COM600 Station Automation Series
IEC 61850 Master (OPC) 3.1

User's Guide

Contents:

1. About this manual

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1.3. General

This manual provides thorough information on the IEC 61850 Master Protocol (OPC) *1.1 (later in this manual IEC 61850 OPC Server) and the central concepts related to it. You will find instructions on how to configure IEC 61850 OPC Server related objects. The basic operation procedures are also discussed.

Information in this user’s guide is intended for application engineers who need to configure the IEC 61850 OPC Server.

As a prerequisite, you should understand the basic principles and the IEC 61850 technology and standard.

This user’s guide is divided into following sections:

Introduction

This section gives an overview of the IEC 61850 OPC Server and its features.

Configuration

In this section you will find an overview of configuration. You are given instructions on how to configure IEC 61850 OPC Server related objects and the model of a substation or system.

Operation

This section covers the basic operation procedures you can carry out when transferring or activating the Communication Gateway COM610 computer and Station Computer 615 with new configurations.

You are also given instructions on how to monitor and control the conditions of IEC 61850 network.

Technical reference

This section describes the IEC 61850 data modeling. This section also contains attributes and a list of status codes.

1.4. Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a window, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the ENTER key.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key, and so on.
- Press CTRL+C indicates that you must hold down the CTRL key while pressing the C key (to copy a selected object in this case).
- Press ESC E C indicates that you press and release each key in sequence (to copy a selected object in this case).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
  - The following convention is used for menu operations: **MenuName > MenuItem > CascadedMenuItem**. For example: select **File > New > Type**.
  - The **Start** menu name always refers to the **Start** menu on the Windows taskbar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if you enter a value out of range, the following message is displayed:

```
Entered value is not valid. The value must be 0 to 30.
```

- You may be told to enter the string MIF349 in a field. The string is shown as follows in the procedure:

  MIF349
- Variables are shown using lowercase letters:

  sequence name

1.5. Use of symbols

This publication includes warning, caution, and information icons that point out safety related conditions or other important information. It also includes tip icons to point out useful information to the reader. The corresponding icons should be interpreted as follows.

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The warning icon indicates the presence of a hazard which could result in personal injury.

The caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard which could result in corruption of software or damage to equipment or property.

The information icon alerts the reader to relevant facts and conditions.

The tip icon indicates advice on, for example, how to design your project or how to use a certain function.

1.6. Terminology

The following is a list of terms associated with the IEC 61850 OPC Server that you should be familiar with. The list contains terms that are unique to ABB or have a usage or definition that is different from standard industry usage.

Term	Description
Alarm	An abnormal state of a condition.
Alarms and Events; AE	An OPC service for providing information about alarms and events to OPC clients.
Data Access; DA	An OPC service for providing information about process data to OPC clients.
Data Object; DO	Part of a logical node object representing specific information, e.g., status or measurement. From an object-oriented point of view a data object is an instance of a class data object. DOs are normally used as transaction objects; i.e., they are data structures.
Data Set	The data set is the content basis for reporting and logging. The data set contains references to the data and data attribute values.
Device	A physical device that behaves as its own communication node in the network, e.g. protection relay.
Event	Change of process data or an OPC internal value. Normally, an event consists of value, quality and timestamp.
Intelligent Electronic Device	A physical IEC 61850 device that behaves as its own communication node in the IEC 61850 protocol.
Logical Device; LD	Representation of a group of functions. Each function is defined as a logical node. A physical device consists of one or several LDs.
Logical Node; LN	The smallest part of a function that exchanges data. A LN is an object defined by its data and methods.
LON	A communication protocol developed by Echelon.
LON Application Guideline for substation automation; LAG	A proprietary method of ABB on top of the standard LON protocol.
OPC	Series of standards specifications aiming at open connectivity in industrial automation and the enterprise systems that support industry.
OPC item	Representation of a connection to the data source within the OPC server. An OPC item is identified by a string <object path>:<property name>. Associated with each OPC item are Value, Quality and Time Stamp.
Property	Named data item.
Report Control Block	The report control block controls the reporting processes for event data as they occur. The reporting process continues as long as the communication is available.

Term	Description
SPA	ABB proprietary communication protocol used in substation automation.
SPA device	Protection and/or Control Product supporting the SPA protocol version 2.5 or earlier.
Substation Configuration Language; SCL	XML-based description language for configurations of electrical substation IEDs. Defined in IEC 61850 standard.

1.7. Abbreviations

The following is a list of abbreviations associated with the IEC 61850 OPC Server that you should be familiar with. See also 1.6, Terminology.

Abbreviation	Description
AE	Alarms and Events
ASDU	Application Service Data Unit
BRCB	Buffered Report Control Block
CET	Communication Engineering Tool
DA	Data Access
DMCD	Data Message Code Definition
DO	Data Object
GW	Gateway, component connecting two communication networks together
HMI	Human Machine Interface
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
LAG	LON Application Guideline for substation automation
LAN	Local Area Network
LD	Logical Device
LMK	LonMark interoperable device communicating in LonWorks network. In this document the term is used for devices that do not support the ABB LON/LAG communication.
LN	Logical Node
LSG	LON SPA Gateway
NCC	Network Control Center
NV	Network Variable
OLE	Object Linking and Embedding
OPC	OLE for Process Control
P&C	Protection & Control

Abbreviation	Description
RTS	Request To Send
SA	Substation Automation
SCL	Substation Configuration Language
SLD	Single Line Diagram
SNTP	Simple Network Time Protocol
SOAP	Simple Object Access Protocol
RCB	Report Control Block
URCB	Unbuffered Report Control Block
XML	eXtended Markup Language

1.8. Related documents

Name of the manual	MRS number
COM600 3.1 User’s Guide	1MRS756125

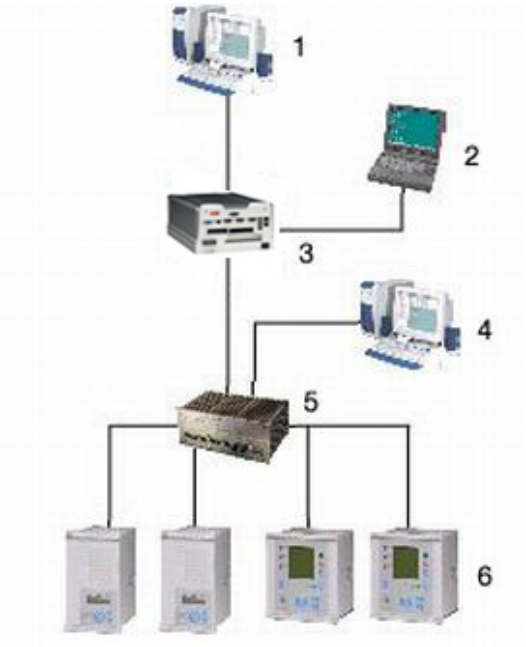
1.9. Document revisions

Document version/date	Product revision	History
A/30.6.2004	1.0	Document created
B/25.2.2005	1.1	File Transfer function additions
C/16.10.2006	3.0	Document revised
D/22.1.2007	3.0	Document revised
E/8.6.2007	3.0	Document revised
E/21.12.2007	3.1	Document revised

2. Introduction

2.1. Product overview

The IEC 61850 OPC Server enables OPC clients to access process data from IEC 61850 devices.



Introduction-1.jpg

Figure 2.1-1 IEC 61850 OPC Server system overview

(1) Network Control Center (NCC)

(2) Communication Engineering Tool (CET)

(3) COM610/615 with IEC 61850 OPC Server

(4) MicroSCADA Pro with IEC 61850 OPC Server

(5) Ethernet switch

(6) Protection and control devices communicating through IEC 61850 protocol

The IEC 61850 OPC server can be used as a part of COM610/615 or as a part of the MicroSCADA Pro system (see Figure 2.1-1).

To create a common data interface between the OPC server and client, the process data is modelled using the IEC 61850 protocol. The IEC 61850 protocol is a set of specifications, which details layered substation communication architecture. The International

Standard IEC 61850 has been prepared by IEC technical committee 57: Power system control and associated communications.

The IEC 61850 specifies usage of Manufacturing Message Specification (MMS, ISO 9506) over TCP/IP as communication between the IEC 61850 server and client (device/IEC 61850 OPC Server).

After the IEC 61850 OPC Server and other required components are installed, you can build and configure hierarchically structured models of a substation or a system for the IEC 61850 OPC Server using a Communication Engineering Tool (CET) configuration files and device.

The configuration data is stored in SCL (XML based) format. After the IEC 61850 OPC Server has been launched, it reads the configuration file and establishes communication with the IEC 61850 devices through the IEC 61850 protocol stack.

Configured IEC 61850 devices and their data are then exposed to OPC clients through an OPC Data Access (DA) server and device reported changes in data with DA subscription are reported to OPC clients.

2.2. IEC 61850 OPC Server features

The IEC 61850 OPC Server supports the following features:

- Communication diagnostics
  - OPC Data Access v. 1.0/2.0
  - OPC Alarms and Events specifications v. 1.10
- IEC 61850 data modelling
- System supervision:
  - IEC 61850 device communication
- Command handling:
  - The IEC 61850 OPC Server supports the IEC 61850 command services.
- IEC 61850 data objects:
  - SPS, DPS, INS, ACT, ACD, SEC, BCR, MV, CMV, SAV, WYE, DEL, SEQ, SPC, DPC, BSC, ISC, APC, SPG, ING, ASG, CURVE, DPL, LPL.
- IEC 61850 buffered and unbuffered reporting services
- IEC 61850 File Transfer
- Automatic Disturbance Recording upload using IEC 61850 file transfer or FTP
- SPA TCP
- SPA Parameter access (configured with Parameter Filtering Tool)
- OPC Alarms and Events specifications v. 1.10
- Time synchronization:
  - The IEC 61850 OPC Server can act as an SNTP client and server for time synchronization. When the IEC 61850 OPC Server is configured for receiving time synchronization, it updates the operating system time of the PC.
- Multiple instance support

3. Configuration

3.1. Overview of configuration

This chapter guides you in the configuration tasks required before you can start using the IEC 61850 OPC Server. For information on the IEC 61850 data modelling, refer to the respective standards and specifications.

Both COM610/615 and MicroSCADA Pro include Communication Engineering Tool (CET). All tasks introduced in this chapter apply for both COM600 CET and MicroSCADA Pro CET. If there are differences between these two CETs, you are informed about these differences. First you need to start the COM600 or MicroSCADA Pro Communication Engineering Tool (CET) to open and name a project.

The configuration work can be divided into two separate tasks:
1. Building an object tree
2. Configuring object properties

First, you need to build an object tree. This is done by adding objects to the object tree, refer to 3.2.1, General about building object tree. Connectivity Packages for certain protection and control products usually contain preconfigurations and tools to facilitate the building of the object tree.

Table 3.1-1 describes the possible objects shown in the object tree. After you have added the necessary objects to the object tree in the Communication structure, you need to configure them, refer to 3.3.1, Configuring object properties.

Table 3.1-1 IEC 61850 OPC Server related objects

Object	Description
IEC 61850 OPC Server	Object representing the IEC 61850 OPC Server
Event Definitions	Object representing event definitions for IEC 61850 OPC Server diagnostics
IEC 61850 Subnetwork	Object representing a physical subnetwork. IEC 61850 OPC Server supports only one subnetwork.
IEC 61850 Device (IEC 61850 IED)	Object representing a physical IEC 61850 protection and control device. You should not have more than 30 devices per each subnetwork.
Attributes	Predefined object that contains items for controlling or retrieving status information for the parent object. The parent object can be the Server, a Subnetwork or a Device object.
Logical Device (LD)	Object representing a group of functions, each function is defined as a logical node. A physical device consists of one or several LDs.
Logical Node (LN)	An object defined by its data and methods. LN is the smallest part of a function that exchanges data.

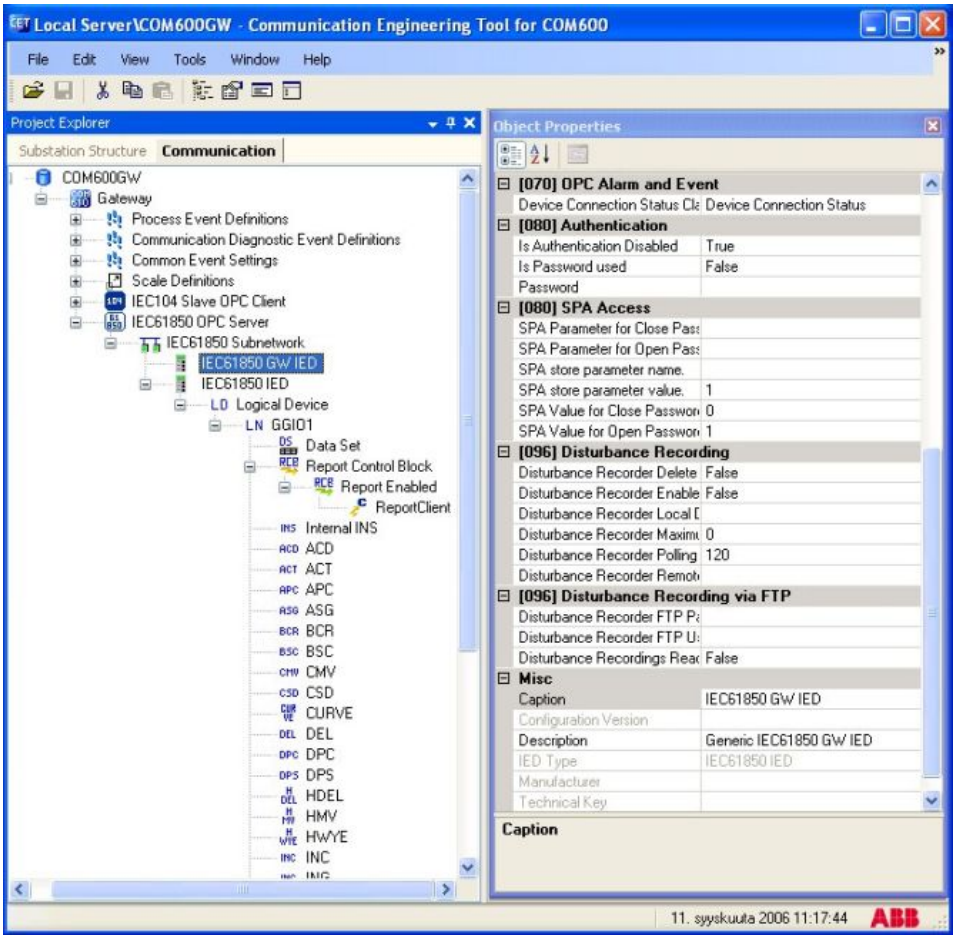
Object	Description
Data Object (DO)	A data object is an instance of one of the IEC 61850 Common Data Classes, for example single point status, measured value etc. Depending on the class, each data object has a set of attributes for monitoring and controlling the object, for instance value, quality and control.
Data Set (DS)	The data set is the content basis for reporting and logging. The data set contain references to the data and data attribute values.
Report Control Block (RCB)	The report control block controls the reporting process for event data as they occur. The reporting process continues as long as the communication is available.

