Telecommunication Environment

Communication interfaces associated with telecommunications.

Telecommunications Interface

Interface point to the telecommunications network link to the remote power system network control center.

Telemonitoring Interface

Communications link to a monitoring engineer's workplace.

Test Equipment

Tools and instruments which simulate and verify the inputs/outputs of the operating environment of the SAS, such as switchgear, transformers, network control centers or connected telecommunication units on the one side, and the communication channels between the IEDs of the SAS on the other.

Test Facility

Organization which is able to provide appropriate test equipment and trained staff to perform conformance testing. The management of conformance tests and the resulting information should follow a quality system and a test facility should be certified in accordance with IEC-61850-10.

Test Item

One single test step from the sequence of tests defined to verify compliance.

Transient Data

Pertaining to or designating a phenomenon or a quantity which varies between two consecutive states during a time interval short compared to the time-scale of interest. Data objects with this designation only exist at the time they occur and must be logged to prove the evidence of their existence.

Transmission

The part of the power system operating at voltages of typically 110 kV and above.

Transport Layer

Layer 4 of the OSI reference model for Open Systems Interconnection. It establishes the transport connection and addressing, controls and monitors the data rate flow and the release of the transport connection. Enables variable size data files to be seamlessly transported.

Type Test

Verification of correct behavior of the IEDs of the SAS by use of the system tested software under the environmental test conditions stated in the technical data. This test marks the final stage of IED hardware development and is the precondition for the start of full production. This test must be carried out with IEDs that have been manufactured through the normal production cycle.

U

Unicast/Point to Point

Communication between a server and a single Client.

Unified Modeling Language

Standardized constructs and semantics for diagrams, including state machines, which are used to describe/specify the functionality of an IED, object model or a process.

Unsolicited Data or Unsolicited Message

Data or message which is supplied to a Client from a server without the Client subscribing to that data or message, for example: reset, abort, time. Does not require a connection to be established.

Utility Communications Architecture

Describes the concepts of standardized models for power system objects.

W

Witness Point

Point, defined in the appropriate document, at which an inspection will take place on an activity. The activity may proceed without the approval of the initiator of the conformance test. The test facility must provide a written notice to the initiator at an agreed time prior to the witness point. The initiator or his representative has the right, but is not obligated, to verify the witness point.

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