3.2. Building object tree

3.2.1. General about building object tree

Before you can start using the IEC 61850 OPC Server, you need to build and configure an object tree in Communication Engineering Tool (CET) to define the Communication structure.

Figure 3.2.1-1 shows an example of how the object tree may look like after it has been built. In the example tree you can see the IEC 61850 OPC Server object and its child objects like subnetworks, devices and data objects. Indentation is used to indicate the parent-child relationship between the objects.



IECCETMain.jpg

Figure 3.2.1-1 Example view of the Communication Engineering Tool

You have several possible ways to add objects to the object tree in the Communication structure:

- You can right-click the object to which you want to add a child object.
- You can copy the object.
- You can drag and drop the object.

Add the objects in the following order:

1. Gateway (COM610/615) or Computer Node (MicroSCADA Pro)
2. IEC 61850 OPC Server
3. IEC 61850 Subnetwork
4. IEC 61850 Device (IEC 61850 IED)
5. Import devices configurations

If you want to connect Device Connection Status events to device objects at this point, make sure that you have already created and configured the event objects.

For information on building a substation structure, refer to COM605, COM615 HMI Configuration Manual.

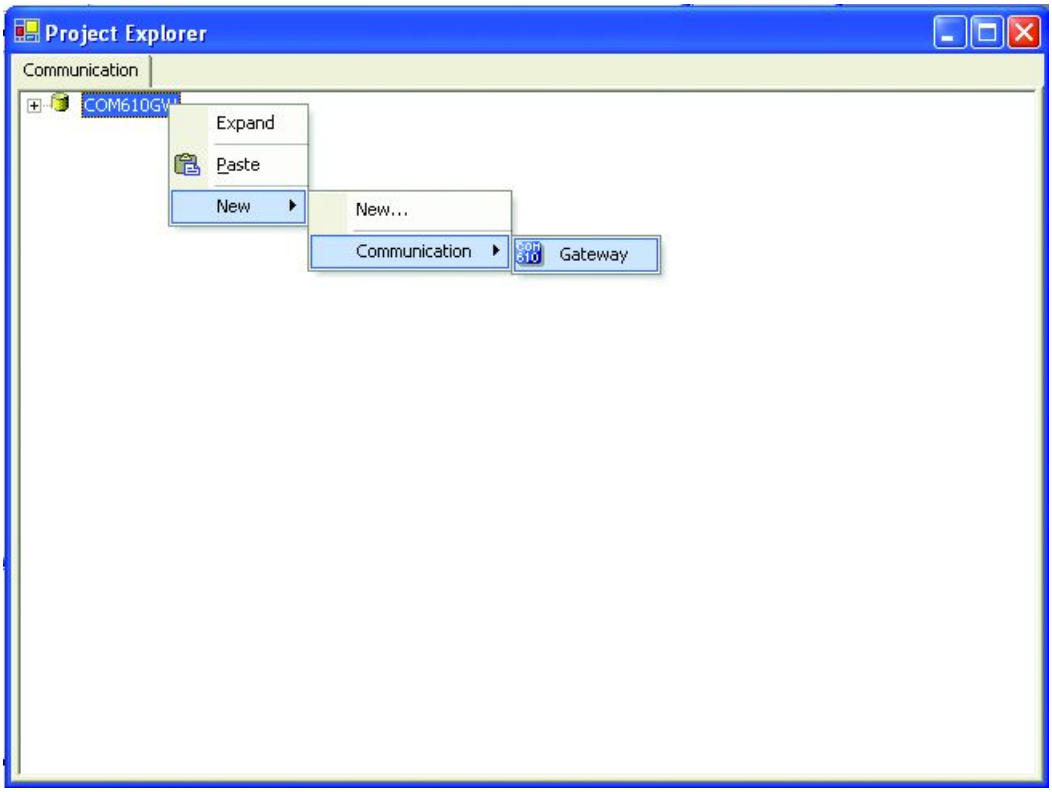
3.2.2. Adding Gateway or Computer Node object

To add a Gateway or Computer Node object:

1. To start building the object tree, add a COM610/615 Gateway object in the Communication structure by selecting the project name.
2. Right-click the project name and select **New > Communication > Gateway**, see Figure 3.2.2-1.

Continue building the object tree in the same way until you have added all the necessary objects in your current project.

This applies similarly to the MicroSCADA Pro CET.



IECGate.jpg

Figure 3.2.2-1 Adding a COM610/615 Gateway object

3.2.3. Adding IEC 61850 OPC Server object

After the Gateway object has been successfully added, you can continue building the object tree by adding an IEC 61850 OPC Server object.

To add an IEC 61850 OPC Server object:
1. Select the Gateway object in the Communication structure
2. Right-click the Gateway object.
3. Add an IEC 61850 OPC Server object.

By using the SCL Import function, it is possible to import configurations of an entire server or individual devices without having to insert them manually.

To open the SCL Import function
1. Click the wanted object.
2. Select **Tools > SCL Import**.

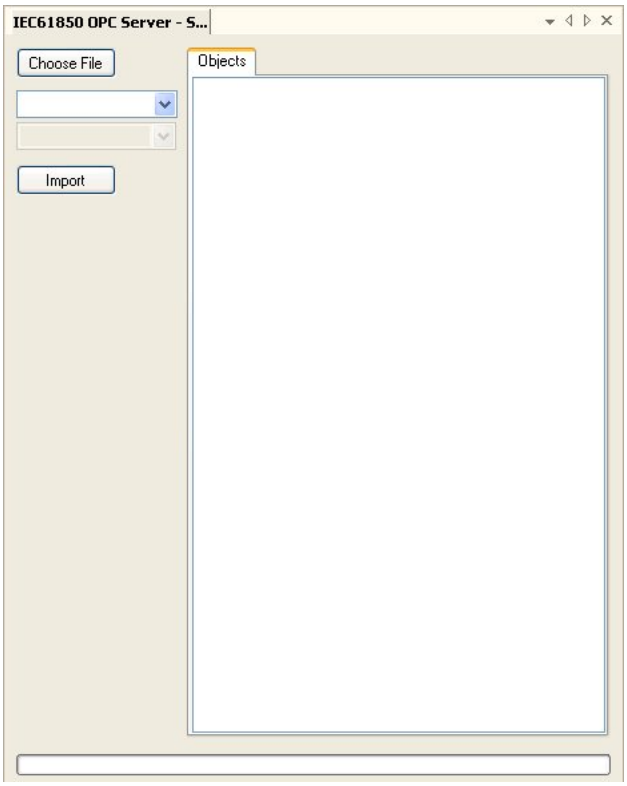
Connectivity Packages for certain protection and control devices may also support other ways to build this structure, depending on the configuration of an individual device, for example device-related object types and wizards. Typically, Connectivity Packages include SCL description files which need to be installed. For further information on these

Connectivity Packages, see the Connectivity Package of a certain device in the product documentation.

You can also import the whole communication structure under IEC 61850 OPC Server with new configurations from an existing file. This is done by SCL import function. The file extentions for the import files can be .icd, .cid, .scd or .xml. Right-click the IEC 61850 OPC Server and select **SCL Import** from the shortcut menu, see Figure 3.2.3-1.

To import a new configuration file:
1. Click **Choose File**.
2. Browse to a new configuration file from the appearing dialog.
3. Select the file and click **Open**.
4. Select the device to import from the drop-down list. You can preview the configuration on the right.
5. Click **Import**.

The new preconfigurated objects appear in the object tree. If the configuration file is very large, the import may take time. To import a configuration file for a different OPC Server, right-click the OPC Server, select **SCL Import** again, and repeat the steps above.



SCLImport.jpg

Figure 3.2.3-1 IEC 61850 OPC Server SCL Import

3.2.4. Adding IEC 61850 Subnetwork objects

After the server object has been successfully added, you can continue building the object tree by adding IEC 61850 subnetwork objects.

To add an IEC 61850 subnetwork object:
1. Select an IEC 61850 OPC Server object.
2. Right-click the IEC 61850 OPC Server object.
3. Add an IEC 61850 subnetwork object.
4. Rename the new object. Note that the names of the IEC 61850 Modbus subnetwork objects have to be unique.

You can define one subnetwork per OPC Server.

3.2.5. Adding IEC 61850 IED objects

After adding a subnetwork you can add device objects.

To add a Device object:
1. Select a Subnetwork object.
2. Add an IEC 61850 Device (IEC 61850 IED) object.
3. Rename the new object. Note that the names of the devices within an IEC 61850 Subnetwork have to be unique.

You should not have more than 30 devices per each subnetwork.

With SCL import function you can import new objects with configurations from an existing file. Right-click the device and select **SCL Import** from the shortcut menu, see Figure 3.2.3-1 .

To import a new configuration file:
1. Click **Choose File**.
2. Browse to a new configuration file from the appearing dialog.
3. Select the file and click **Open**.
4. Select the device to import from the drop-down list. You can preview the configuration on the right.
5. Click **Import**.

The new preconfigurated objects appear in the object tree. If the configuration file is very large, the import may take time. To import a configuration file for a different device, right-click the device, select **SCL Import** again and repeat the steps above.

3.3. Configuring objects

3.3.1. Configuring object properties

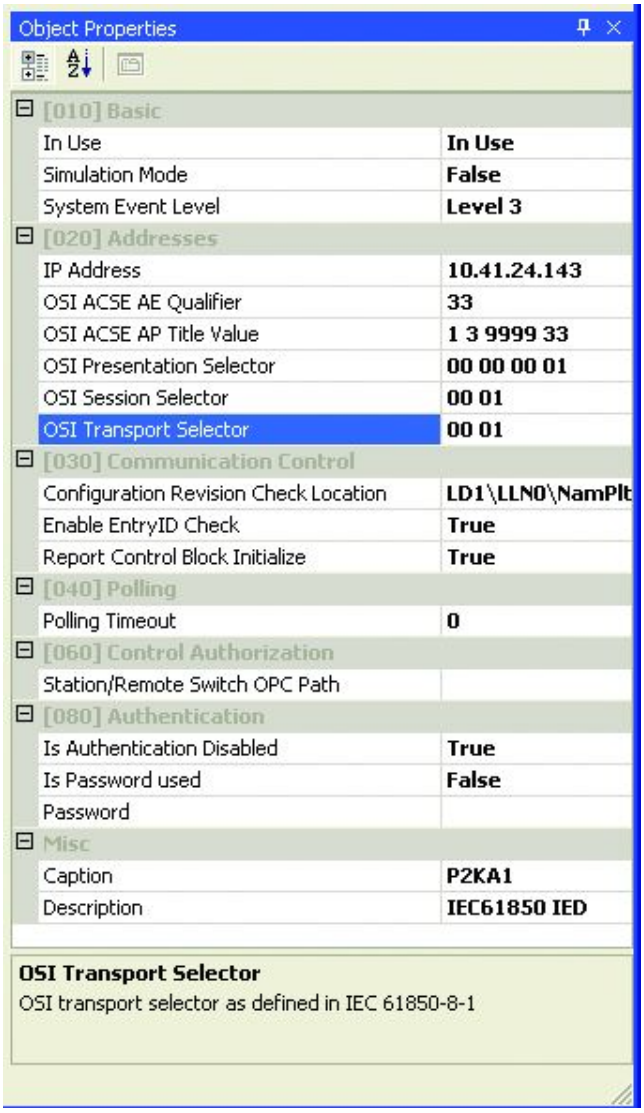
After the objects have been added, you need to configure the object properties.

To configure an object:
1. Select an object in the object tree of the Communication structure.
2. The object properties appear now in the Object Properties window, see Figure 3.3.1-1. You can see the selected object on the left and the available properties on the right.
3. Select the property you want to configure. Depending on the property value type, configuring is always done either by
   - selecting a predefined value from a drop-down combo box, or
   - entering a text string or a numerical value in a text field.

With SCL import function you can import new objects with configurations from an existing file. Right-click the device and select **SCL Import** from the shortcut menu, see Figure 3.2.3-1.

To import a new configuration file:
1. Click **Choose File**.
2. Browse to a new configuration file from the appearing dialog.
3. Select the file and click **Open**.
4. Select the device to import from the drop-down list. You can preview the configuration on the right.
5. Click **Import**.

The new preconfigurated objects appear in the object tree. If the configuration file is very large the import may take time. To import a configuration file for a different device,right-click the device, select **SCL Import** again and repeat the steps above.



IECObjProp.jpg

Figure 3.3.1-1 Example of object properties

The available properties for different objects are listed in the following subsections.

3.3.2. Configuring IEC 61850 OPC Server properties

Table 3.3.2-1 lists the configurable IEC 61850 OPC Server properties and value ranges for them. The actual configuration by using Communication Engineering Tool (CET) is performed as described in 3.3.1, Configuring object properties.

Table 3.3.2-1 IEC 61850 OPC Server properties

Name	Value/Value range	Description
Basic		

Name	Value/Value range	Description
AE Prog ID		Prog ID for OPC Alarm and Event Server (Automatically generated by management function)
DA Prog ID		Prog ID for OPC Data Access Server
SNTP Client		
1. Address for SNTP Server		IP address or node name for SNTP Server (Primary)
1. Port Number	(1..65535) Default: 123	TCP/IP port number
1. Synchronization Interval	(0..3600) Default: 15	Time syncronization interval in seconds. If value is 0, no time syncronization will be done.
2. Address for SNTP Server		IP address or node name for SNTP Server
2. Port Number	(1...65535) Default: 123	TCP/IP port number
2. Synchronization Interval	(0..3600) Default: 15	Time synchronization interval in seconds. If value is 0, no time syncronization will be done.
3. Address for SNTP Server		IP address or node name for SNTP Server
3. Port Number	(1...65535) Default: 123	TCP/IP port number
3. Synchronization Interval	(0..3600) Default: 15	Time syncronization interval in seconds. If value is 0, no time syncronization will be done.
4. Address for SNTP Server		IP address or node name for SNTP Server
4. Port Number	(1...65535) Default: 123	TCP/IP port number
4. Synchronization Interval	(0..3600) Default: 15	Time syncronization interval in seconds. If value is 0, no time syncronization will be done.
SNTP Enable Client	True False Default: True	Controls if time synchronization client is initially in use or not
SNTP Server		

Name	Value/Value range	Description
Enable Time Synchronization server	True False Default: True	Controls if time synchronization server is initially in use or not
Port Number For Time Synchronization Server	(1...65535) Default: 123	Port number for time synchronization server
Communication Control		
Report Control Identity	HSI1 HSI2 GW1 GW2 (or free string) Default: GW1	Report Control Identity specifies, which report control block instance is used by the OPC Server. The value must match with the Report Client attribute under the Report Enabled attribute of the report control block to be used. To enable the IEC 61850 OPC Server to use the specific report control blocks and therefore receive spontanious events, the Report Control Identity field must match with one of the Report enabled fields on device's report control block configurations. This dedicates a report control block's specific instance from the device to be used by the IEC 61850 OPC Server. If the fields do not match, the configured report control block is discarded.
Server Originator Category	Control operation issued from an operator using a client located at station level Control operation issued from an unknown location Control operation from a remote operater outside the substation (for example network control center) Default: Control operation issued from an operator using a client located at station level	Specifies the default originator category that is used for changing values and IEC 61850 control services. This can be override by OPC client for DPC control.
Server Originator Identification	Free string (max length 64 characters). For numeric values hex code can be used (starting with "0x" e.g. 0xABB). Default: ABB	Specifies the default originator identification that is used for IEC 61850 control services.

3.3.3. Configuring IEC 61850 Subnetwork properties

The IEC 61850 Subnetwork properties that can be configured and value ranges for them can be found in Table 3.3.3-1. The actual configuration by using the Communication Engineering Tool (CET) is performed as described in 3.3.1, Configuring object properties.

Each IEC 61850 node of the system must have a unique subnet/node address.

Table 3.3.3-1 IEC 61850 Subnetwork properties

Property/Parameter	Value or Value range/ Default	Description
Basic		
In Use	In Use Not In Use Default: In Use	Controls whether the device communication is initially in use or not
Communication Port		
IP Address	127.0.0.1	IP Address for communication channel. Dotted decimal to be used.
OSI ACSE AE Qualifier	23	OSI ACSE AE Qualifier as defined in IEC 61850-8-1
OSI ACSE AP Title Value	1,3,9999,23	OSI ACSE AP Title Value as defined in IEC 61850-8-1
OSI Presentation Selector	0001	OSI Presentation Selector as defined in IEC 61850-8-1
OSI Session Selector	0001	OSI Session Selector as defined in IEC 61850-8-1
OSI Transport Selector	00000001	OSI Transport Selector as defined in IEC 61850-8-1
Communication Control		

Property/Parameter	Value or Value range/ Default	Description
System Event Level	Disabled Level 1 (main operation and errors) Level 2 (time synchronization errors) Level 3 (time synchronization done) Level 4 (reported local updates from devices) Level 5 (reported unconfigured updates from devices) Default: Disabled	Level of system events (OPC AE events) can be viewed with an OPC AE client or with a CET Diagnostic AE client for OPC Server. Amount of events sent is cumulative: higher level also contains lower level events. System event level configuration at subnetwork overrides definitions at device level. Same or higher event level must be set for Subnetwork as for IED. System events can be used for debugging and event flow monitoring, see Table 3.3.4-1. Event level can be changed during the runtime by using the Diagnostic events level attribute, see 5.3.3, IEC 61850 line attributes.
TCP/IP Keepalive Time-out	(1..3600) Default: 15	TCP/IP Keepalive time-out in seconds

3.3.4. Configuring IEC 61850 Device properties

Table 3.3.4-1 lists the configurable properties for IEC 61850 Devices (used for ABB protection and control devices) and value ranges for these properties. The actual configuration by using the Communication Engineering Tool (CET) is performed as described on 3.3.1, Configuring object properties.

Each IEC 61850 node of the system must have a unique subnet or node address.

Table 3.3.4-1 IEC 61850 Device properties

Name	Value or Value range/ Default	Description
Basic		
In Use	In use Not in use Default: In use	Controls if the device communication is initially in use or not.
Simulation Mode	True False Default: False	Defines if the device is in simulation mode.

Name	Value or Value range/ Default	Description
System Event Level	Level0=Disabled Level1=Level 1 (main operation, error replies, errors) Level2=Level 2 (information reports, OK replies, RCB initializing) Level3=Level 3 (sent requests (connect, read, write), transparent SPA messages) Level4=Level 4 (reported local updates) Level5=Level 5 (reported unconfigured updates)	Level of system events (OPC AE events) can be viewed with a CET Diagnostic AE client for OPC Server or with an OPC AE client. Amount of events sent is cumulative: higher level also contains lower level events. System event level configuration at subnetwork overrides definitions at device level. The same or higher event level must be set for Subnetwork as for IED. System events can be used for debugging and event flow monitoring, see Table 3.3.3-1. Event level can be changed during the run time by using the Diagnostic events level attribute, see 5.3.4, IEC 61850 device attributes .
Addresses		
IP Address	127.0.0.1	IEC 61850 Node Number of the device
OSI ACSE AE Qualifier	23	IEC 61850 Subnet Number of the device
OSI ACSE AP Title Value	1,3,9999,23	OSI ACSE AP Title Value as defined in IEC 61850-8-1.
OSI Presentation Selector	00000001	OSI Presentation Selector as defined in IEC 61850-8-1.
OSI Session Selector	0001	OSI Session Selector as defined in IEC 61850-8-1.
OSI Transport Selector	0001	OSI Transport Selector as defined in IEC 61850-8-1.
Communication Control		
Configuration Revision Check Location	Shall be empty if the configuration check is not in use.	Location for checking configuration revision for IED before establishing communication. The format is Logical Device Name\Logical Node Name\Data Object Name\Attribute Name e.g. LD1\LLN0\NamPlt\configRev
Enable EntryID Check	True False Default: False	Enable reporting EntryID check. Report EntryIDs are used as sequence numbers for buffered reporting. A gab in sequence numbers caused a restart of reporting starting from lost sequence number.
Report Control Block Initialize	True False Default: True	Initialize to report control blocks and enable reporting.

Name	Value or Value range/ Default	Description
Use 32 Bit Entry ID	True False Default: False	Enables or disables usage of 32 bit EntryIDs for information report sequence. The IEC 61850 standard defines 64 bit EntryID, but e.g. SPA-ZC 40x uses 32 bit EntryID.
Use Sequence Number Check	True False Default: False	Enables or disables sequence number checking information reports for the IEC 61850 OPC server.
MMS Request Timeout	0...60000 0 = disabled Default: 5000	Timeout for the MMS level is requested in milliseconds (msec).
Polling		
Polling Timeout	(0..3600) Default: 0 (disabled)	Polling Timeout in seconds. If the device does not support reporting, ST and MX attributes can be polled with this interval.
Control Authorization		
Station/Remote Switch OPC Path		OPC path of the station remote switch position to be used with this device. The format is Node#ProgID For OPC Server#Channel Name\\IED Name\\Logical Device Name\\Logical Node Name\\Data Object Name E.g. GW#ABB.IEC61850_OPC_DA_Server.Instance[1]1#Channel1\\IED1\\LD1\\GGIO1\\Ioc
Configuration		

Name	Value or Value range/ Default	Description
Dynamically Create Data Sets		Controls dynamic dataset creation to the device. When the dynamic dataset is created and the connection is established, the IEC 61850 OPC server creates all configured datasets to the device and initializes the dedicated report control blocks according to the configuration. Dynamic datasets can be created persistent or non-persistent. This attribute is configured with the dataset name. Non-persistent datasets are destroyed in the device when communication is lost and persistent datasets remain. @DatasetName = Non-persistent NVL, AA-specific /DatasetName = Persistent NVL, VMD specific DataSetName = Persistent NVL, DOMAIN specific Refer to the IED manuals, if IED supports the dynamic dataset creation services.
Disturbance Recording		
Disturbance Recorder Remote Directory		Specifies the folder where all disturbance recordings will be stored in this IED.
Disturbance Recorder Delete Recordings	Default: False	Specifies whether DRs are deleted from IED after upload.
Disturbance Recorder Enabled	Default: False	Specifies whether DR upload is enabled.
Disturbance Recorder Local Directory		Specifies the folder where all disturbance recordings will be stored in COM600 computer. If left empty "C:\COMTRADE\IEDName" will be used.
Disturbance Recorder Maximum Total File Size	0 - 2147483647 0: no limit Default: 0	Specifies maximum size for folder where uploaded DRs are locally stored for this IED.

Name	Value or Value range/ Default	Description
Disturbance Recorder Polling Period	0 - 2147483647 0: disabled Default: 120	DR polling period in seconds
Disturbance Recording via FTP		
Disturbance Recorder FTP Password		FTP password to be used with DR functionality
Disturbance Recorder FTP User Name		FTP username to be used with DR functionality
Disturbance Recorder Read Via FTP	False: MMS (IEC 61850) True: FTP Default: False	Specifies whether DRs shall be read using FTP.
IED		
SPA parameter for Close Password		SPA parameter for Close Password
SPA value for Close Password		SPA parameter value for Close Password
SPA parameter for Open Password		SPA parameter for Open Password
SPA value for Open Password		SPA parameter value for Open Password
SPA Store parameter name		SPA parameter for Store
SPA Store parameter value		SPA parameter value for Store

3.3.5. Configuring Logical Device properties

The logical devices are already configured when they are imported with IEC61850 devices. The configurations can be monitored with viewers, refer to 3.3.7, Provided viewers.

Table 3.3.5-1 Logical Device properties

Name	Value or Value range/ Default	Description
Transparent SPA		

Name	Value or Value range/ Default	Description
SPA Address	(0..999) Default: 0	The SPA address of the device connected via TCP/IP. By setting value >0 enables the built in TCP/SPA client, wich can be used through the Transparent SPA attribute, see 5.3.6, IEC 61850 logical device attributes.
SPA TCP Port	(1..65535) Default: 7001	SPA TCP Port
SPA TCP Timeout	(1..65535) Default: 3	SPA TCP Timeout in seconds
Control Authorization		
Station/Remote Switch OPC Path		Station/Remote Switch OPC Path OPC path of the station remote switch position to be used with this device. The format is Node#ProgID For OPC Server#Channel Name\IED Name\Logical Device Name\Logical Node Name\Data Object Name E.g. GW#ABB.IEC61850_OPC_DA_Server.Instance[1]#Channel1\IED1\LD1\GGIO1\loc

3.3.6. Viewing data object configuration

IEC 61850 OPC Server supports data objects for status, measurand, controllable status, and controllable analog information. IEC 61850 OPC Server supports 28 data object types for an IEC 61850 Device. The data objects are already configured when they are imported with IEC 61850 devices. The configurations can be monitored with viewers, refer to 3.3.7, Provided viewers.

Data classes for status information:
- Single point status (SPS)
- Double point status (DPS)
- Integer status (INS)
- Protection activation information (ACT)
- Directional protection activation information (ACD)
- Security violation counter (SEC)
- Binary counter reading (BCR)

Data classes for measurand information:
- Measured value (MV)
- Complex measured value (CMV)

- Sampled value (SAV)
- WYE
- Delta (DEL)
- Sequence (SEQ)

Data classes for controllable status information:
- Controllable single point (SPC)
- Controllable double point (DPC)
- Controllable integer status (INC)
- Binary controlled step position information (BSC)
- Integer controlled step position information (ISC)

Data classes for controllable analog information:
- Analog set point (APC)

Data objects classes for status settings:
- Single setting point (SPG)
- Integer status setting (ING)

Data classes for analogue settings:
- Analogue setting (ASG)
- Setting curve (CURVE)

Data classes classes for description information:
- Device name plate (DPL)
- Logical Node name plate (LPL)

Data classes for internal status information:
- Integer status (Internal INS)
- Single point status (Internal SPS)
- Controllable single point (Internal SPC)

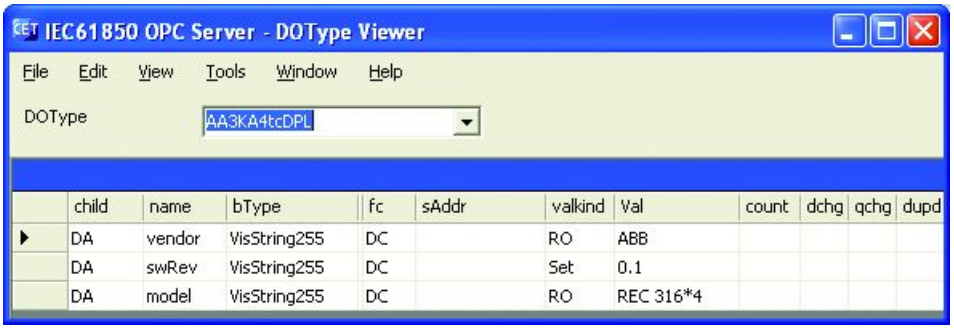
The parameters are stored in object properties in the Communication Engineering Tool (CET). The actual configuration for data objects is not supported.

3.3.7. Provided viewers

You can view configurated data object types, data attribute types and enumerated attributes with provided viewers for IEC 61850 OPC Server.

To view data object type viewer:
1. Right-click the IEC 61850 OPC Server.
2. Select **DOType Viewer** from the shortcut menu.

With DOType Viewer you can view the attributes of the DOtypes under the IEC 61850 OPC Server in the communication structure. From the DOType drop-down menu you can select the data object types to view, see Figure 3.3.7-1.

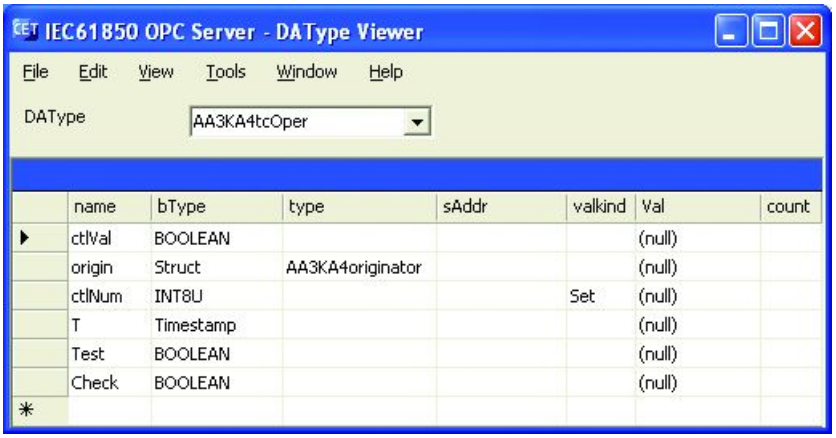


DOTypeView.jpg

Figure 3.3.7-1 IEC 61850 OPC Server DOType Viewer

To view data attribute type viewer:
1. Right-click the IEC 61850 OPC Server.
2. Select **DAType Viewer** from the shortcut menu.

With DAType Viewer you can view the attributes of the DAtypes under the IEC 61850 OPC Server in the communication structure. From the DAType drop-down menu you can select the data attribute types to view, see Figure 3.3.7-2.

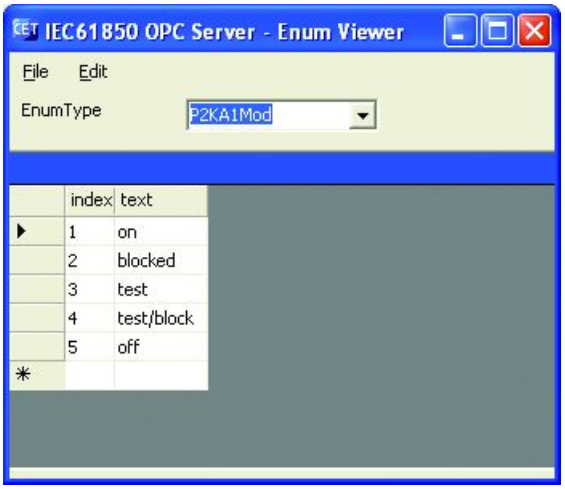


DATypeView.jpg

Figure 3.3.7-2 IEC 61850 OPC Server DAType Viewer

To view enumerated basic type attributes:
1. Right-click the IEC 61850 OPC Server.
2. Select **Enum Viewer** from the shortcut menu.

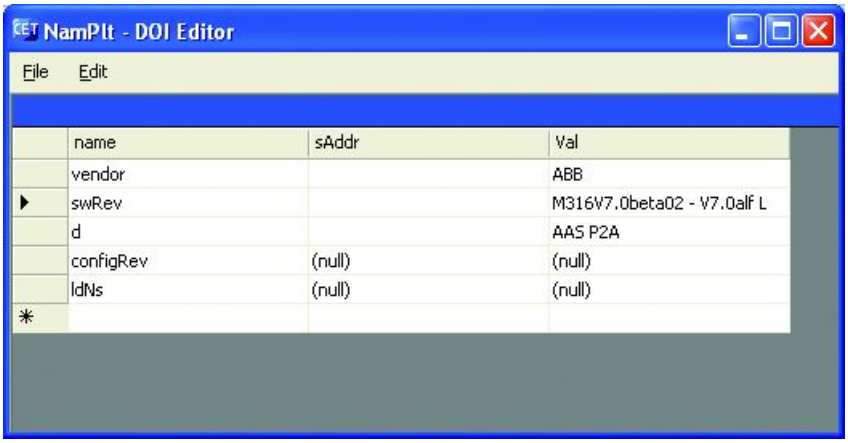
With Enum Viewer you can view the enumeration of EnumTypes under the IEC 61850 OPC Server in the communication structure. From the EnumType drop-down menu you can select the enumerated basic type attributes to view, see Figure 3.3.7-3.



EnumView.jpg

Figure 3.3.7-3 IEC 61850 OPC Server Enum Viewer

With DOI Editor you can override the data object's default values if necessary, see Figure 3.3.7-4. Refer to IEC standards IEC 61850-6 and IEC 61850-7-3.



DOIEdit.jpg

Figure 3.3.7-4 DOI Editor

3.3.8. Configuring report control blocks

A report control block (RCB) controls the spontaneous event reporting, and the client can modify report sending behaviour by setting RCB attributes. Buffered Report Control Blocks (BRCB) and Unbuffered Report Control Blocks (URCB) are supported RCBs.

For BRCB, events issue immediate sending of reports or buffer the events for transmission, such that data values are not lost due to transport flow control constraints or loss of connection. For URCB, events issue immediate sending of reports on a best efforts

basis. If no association exists or if the transport data flow is not fast enough to support it, events may be lost.

To allow multiple clients to receive the same data values, multiple instances of the report control classes need to be made available. Report Enabled and Report Client definitions are used to specify RCB instances to clients. Report Enabled shows the maximum number of available RCB instances, and Report Client dedicates an instance to a client (see Report Control Identity in Table 3.3.2-1). All configured RCBs without IEC 61850 OPC Server specified instances are discarded.

Report Clients' order specifies the RCB instance to be used and the RCB name. IEC 61850 OPC Server builts the RCB instance name to type RCBName<xx>. Each RCB instance takes on the values from 01 to 99 as <xx>, for example the first Report Client uses RCBName01. The naming convention can also be overriden by removing the Report Enabled element. Now the RCBName is used as it is.

The control attribute values are received from the imported device configuration. Some values can be overriden with the IEC 61850 OPC Server configuration.

- Buffer Time
  Controls the time interval in milliseconds when the BRCB buffers the events for inclusion into a single report. Overridable.
- Buffered
  Controls RCB to to buffered (true) or unbuffered (false). Must be true for BRCB.
- Configuration Revision
  Represents the number of times that the configuration of the RCB has changed.
- Data Set
  Specifies the data set being monitored and what values are reported.
- Integrity period
  If this is set to integrity (>0), it indicates the period in milliseconds used for generating an integrity report. An integrity report shall report the values of all members of the related data set. Overridable.
- Report ID
  Report identifier is the BRCB's client-specified report identifier. Report identifier generates the report.
- Option Fields
  Client specified optional fields to be included in the report issued by BRCB. This attribute defines the optional header fields' subset of the report that are included in the report. Refer to IEC 61850-7-2 and IEC 61850-8-1 standards. The IEC 61850 OPC Server uses a default value for option fields to receive the necessary information for event updates and event flow control (cannot be overriden): BRCB (Sequence Number, Reason Code, Buffer Overflow, Entry ID), URCB (Sequence Number, Reason Code). Overridable.
- Trigger Options
  Specifies the trigger conditions which BRCB monitores. The following values are defined: Data Change(dchg), Quality Change(qchg), Data Update(dupd), Period.

Buffer time and Integrity period are overridable. Option fields are also overridable, except the default values that IEC 61850 OPC Server uses to receive the necessary information for event updates and event flow control.

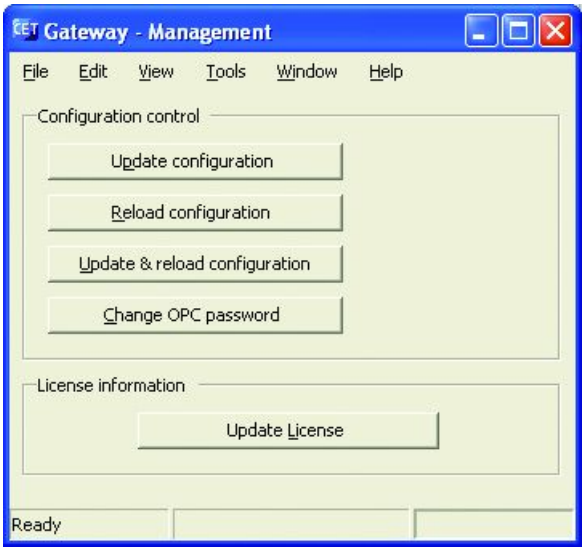
4. Operation

4.1. Activating gateway or OPC server with new configuration

4.1.1. General about activating Gateway or OPC Server with new configuration

This section describes the basic operation procedures you can carry out after the object properties for the IEC 61850 OPC Server have been configured.

Normally the IEC 61850 OPC server starts automatically when the first client connects to it and shuts down when the last client disconnects. You can either update the configuration files to the Gateway or restart the OPC server with the management function. This is done by clicking the respective buttons. Figure 4.1.1-1 shows the Gateway Management function for the IEC 61850 OPC Server. For more detailed information, see COM600 User's Guide.



GWManage.jpg

Figure 4.1.1-1 Gateway Management function

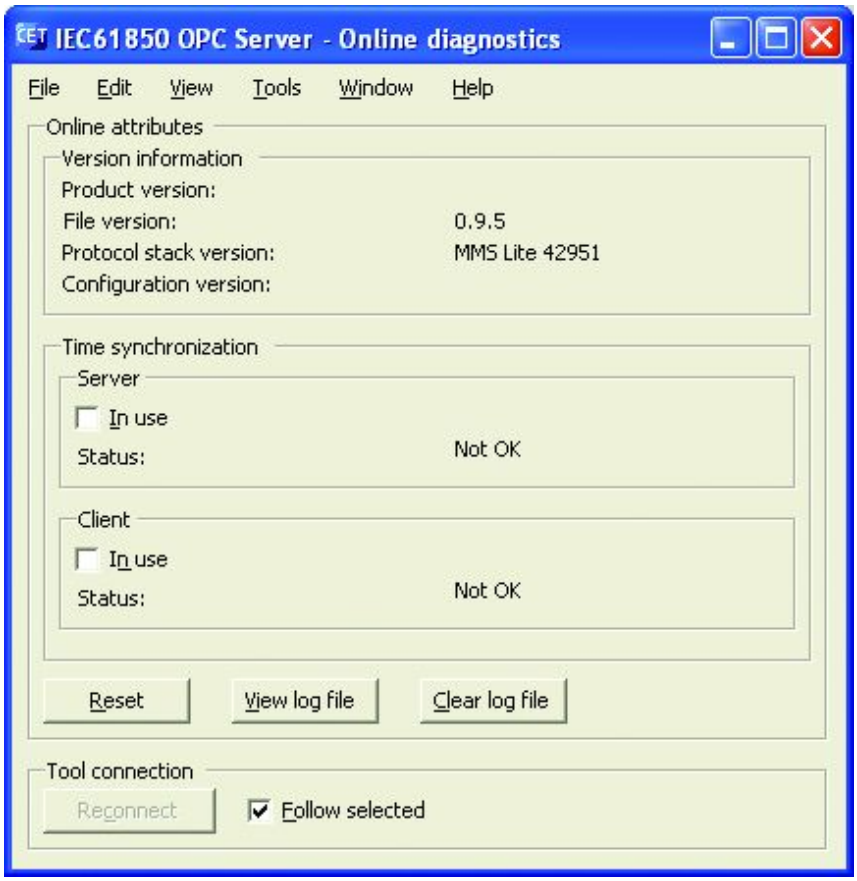
4.1.2. IEC 61850 OPC Server diagnostics

After the IEC 61850 OPC Server has been installed and configured, you can, for example, monitor and control the condition of connections in an IEC 61850 network.

This is done by using the Online Diagnostics function in the Communication Engineering Tool (CET), select **Tools** > **Online Diagnostics** or select the object, right-click the IEC

61850 Server object and select **Online Diagnostics** from the shortcut menu, see Figure 4.1.2-1.

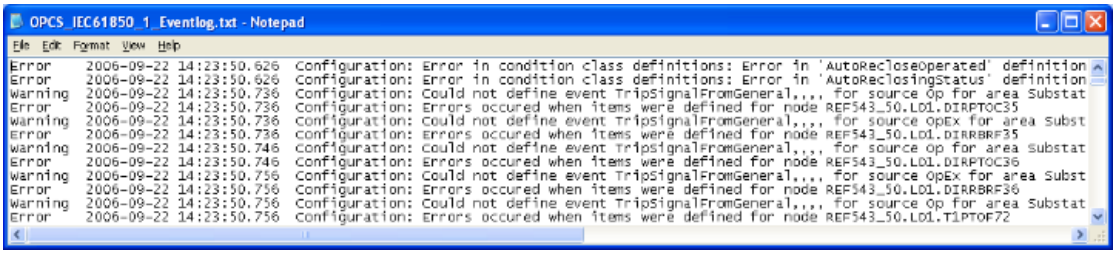
The server, a device or data object is dragged and dropped from the Project Explorer's Communication structure under the Online Diagnostics function. Select the Project Explorer from the **View** menu if it is not already open.



OPCDiag.jpg

Figure 4.1.2-1 IEC 61850 OPC Server Online Diagnostics

You have the following alternatives:
- to reset counters (restart the OPC server)
- to view the event log file
- to clear the log file
- to reconnect the online diagnostics
- to enable or disable the SNTP client



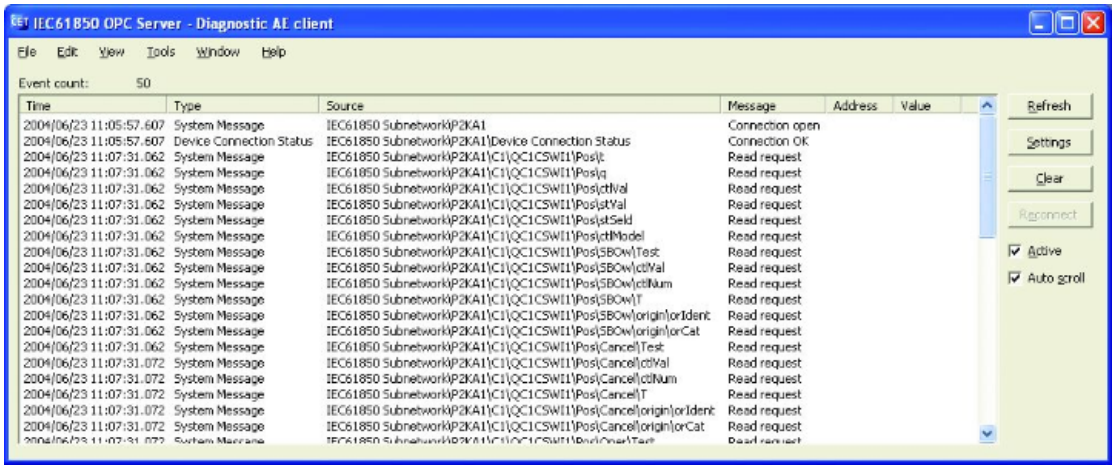
Event_log_61850.bmp

Figure 4.1.2-2 Event log file

4.1.3. Diagnostic AE Client

Diagnostic events can be monitored and controlled using the Diagnostic AE Client function, see Figure 4.1.3-1. Click **Refresh** to update the status information. To be able to receive events from a certain device, diagnostic events must be enabled for this device

To enable diagnostic events:
1. Right-click the device.
2. Select **Diagnostic AE client**.



DiagAEClient.jpg

Figure 4.1.3-1 IEC 61850 OPC Server Diagnostics AE client

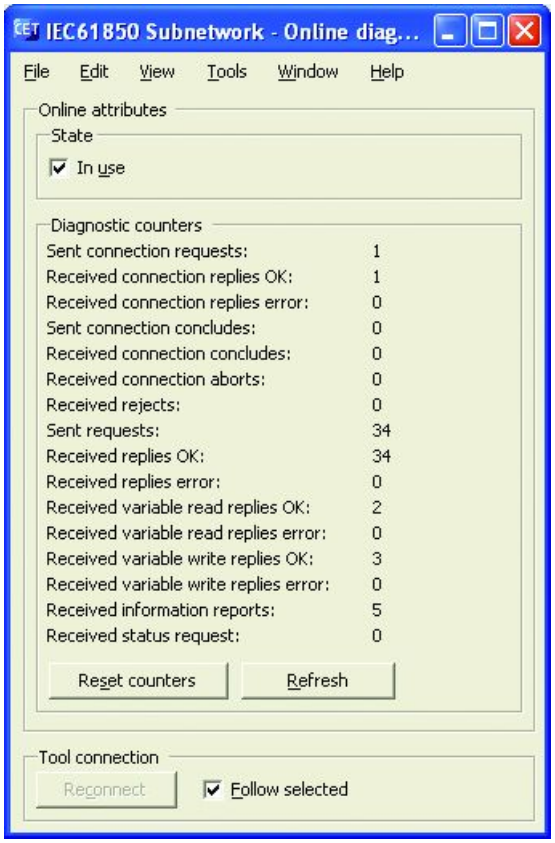
4.2. Monitoring and controlling IEC 61850 subnetwork activity

The IEC 61850 subnetwork activity can be monitored with the Online Diagnostics function.

You can also take a subnetwork into use or out of use.

To monitor and control IEC 61850 subnetwork activity:

1. Select the subnetwork you want to monitor in the object tree of the Communication Engineering Tool (CET).
2. Right-click the channel.
3. Select **Online Diagnostics**.



SubDiag.jpg

Figure 4.2-1 IEC 61850 subnetwork Online Diagnostics

In the Diagnostic counters field, you can monitor the subnetwork activity and the available properties, see Figure 4.2-1. To reset Diagnostic counters, click **Reset counters**.

You can take an IEC 61850 subnetwork into use by selecting the In **Use check** box. If you clear the check box, the subnetwork is taken out of use. To update the diagnostic counters click **Refresh**.

4.3. Monitoring and controlling IEC 61850 device communication

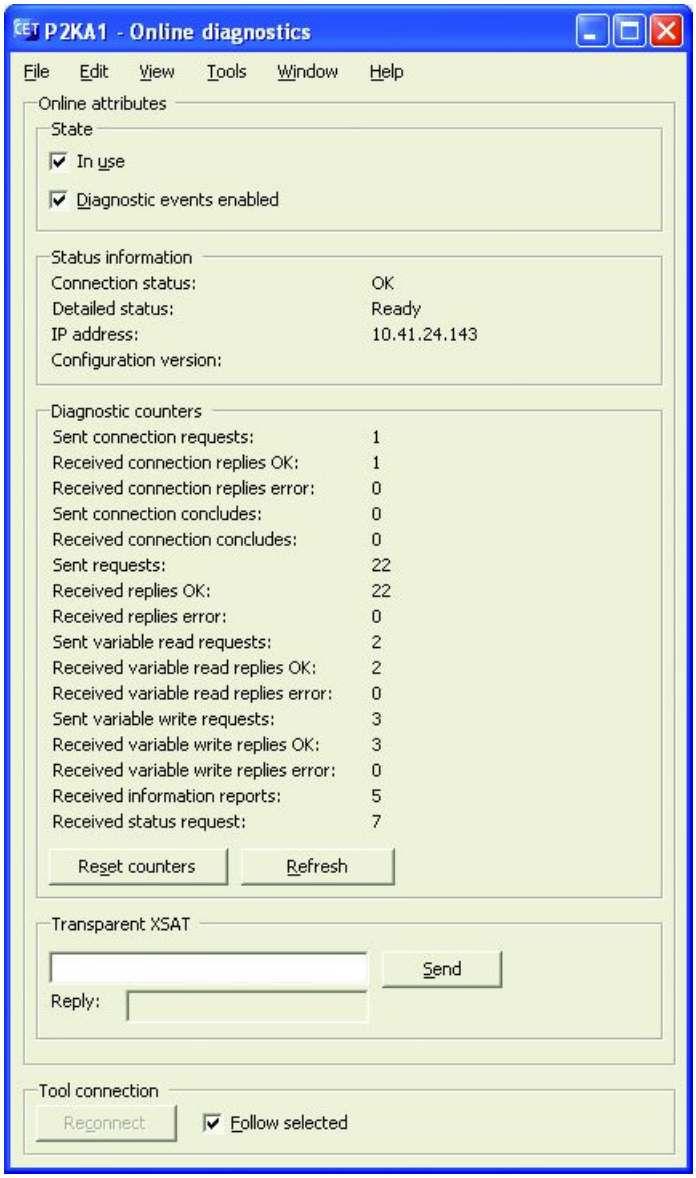
The IEC 61850 device communication can be monitored with the Online Diagnostics function.

To monitor and control IEC 61850 device communication:

1. Select the device you want to monitor in the object tree of the Communication Engineering Tool (CET).
2. Right-click the device.
3. Select **Online Diagnostics**.

In the Status information field, you can monitor the device status. The Diagnostic counters field provides information on device activity. To reset diagnostic counters, click **Reset counters**. To update the diagnostic counters click **Refresh**.

You can take an IEC 61850 device into use by selecting the **In Use** check box. If you clear the check box, the device is taken out of use.



DeviceDiag.jpg

Figure 4.3-1 IEC 61850 Device Online Diagnostics

4.4. Monitoring and controlling IEC 61850 data object communication

The IEC 61850 data object diagnostics can be monitored with the Online Diagnostics function.

To monitor and control IEC 61850 data object communication:

1. Select the data object you want to monitor in the object tree.

2. Right-click the device.
3. Select **Online Diagnostics**.

In the Status information field, you can monitor and set attribute values and use control services. The Diagnostic counters field provides information on device activity.

5. Technical reference

5.1. About this section

This document describes how IEC-61850 data objects according to IEC-61850-7-3 are mapped to OPC nodes and item tags.

In general it is done by using an OPC node to represent an IEC-61850 object, and OPC item tags to represent the attributes of the object. Most objects are single-level (i.e. use only on node) but some are hierarchical and use several nodes.

This section provides reference information about the following issues:
- IEC 61850 data object modelling
- IEC 61850 OPC Server data object modelling
- Attributes
- Status codes

5.2. IEC 61850 OPC server data object modeling

5.2.1. Common data attribute types

The relationship between IEC 61850 data models and the LON OPC Server is described in this section.

For each data class, there is a table giving a detailed description about the relation between the LON data and the IEC 61850 data object attributes and services. The tables also describe how the data is presented on the OPC Server name space.

The columns in the tables have the following content types:
- **Name** specifies the OPC item name of the attribute or service.
- **Type** specifies the IEC 61850 type of the attribute.
- **Value/Value range** specifies the allowed values and ranges of the attribute or service.
- **Mandatory/Optional** specifies whether the attribute is considered as mandatory or optional according to the IEC 61850 standard.
- **OPC data type** specifies the OPC data type used for the OPC item.
- **Bit** specifies how many bits the attribute takes.
- **Description** describes the data type and access and gives useful information.

5.2.2. IEC 61850 quality

The table below defines the mapping of quality in MMS (IEC 61850 7-3). Only 14 bits (LSB) in quality are valid.

Table 5.2.2-1 IEC 61850 quality

Name	Type	Value/Value range	M/O/C	Bit
validity	2bit	good (0) | invalid (1) | reserved (2) | questionable (3)	M	0-1
overflow	1bit	FALSE (0) | TRUE (1)	M	2
outOfRange	1bit	FALSE (0) | TRUE (1)	M	3
badReference	1bit	FALSE (0) | TRUE (1)	M	4
oscillatory	1bit	FALSE (0) | TRUE (1)	M	5
failure	1bit	FALSE (0) | TRUE (1)	M	6
oldData	1bit	FALSE (0) | TRUE (1)	M	7
inconsistent	1bit	FALSE (0) | TRUE (1)	M	8
inaccurate	1bit	FALSE (0) | TRUE (1)	M	9
source	2bit	process (0) | substituted (1)	M	10-11
test	1bit	FALSE (0) | TRUE (1)	M	12
operatorBlocked	1bit	FALSE (0) | TRUE (1)	M	13

5.2.3. Mapping quality value to OPC

The value of validity is presented as the value of the quality attribute and the other values are presented as OPC properties of the quality in the OPC namespace.

Table 5.2.3-1 Mapping quality value to OPC

Name	Type	Value/ Value range	M/O/C	OPC Data Type
Validity		good (0) | invalid (1) | reserved (2) | questionable (3)	M	VT_I4
DetailQuality		DetailedQuality	M	VT_I4
Source		process (0) | substituted (1)	M	VT_I4

Name	Type	Value/ Value range	M/O/C	OPC Data Type
Test		FALSE (0) | TRUE (1)	M	VT_BOOL
OperatorBlocked		FALSE (0) | TRUE (1)	M	VT_BOOL

5.2.4. Mapping of DetailedQuality

The value of DetailQuality is mapped to a DetailedQuality bitmap.

Table 5.2.4-1 Mapping of DetailedQuality

Name	Type	Value/ Value range	M/O/C	Bit
overflow	1bit	FALSE (0) | TRUE (1)	M	0
outOfRange	1bit	FALSE (0) | TRUE (1)	M	1
badReference	1bit	FALSE (0) | TRUE (1)	M	2
oscillatory	1bit	FALSE (0) | TRUE (1)	M	3
failure	1bit	FALSE (0) | TRUE (1)	M	4
oldData	1bit	FALSE (0) | TRUE (1)	M	5
inconsistent	1bit	FALSE (0) | TRUE (1)	M	6
inaccurate	1bit	FALSE (0) | TRUE (1)	M	7

Example:

DetailQuality = 1d = 00000001b > overflow = true

DetailQuality = 16d = 00010000b > failure = true

5.2.5. Analogue value (AnalogueValue)

Analogue values are always presented as 32 bit float values (VT_R4) so that the .f and .i extensions are discarded from the attribute names to simplify the OPC namespace. If a device only supports integer values, the value is converted to a floating point presentation of the value according to its configuration and the following formula, refer to 5.2.6, Configuration of analogue value (ScaledValueConfig).

$f \times 10^{units.multiplier} = (i \times scaleFactor) + offset$

Table 5.2.5-1 Analogue value (AnalogueValue)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
i	INT32	integer value	Not Used	Not Used
f	FLOAT32	floating point value	Not Used	Not Used

Example:

MV: mag.f (VT_R4) & mag.i (VT_I4) > mag (VT_R4)

5.2.6. Configuration of analogue value (ScaledValueConfig)

The table below defines the mapping of configuration of analogue value (ScaledValue-Config).

Table 5.2.6-1 Configuration of analogue value (ScaledValueConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
scaleFactor	FLOAT32	floating point value	M	VT_R4
offset	FLOAT32	floating point value	M	VT_R4

5.2.7. Range configuration (RangeConfig)

The table below defines the mapping of range configuration (RangeConfig).

Table 5.2.7-1 Range configuration (RangeConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
hhLim	AnalogueValue	floating point value	M	VT_R4
hLim	AnalogueValue	floating point value	M	VT_R4
lLim	AnalogueValue	floating point value	M	VT_R4
llLim	AnalogueValue	floating point value	M	VT_R4
min	AnalogueValue	floating point value	M	VT_R4

Name	Type	Value/ Value range	M/O/C	OPC Data Type
max	AnalogueValue	floating point value	M	VT_R4

hhLim, hLim, lLim, llLim: These attributes are configuration parameters used in the context with the range attribute.

min: The min (minimum) attribute represents the minimum process measurement for which values of i or f are considered within process limits.

max: The max (maximum) attribute represents the maximum process measurement for which values of i or f are considered within process limits.

5.2.8. Step position with transient indication (ValWithTrans)

The table below defines the mapping of Step position with transient indication (ValWithTrans).

Table 5.2.8-1 Step position with transient indication (ValWithTrans)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
posVal	INT8	-64 ... 63	M	VT_I4
transInd	BOOLEAN	TRUE | FALSE	M	VT_BOOL

5.2.9. Pulse configuration (PulseConfig)

The table below defines the mapping of pulse configuration (PulseConfig).

Table 5.2.9-1 Pulse configuration (PulseConfig)

Name	Type	Value/ Value range	M/O/C	OPC Data Type
cmdQual	ENUMERATED	pulse(0) | persistent(1)	M	VT_I4
onDur	INT32U		M	VT_I4
offDur	INT32U		M	VT_I4
numPls	INT32U		M	VT_I4

5.2.10. Originator

The table below defines the mapping of originator (Originator).

Table 5.2.10-1 Originator

Name	Type	Value/ Value range	M/O/C	OPC Data Type
orCat	ENUMERATED	not-supported(0) | bay-control(1) | station-control(2) | remote-control(3) | automatic-bay(4) | automatic-station(5) | automatic-remote(6) | maintenance(7) | process(8)	M	VT_I4
orident	OCTET STRING64	TRUE | FALSE	M	VT_BSTR

5.2.11. Unit

The table below defines the mapping of unit (Unit).

Table 5.2.11-1 Unit

Name	Type	Value/ Value range	M/O/C	OPC Data Type
SIUnit	ENUMERATED		M	VT_I4
multiplier	ENUMERATED		O	VT_I4

5.2.12. Vector

The table below defines the mapping of vector (Vector).

Table 5.2.12-1 Vector

Name	Type	Value/ Value range	M/O/C	OPC Data Type
mag	AnalogueValue	floating point value	M	VT_R4
ang	AnalogueValue	floating point value	O	VT_R4

5.2.13. TimeStamp

The timestamp OPC attributes are presented as OPC type VT_DATE. It is implemented using an 8-byte floating-point number. Days are represented by whole number increments

starting with 30 December 1899, midnight as time zero. Hour values are expressed as the absolute value of the fractional part of the number.

5.2.14. AbbCommandBitmask

The table below defines the mapping of AbbCommandBitmask. This ABB specific control value is a bitmask value of a command to a device. This value is applicable to ABB extension control attributes.

Table 5.2.14-1 AbbCommandBitmask

Name	Type	Value/ Value range	M/O/C	Bit Position
NormalControl	1bit	FALSE (0) | TRUE (1)	M	0
InterlockOverride	1bit	FALSE (0) | TRUE (1)	M	1
Synchrocheck-Override	1bit	FALSE (0) | TRUE (1)	M	2
TestCommand	1bit	FALSE (0) | TRUE (1)	M	3
Originator	4bit	not-supported(0) | bay-control(1) | station-control(2) | remote-control(3) | automatic-bay(4) | automatic-station(5) | automatic-remote(6) | maintenance(7) | process(8)	M	4-7
ControlValue	nbit		M	8-31

NormalControl : True = normal operation, false = inverse operation (e.g. On > Off).

InterlockOverride : True = interlockcheck > false

SynchrocheckOverride : True = syncrocheck > false

TestCommand : True = test command

Originator : Command originator (= Originator.orCat)

5.2.15. Common data class specifications for status information

5.2.15.1. Single point status (SPS)

The table below defines the common data class of single point status.

Table 5.2.15.1-1 Single point status (SPS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	BOOLEAN	ST	TRUE | FALSE	M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	BOOLEAN	SV	TRUE | FALSE	O	VT_BOOL
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING64	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.2. Double point status (DPS)

The table below defines the common data class of double point status.

Table 5.2.15.2-1 Double point status (DPS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	CODED ENUM	ST	intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	VT_I4
q	Quality	ST		M	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	CODED ENUM	SV	intermediate-state (0) | off (1) | on (2) | bad-state (3)	O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.3. Integer status (INS)

The table below defines the common data class of integer status.

Table 5.2.15.3-1 Integer status (INS)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	INT32	ST		M	VT_I4
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
d	VISIBLE STRING255	DC		O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.4. Protection activation information (ACT)

The table below defines the common data class of protection activation information.

Table 5.2.15.4-1 Protection activation information (ACT)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
general	BOOLEAN	ST		M	VT_BOOL
phsA	BOOLEAN	ST		O	VT_BOOL
phsB	BOOLEAN	ST		O	VT_BOOL
phsC	BOOLEAN	ST		O	VT_BOOL
neut	BOOLEAN	ST		O	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
operTm	TimeStamp	CF		O	VT_DATE
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.5. Directional protection activation information (ACD)

The table below defines the common data class of directional protection activation information.

Table 5.2.15.5-1 Directional protection activation information (ACD)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
general	BOOLEAN	ST		M	VT_BOOL
dirGeneral	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	M	
phsA	BOOLEAN	ST		O	VT_BOOL
dirPhsA	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
phsB	BOOLEAN	ST		O	VT_BOOL
dirPhsB	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
phsC	BOOLEAN	ST		O	VT_BOOL
dirPhsC	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
neut	BOOLEAN	ST		O	VT_BOOL
dirNeut	ENUMERATED	ST	unknown (3) | forward (1) | backward (2)	O	
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.6. Security violation counter (SEC)

The table below defines the common data class of security violation counting.

Table 5.2.15.6-1 Security violation counting (SEC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
cnt	INT32U	ST		M	VT_I4
sev	ENUMER-ATED	ST	unknown (0) | critical (1) | major (2) | minor (3) | warning (4)	M	VT_I4
t	TimeStamp	ST		M	VT_DATE
addr	OCTET STRING64	ST		O	VT_BSTR
addInfo	VISIBLE STRING64	ST		O	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.15.7. Binary counter reading (BCR)

The table below defines the common data class of binary counter reading.

Table 5.2.15.7-1 Binary counter reading (BCR)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
actVal	INT128	ST		M	VT_I4
frVal	INT128	ST		O[a]	VT_I4
frTm	TimeStamp	ST		O[a]	VT_DATE
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
units	Unit	CF		O	VT_R4
pulsQty	FLOAT32	CF		M	VT_BOOL
frEna	BOOLEAN	CF		O [a]	VT_DATE
strTm	TimeStamp	CF		O [a]	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
frPd	INT32	CF		O [a]	VT_BOOL
frRds	BOOLEAN	CF		O [a]	VT_BSTR
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. All or none of these items must be present.

5.2.16. Common data class specifications for measured information

5.2.16.1. Measured value (MV)

The table below defines the common data class of measured value.

Table 5.2.16.1-1 Measured value (MV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instMag	Analogue-Value	MX		O	VT_R4
mag	Analogue-Value	MX		M	VT_R4
range	ENUMER-ATED	MX	normal (0) | high (1) | low (2) | high-high (3) | low-low (4) | ...	O	VT_I4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	Analogue-Value	SV		O	VT_R4
subQ	Quality	SV		O	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subID	VISIBLE STRING64	SV		O	VT_BSTR
units	Unit	CF		O	
db	INT32U	CF	0...100 000	O	VT_I4
zeroDb	INT32U	CF	0...100 000	O	VT_I4
sVC	ScaledValue-Config	CF		O	
rangeC	RangeConfig	CF		O	
smpRate	INT32U	CF		O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.16.2. Complex measured value (CMV)

The table below defines the common data class of measured value.

Table 5.2.16.2-1 Complex measured value (CMV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instCVal	Vector	MX		O	
cVal	Vector	MX		M	
range	ENUMER-ATED	MX	normal (0) | high (1) | low (2) | high-high (3) | low-low (4) | ...	O	VT_I4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	Vector	SV		O	
subQ	Quality	SV		O	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subID	VISIBLE STRING64	SV		O	VT_BSTR
units	Unit	CF		O	
db	INT32U	CF	0...100 000	O	VT_I4
zeroDb	INT32U	CF	0...100 000	O	VT_I4
rangeC	RangeConfig	CF		O	
magSVC	ScaledValue-Config			O	
angSVC	ScaledValue-Config			O	
angRef	ENUMER-ATED	CF	V | A | other ...	O	VT_I4
smpRate	INT32U	CF		O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.16.3. Sampled value (SAV)

The table below defines the common data class of sampled value.

Table 5.2.16.3-1 Sampled value (SAV)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
instMag	Analogue-Value	MX		M	VT_R4
q	Quality	MX		M	VT_I4
t	TimeStamp	MX		M	VT_DATE
units	Unit	CF		O	
sVC	ScaledValue-Config	CF		O	

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
min	Analogue-Value	CF		O	VT_R4
max	Analogue-Value	CF		O	VT_R4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.16.4. WYE

The table below defines the common data class of WYE. This class is a collection of simultaneous measurements of values in a three phase system that represent phase to ground values.

Table 5.2.16.4-1 WYE

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
phsA	CMV	MX		O[a]	
phsB	CMV	MX		O[a]	
phsC	CMV	MX		O[a]	
neut	CMV	MX		O[a]	
net	CMV	MX		O[a]	
res	CMV	MX		O[a]	
angRef	ENUMER-ATEDe	CF	Va (0) | Vb (1) | Vc (2) | Aa (3) | Ab (4) | Ac (5) | Vab (6) | Vbc (7) | Vca (8) | Vother (9) | Aother (10)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these items (1 - 6) must be present.

5.2.16.5. Delta (DEL)

The table below defines the common data class of delta. This class is a collection of measurements of values in a three phase system that represent phase to phase values.

Table 5.2.16.5-1 Delta (DEL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
phsAB	CMV	MX		O [a]	
phsBC	CMV	MX		O [a]	
phsCA	CMV	MX		O [a]	
angRef	ENUMER-ATED	CF	Va (0) | Vb (1) | Vc (2) | Aa (3) | Ab (4) | Ac (5) | Vab (6) | Vbc (7) | Vca (8) | Vother (9) | Aother (10)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these groups (1 - 3) must be present.

5.2.16.6. Sequence (SEQ)

The table below defines the common data class of sequence.

Table 5.2.16.6-1 Sequence (SEQ)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
c1	CMV	MX		O [a]	
c2	CMV	MX		O [a]	
c3	CMV	MX		O [a]	
seqT	ENUMERATED	CF	pos-neg-zero (0) | dir-quad-zero (1)	O	VT_I4
phsRef	ENUMERATED	CF	A (0) | B (1) | C (2) | ...		VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

a. One or more of these groups (1 - 3) must be present.

5.2.17. Common data class specifications for controllable status information

5.2.17.1. Controllable single point (SPC)

The table below defines the common data class of controllable single point.

Table 5.2.17.1-1 Controllable single point (SPC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 5.2.22, Application error codes		VT_I4
ctlVal	BOOLEAN	CO	off (FALSE) | on (TRUE)	M	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
operTm	TimeStamp	CO		O	VT_DATE
origin	Originator	CO, ST			
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	BOOLEAN	ST	FALSE | TRUE	M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	BOOLEAN	SV	FALSE | TRUE	O	VT_BOOL
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRIN64	SV		O	VT_BSTR
pulseConfig	PulseConfig	CF		O	
ctlModel	ENUMER-ATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMER-ATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to ctlVal with value. IEC61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- tlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to ctlVal with value. IEC61850 OPC Server will do the select before operate.

5.2.17.2. Controllable double point (DPC)

The table below defines the common data class of controllable double point.

Table 5.2.17.2-1 Controllable double point (DPC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
ctlSelOn	AbbCommand-Bitmask			M	VT_I4
ctlSelOff	AbbCommand-Bitmask			M	VT_I4
ctlOperOn	AbbCommand-Bitmask			M	VT_I4
ctlOperOff	AbbCommand-Bitmask			M	VT_I4
ctlCan	AbbCommand-Bitmask			M	VT_I4
ctlOper	AbbCommand-Bitmask			M	VT_I4
lastApplError	ApplicationErr-orCode		Refer to 5.2.22, Applica-tion error codes		VT_I4
ctlVal	BOOLEAN	CO	off (FALSE) | on (TRUE)	M	VT_BOOL
operTm	TimeStamp	CO		O	VT_DATE
origin	Originator	CO, ST		O	
ctlNum	INT8U	CO, ST	0..255	O	VT_I4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
stVal	CODED ENUM	ST	intermediate-state (0) | off (1) | on (2) | bad-state (3)	M	VT_I4
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	CPT	SV	intermediate-state (0) | off (1) | on (2) | bad-state (3)	O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV		O	VT_BSTR
pulseConfig	PulseConfig	CF		O	
ctlModel	ENUMER-ATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMER-ATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

ctlOperOn: This attribute shall determine the control activity operation in direction On/Close.

ctlOperOff: This attribute shall determine the control activity operation in direction Off/Open.

ctlSelOn: This attribute shall determine the selection with direction On/Close.

ctlSelOff; This attribute shall determine the selection with direction Off/Open.

ctlCan: This attribute shall determine the cancellation of the selection

ctlOper: This attribute shall determine the selection with direction (direction got from previous select). Only applicable for controls with SBO.

Mapping of controls

Direct Control with Normal Security:
- ctlSelOn: (not used)
- ctlSelOff: (not used)
- ctlOperOn: MS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: (not used)
- ctlOper: (not used)

The ctlSelOn, ctlSelOff, ctlCan, selCause, cmdTermCause, stSeld and the bits in ControlValues are not applicable.

SBO with Normal Security:
- ctlSelOn: MMS Read.request to SBO structure (to perform select).
- ctlSelOff: MMS Read.request to SBO structure (to perform select).
- ctlOperOn: MMS Write.request to Oper structure with value ON (to operate).
- ctlOperOff: MMS Write.request to Oper structure with value OFF (to operate).
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: MMS Write.request to Oper structure with value ON/OFF according to previous direction of select.

Direct Control with Enhanced Security:
- ctlSelOn: (not used)
- ctlSelOff: (not used)
- ctlOperOn: MMS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: (not used)

SBO with Enhanced Security:
- ctlSelOn: MMS Read.request to SBOw structure.
- ctlSelOff: MMS Read.request to SBOw structure.

- ctlOperOn: MMS Write.request to Oper structure with value ON.
- ctlOperOff: MMS Write.request to Oper structure with value OFF.
- ctlCan: MMS Write.request ro Cancel structure
- ctlOper: MMS Write.request to Oper structure with value ON/OFF according to previous direction of select.

5.2.17.3. Controllable integer status (INC)

The table below defines the common data class of controllable integer status.

Table 5.2.17.3-1 Controllable integer status (INC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErr-orCode		Refer to 5.2.22, Applica-tion error codes		VT_I4
ctlVal	INT32	CO		M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMER-ATED			O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
stVal	INT32	ST		M	VT_I4
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
ctlModel	ENUMERATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT32	CF		O	VT_I4
maxVal	INT32	CF		O	VT_I4
stepSize	INT32U	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:

- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

5.2.17.4. Binary controlled step position information (BSC)

The table below defines the common data class of binary controlled step position information.

Table 5.2.17.4-1 Binary controlled step position information (BSC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	Application-Erro rCode		Refer to 5.2.22, Application error codes		VT_I4
ctlVal	ENUMERATED		stop (0) | lower (1) | higher (2) | reserved (3)	M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED		not-supported | bay-control | station-control | remote-control | automatic-bay | automatic-station | automatic-remote | maintenance | process	O	VT_I4
orIdent	OCTET STRING64				VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
valWTr.posVal	INT8	ST		M	VT_I4
valWTr.transInd	BOOLEAN	ST		M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	M	VT_I4
q	Quality	ST		O	VT_BOOL
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VISIBLE STRING64	SV	Text	O	VT_BSTR
				O	
ctlModel	ENUMER-ATED	CF	Status-only (0) | direct-withnor-mal- security (1) | sbo-with-normal- secur-ity (2) | direct-withenhanced-security (3) | sbo-withen-hanced- secur-ity (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMER-ATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT8	CF		O	VT_I4
maxVal	INT8	CF		O	VT_I4
stepSize	INT8	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:

- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

5.2.17.5. Integer controlled step position information (ISC)

The table below defines the common data class of integer controlled step position information.

Table 5.2.17.5-1 Integer controlled step position information (ISC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 5.2.22, Application error codes		VT_I4
ctlVal	INT8	CO	-64 … 63	M	VT_I4
operTm	TimeStamp	CO		O	VT_DATE
orCat	ENUMERATED		not-supported | bay-control | station-control | remote-control | automatic-bay | automatic-station | automatic-remote | maintenance | process	O	VT_I4
orIdent	OCTET STRING64			O	VT_BSTR
ctlNum	INT8U	CO, ST	0..255	O	VT_I4
valWTr.posVal	INT8	ST		M	VT_I4
valWTr.transInd	BOOLEAN	ST		M	VT_BOOL
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
stSeld	BOOLEAN	ST	FALSE | TRUE	O	VT_BOOL

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
				O	
subEna	BOOLEAN	SV		O	VT_BOOL
subVal	INT32	SV		O	VT_I4
subQ	Quality	SV		O	VT_I4
subID	VisibleString	SV	Text	O	VT_BSTR
				O	
ctlModel	ENUMERATED	CF	Status-only (0) | direct-with-normal-security (1) | sbo-with-normal-security (2) | direct-with-enhanced-security (3) | sbo-with-enhanced-security (4)	M	VT_I4
sboTimeout	INT32U	CF		O	VT_I4
sboClass	ENUMERATED	CF	operate-once (0) | operate-many (1)	O	VT_I4
minVal	INT8	CF		O	VT_I4
maxVal	INT8	CF		O	VT_14
stepSize	INT8	CF	1 ... (maxVal - minVal)	O	VT_14
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:

- ctlVal: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- ctlVal: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

5.2.18. Common data class specifications for controllable analogue information

5.2.18.1. Analogue set point (APC)

The table below defines the common data class of analogue set point.

Table 5.2.18.1-1 Analogue set point (APC)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
lastApplError	ApplicationErrorCode		Refer to 5.2.22, Application error codes		VT_I4
setMag	AnalogueValue	SP, MX		M	VT_R4
origin	Originator	SP, MX		O	
operTm	TimeStamp	SP		O	VT_DATE
q	Quality	ST		M	VT_I4
t	TimeStamp	ST		M	VT_DATE
ctlModel	ENUMERATED	CF	direct-with-normal-security (1)	M	VT_I4
units	Unit	CF		O	
sVC	ScaledValueConfig	CF		O	
minVal	AnalogueValue	CF		O	VT_R4
maxVal	AnalogueValue	CF		O	VT_R4
stepSize	AnalogueValue	CF	1 ... (maxVal-minVal)	O	VT_R4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

Mapping of controls

Direct Control with Normal Security:
- setMag: MMS Write.request to Oper structure with value.

SBO with Normal Security:
- setMag: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

Direct Control with Enhanced Security:
- setMag: MMS Write.request to Oper structure with value.

SBO with Enhanced Security:
- setMag: MMS Write.request to Oper structure with value. IEC61850 OPC Server will do the select before operate.

5.2.19. Common data class specifications for status settings

5.2.19.1. Single point setting (SPG)

The table below defines the common data class of single point setting.

Table 5.2.19.1-1 Single point setting (SPG)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setVal	BOOLEAN	SP	off (FALSE) | on (TRUE)	M	VT_BOOL
d	VISIBLE STRING255	DC	Text	O	VT_BSTR

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.19.2. Integer status setting (ING)

The table below defines the common data class of integer status setting.

Table 5.2.19.2-1 Integer status setting (ING)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setVal	INT32	SP		M	VT_I4
minVal	INT32	CF		O	VT_I4
maxVal	INT32	CF		O	VT_I4
stepSize	INT32	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.20. Common data class specifications for analogue settings

5.2.20.1. Analogue setting (ASG)

The table below defines the common data class of analogue setting.

Table 5.2.20.1-1 Analogue setting (ASG)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setMag	Analogue-Value	SP		M	VT_I4
units	Unit	CF		O	
sVC	ScaledValue-Config	CF		O	
minVal	Analogue-Value	CF		O	VT_I4
maxVal	Analogue-Value	CF		O	VT_I4
stepSize	Analogue-Value	CF	1 ... (maxVal - minVal)	O	VT_I4
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.20.2. Setting curve (CURVE)

The table below defines the common data class of setting curve.

Table 5.2.20.2-1 Setting curve (CURVE)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
setCharact	ENUMER-ATED	SP		M	VT_I4
setParA	FLOAT32	SP		O	VT_R4
setParB	FLOAT32	SP		O	VT_R4
setParC	FLOAT32	SP		O	VT_R4
setParD	FLOAT32	SP		O	VT_R4
setParE	FLOAT32	SP		O	VT_R4
setParF	FLOAT32	SP		O	VT_R4

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
d	VISIBLE STRING255	DC	Text	O	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.21. Common data class specifications for description information

5.2.21.1. Device name plate (DPL)

The table below defines the common data class of device name plate. Data of this common data class are used to identify entities like primary equipment or physical devices.

Table 5.2.21.1-1 Device name plate (DPL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
vendor	VISIBLE STRING255	DC		M	VT_BSTR
hwRev	VISIBLE STRING255	DC		O	VT_BSTR
swRev	VISIBLE STRING255	DC		O	VT_BSTR
serNum	VISIBLE STRING255	DC		O	VT_BSTR
model	VISIBLE STRING255	DC		O	VT_BSTR
location	VISIBLE STRING255	DC		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX			VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.21.2. Logical node name plate (LPL)

The table below defines the common data class of logical node name plate. Data of this common data class are used to identify logical nodes.

Table 5.2.21.2-1 Logical node name plate (LPL)

Name	Type	FC	Value/ Value range	M/O	OPC Data Type
vendor	VISIBLE STRING255	DC		M	VT_BSTR
hwRev	VISIBLE STRING255	DC		M	VT_BSTR
d	VISIBLE STRING255	DC	Text	M	VT_BSTR
dU	UNICODE STRING255	DC		O	VT_BSTR
configRev	VISIBLE STRING255	DC		O	VT_BSTR
ldNs	VISIBLE STRING255	EX	will be included only in LLN0	O	VT_BSTR
lnNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcNs	VISIBLE STRING255	EX		O	VT_BSTR
cdcName	VISIBLE STRING255	EX		O	VT_BSTR
dataNs	VISIBLE STRING255	EX		O	VT_BSTR

5.2.22. Application error codes

Command Error codes of lastApplError attribute. The attribute is valid only for command data classes and its value presents the status of the last command. It is updated when command responses are received from devices.

The status code is received by adding the additional status code to main status code.

Example: 1003 = Unknown, select failed

Table 5.2.22-1 Main status codes

0	OK
1000	Unknown
2000	Timeout test not ok

3000	Operator test not ok

Table 5.2.22-2 Additional status codes

0	Unknown
1	Not supported
2	Blocked by switching hierarchy
3	Select failed
4	Invalid position
5	Position reached
6	Parameter change in execution
7	Step limit
8	Blocked by mode
9	Blocked by process
10	Blocked by interlocking
11	Blocked by synchrocheck
12	Command already in execution
13	Blocked by health
14	1 of n control
15	Abortion by cancel
16	Time limit over
17	Abortion by trip
18	Object not selected

5.3. Attributes

5.3.1. General about attributes

In addition to attributes for process data (indications and commands), the OPC Server also provides some attributes for controlling the devices and retrieving status information from them. These attributes are available for the OPC access client.

5.3.2. Server attributes

Table 5.3.2-1 Server attributes

Name	Value or Value range/ Default	Description
Protocol stack version	Version information	Data type: Text Access: Read-only The version information of the Protocol Stack
Configuration version	Version information	Data type: Text Access: Read-only The version information of the current configuration file.
Reset	By writing 1 the server is reset. By writing 2 the log file is cleared. Other values are currently ignored.	Data type: Integer Access: No limitations Makes it possible for clients to reset the OPC server. A reset means that the server disconnects all clients and reloads the configuration file. When the last client is disconnected the server usually shuts down. The server does not shut down if it was not started by the COM runtime or if it is running as a Windows service. In that case the configuration file is not reloaded.
File version	Version information	Data type: Text Access: Read-only The file version number of the OPC server/client exe file.
Product version	Version information	Data type: Text Access: Read-only The version (revision) of the package that the server/client belong to.
Timesync client		

Name	Value or Value range/ Default	Description
In use	0 = Not in use 1 = In use Default: 1	Data type: Integer Access: No limitations Status of the integrated SNTP clients time synchronization routine. Value is 0 when not in use and 1 when in use. By writing 0 the client is started and by writing 1 it is stopped. The client can be started only if configuration parameters are given in a configuration file.
Timesync status	False = Not synchronised True = Synchronised OK	Data type: Boolean Access: Read-only Status of the integrated SNTP client time synchronization routine. Value is false when synchronization is not received and true when synchronization received and local time set OK.
Timesync server		
In use	0 = Not in use 1 = In use Default: 1	Data type: Integer Access: No limitations Status of the integrated SNTP servers time synchronization routine. Value is 0 when not in use and 1 when in use. By writing 0 the client is started and by writing 1 it is stopped.
Timesync status	False = Failure True = OK	Status of the integrated SNTP servers time synchronization routine. Value is false when operation fails and true when operating OK.

5.3.3. IEC 61850 line attributes

Table 5.3.3-1 IEC 61850 line attributes

Name	Value or Value range/ Default	Description
In use	0 = Not in use, the line communication is stopped 1 = In use Default: 1	Data type: Integer Access: No limitations The state of the line whether it is in use or not. When a line is not in use, no data can be transmitted on it, and no data is received from it. When a line is stopped by setting the in use attribute to 0, all data transmission on the line ceases and all open connections to the devices will be closed. Single devices in use attribute may be set to 1 and this operation also takes the line in use. Now only the one device is in use. If the line's in use is set to 1, the rest of the devices are taken in use. The in use attribute has no affect on devices in simulation mode.
Object status	89 = Initialize error 90 = Not connected 91 = Initializing 100 = Ready 101 = Suspended (=Not in use) 102 = Simulated	Data type: Integer Access: Read-only Indicates the operating status of the device
Diagnostic events enabled	False = Diagnostic events disabled True = Diagnostic events enabled	Data type: Boolean Access: No limitations Enables/disables diagnostic events
Diagnostic events level	0 = Disabled 1 = Level1 (main operation and errors) 2 = Level2 (+ time synchronization error) 3 = Level3 (+ time synchronization done) 4 = Level4 5 = Level5	Data Type: Integer Access: No limitations Sets the maximum level for events coming from devices. Limits the lower level events to pass through. See also System Event level shown in Table 3.3.3-1.
Diagnostic counters		

Name	Value or Value range/ Default	Description
Sent connection request		Data type: Integer Access: No limitations Connect requests sent to devices
Received connection replies ok		Data type: Integer Access: No limitations Successful connect replies from devices
Received connection replies error		Data type: Integer Access: No limitations Failed connect replies from devices
Sent connection concludes		Data type: Integer Access: No limitations Connections closed by IEC 61850 OPC server
Received connection concludes		Data type: Integer Access: No limitations Received connection concludes
Received connection aborts		Data type: Integer Access: No limitations Connections refused and aborted by devices
Received rejects		Data type: Integer Access: No limitations Request rejected by devices (usually if device could not decode the request or they do not support the used service)
Sent requests		Data type: Integer Access: No limitations Request sent to devices
Received replies ok		Data type: Integer Access: No limitations Successful requests to devices (received success responses)

Name	Value or Value range/ Default	Description
Received replies error		Data type: Integer Access: No limitations Failed requests to devices (received error responses)
Received variable read replies ok		Data type: Integer Access: No limitations Variable read success responses from devices
Received variable read replies error		Data type: Integer Access: No limitations Variable read failure responses from devices
Received variable write replies ok		Data type: Integer Access: No limitations Variable write success responses from devices
Received variable write replies error		Data type: Integer Access: No limitations Variable read failure responses from devices
Received information reports		Data type: Integer Access: No limitations Information reports received from devices
Received status requests		Data type: Integer Access: No limitations Unsolicited status requests received from devices

5.3.4. IEC 61850 device attributes

Table 5.3.4-1 IEC 61850 device attributes

Name	Value or Value range/ Default	Description
In use	0 = Out of use 1 = In use Default: 1	Data type: Integer Access: No limitations The operational status of the device whether it is in use or out of use. Taking the device out of use with this attribute stops all data communication with the device and closes the connection. All operations that would result in a data exchange are disabled. Setting in use to 1 will take the device back in use and tries to reestablish the connection to a physical device. The device itself is not affected by the attribute, only protocol stack's image of the device. The in use attribute has no affect on devices in simulation mode.

Name	Value or Value range/ Default	Description
Object status	94 = Init (checking configuration version for single rcb) 95 = init (checking rcb attributes for single rcb) 96 = Init (reading rcb variable list for single rcb) 97 = Init (enabling reporting for single rcb) 98 = Init (rcb init ok for single rcb) 100 = Ready 101 = Suspended (= not in use) 102 = Device simulated 86 = Report control block initialization error (restarting rcb init) 88 = Configuration version error (device is suspended) 89 = error (not specified) 90 = Device not connected 91 = Initializing 92 = Initializing rcb (after error in reporting init or information report flow) 93 = Reinitialize (after reconnection if init done)	Data type: Integer Access: Read-only Indicates the operating status of the device Data type: Integer Access: Read-only Indicates the operating status of the device
Device connection status	False = Device connection suspended True = Device connection OK	Data type: Boolean Access: Read-only Indicates the status of the device connection.
Diagnostic events enabled	False = Diagnostic events disabled True = Diagnostic events enabled	Data type: Boolean Access: No limitations Enables/disables diagnostic events

Name	Value or Value range/ Default	Description
Diagnostic events level	0 = Disabled 1 = Level1 (main operation, error replies, errors) 2 = Level2 (+ Information Reports, OK replies, RCB init) 3 = Level3 (+ sent requests (connect,read,write), transparent SPA messages) 4 = Level4 (+ reported local updates) 5 = Level5 (+ reported unconfigured updates)	Data Type: Integer Access: No limitations Sets diagnostics event level See also System Event Level shown in Table 3.3.4-1.
IP address	0.0.0.0 - 255.255.255.255	Data type: Text Access: Read-only (configuration) IP address of the physical device
Configuration version	Version information	Data type: Text Access: Read-only The version information of the current configuration for this device.
Transparent XSAT		See 5.3.5, Transparent XSAT.
Diagnostic counters		
Sent connection requests		Data type: Integer Access: No limitation Connection requests sent to device
Received connection replies ok		Data type: Integer Access: No limitation Success connection replies received from device (connection accepted)
Received connection replies error		Data type: Integer Access: No limitation Failure connection replies received from device (connection refused).

Name	Value or Value range/ Default	Description
Sent connection concludes		Data type: Integer Access: No limitation Connection to the device closed by IEC 61850 OPC Server.
Received connection concludes		Data type: Integer Access: No limitation Connections closed by device.
Sent requests		Data type: Integer Access: No limitation Additional requests (variable list, access attributes) sent to device
Received replies ok		Data type: Integer Access: No limitation Success replies to additional requests from device.
Received replies error		Data type: Integer Access: No limitation Failure replies to additional requests from device
Sent variable read requests		Data type: Integer Access: No limitation Variable read requests sent to device
Received variable read replies ok		Data type: Integer Access: No limitation Success replies to variable reads from device
Received variable read replies error		Data type: Integer Access: No limitation Failure replies to variable reads from device
Sent variable write requests		Data type: Integer Access: No limitation Variable write requests sent to device

Name	Value or Value range/ Default	Description
Received variable write replies ok		Data type: Integer Access: No limitation Success replies to variable write from device
Received variable write replies error		Data type: Integer Access: No limitation Failure replies to variable write from device
Received information reports		Data type: Integer Access: No limitation Information reports received from device
Received status replies		Data type: Integer Access: No limitation Successful replies to Status requests received from device

5.3.5. Transparent XSAT

The Transparent XSAT attribute can be used to read and write IEC 61850 attributes, which are not configured to the OPC namespace of the IEC 61850 OPC Server. For example, the transparent XSAT attribute can be used for setting group controlling. The Transparent XSAT attribute is used through an OPC client. The attribute uses the OPC data type BSTR, which is a variant of VT_BSTR data type.

The Transparent XSAT attribute passes on request the IEC 61850 servers and their attributes outside the IEC 61850 OPC servers namespace. The IEC 61850 OPC server does not check the outgoing attributes. Therefore the IEC 61850 OPC clients which are using the Transparent XSAT attribute know what attributes they are accessing. The Transparent XSAT attribute only supports read and write requests.

The Transparent XSAT attribute uses synchronic data access in the IEC 61850 OPC server. When an IEC 61850 OPC client writes a request, the IEC 61850 OPC server parses and sends the request to the IEC 61850 server.

The Transparent XSAT attribute returns and releases the request after it has received reply from the IEC 61850 server. The reply is written in the Transparent XSAT attribute as an XSAT string.

XSAT Read Request

Attribute Data Type Unknown

The attribute’s data type is not known, because it is not included in the IEC 61850 OPC Server configuration (SCL). The Transparent XSAT attribute asks first the required data type, before reading the data from an IEC 61850 server.

If the Transparent XSAT attribute receives a success message, the data type is saved. If the Transparent XSAT attribute receives an error message, an XSAT error string is send to the IEC 61850 OPC client.

The IEC 61850 OPC server request for the data type with a ReadVariableData service and results are written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

Attribute Data Type Known

The attribute data type is known from a previous request or the attribute is included in the IEC 61850 OPC Server configuration (SCL). The IEC 61850 OPC server directly uses a ReadVariableData service to complete the request. The reply message is written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

XSAT Write Request

Attribute Data Type Unknown

The attribute’s data type is not known, because it is not included in the IEC 61850 OPC Server configuration (SCL). The Transparent XSAT attribute first asks the required data type, before writing the data from an IEC 61850 server.

If the Transparent XSAT attribute receives a success message, the data type is saved. If the Transparent XSAT attribute receives a error message, an XSAT error string is sent to the IEC 61850 OPC client.

The IEC 61850 OPC server requests for the data type with a WriteVariableData service and results are written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.

Attribute Data Type Known

The attribute data type is known from a previous request or the attribute is included in the IEC 61850 OPC Server configuration (SCL). The IEC 61850 OPC server directly uses a WriteVariableData service to complete the request. The reply message is written in the Transparent XSAT attribute as an XSAT string. The XSAT string contains success and error messages.’

XSAT Formats

- *XSAT Read Request*
  GetDataValue&result={name|noname}&LDInst=””&FunCon-
  str=””&LNName=””[&DORef=””&Attr=””]]
- *XSAT Write Request*
  SetDataValue&LDInst=””&FunCon-
  str=””&LNName=””[&DORef=””[&Attr=””]]&v=””
- *XSAT Read Reply*
  Success with names (result=name)
  <?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"><XSAT>
  <Response><DO><LDInst>…</LDInst><LNName>…</LNName><DORef>…</DORef>
  <At><n>…</n><v>…</v><FunConstr>…</FunConstr></At> … </DO> …
  </Response> </XSAT>
  Success without names (result=noname)
  <?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"><XSAT>
  <Response><Values> <v>…</v> … </Values></Response></XSAT>
  Failure
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>failure</Result></Response></XSAT>
- *XSAT Write Reply*
  Success
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>ok</Result> </Response> </XSAT>
  Failure
  <?xml version=\"1.0\"?><!DOCTYPE XSAT SYSTEM \"xsat-004.dtd\"> <XSAT>
  <Response> <Result>failure</Result> </Response> </XSAT>
  EXAMPLE 1 (Read request + success reply)
  IEC 61850 Path:
  LD1$PTOC1$ST
  Request:
  GetDataValue&result=name&LDInst=LD1&LNName=PTOC1&FunConstr=ST
  Reply OK:
  <?xml version="1.0"?> <!DOCTYPE XSAT SYSTEM "xsat-004.dtd"> <XSAT>
  <Response>
  <DO><LDInst>LD1</LDInst><LNName>PTOC1</LNName><DORef>Str</DORef>
  <At><n>general</n><v>False</v><FunConstr>ST</FunConstr></At>
  <At><n>t</n><v>1.1.1970</v><FunConstr>ST</FunConstr></At>
  <At><n>q</n><v>12288</v><FunConstr>ST</FunConstr></At> </DO>
  <DO><LDInst>LD1</LDInst><LNName>PTOC1</LNName><DORef>Op</DORef>
  <At><n>general</n><v>False</v><FunConstr>ST</FunConstr></At>
  <At><n>t</n><v>1.1.1970</v><FunConstr>ST</FunConstr></At>
  <At><n>q</n><v>68</v><FunConstr>ST</FunConstr></At> </DO> </Response>
  </XSAT>
  EXAMPLE 2 (Write request + failure reply)
  IEC 61850 Path:
  LD1$LLN0$BR$brcbStatUrg02&RptEna

Request:
SetDataValue&LDInst=LD1&LNName=LLN0&DORef=brcbStat-Urg02&Attr=RptEna&FunConstr=BR&v=False
Reply OK:
<?xml version="1.0"?><!DOCTYPE XSAT SYSTEM "xsat-004.dtd"> <XSAT> <Response> <Result>failure</Result> </Response> </XSAT>

5.3.6. IEC 61850 logical device attributes

Table 5.3.6-1 IEC 61850 logical device attributes

Name	Value or Value range/ Default	Description
Transparent SPA	The contents of a valid SPA request	Data type: Text Access: No limitations Makes it possible to communicate with SPA unit by sending SPA message and reading the reply as text in SPA format from this item. The communication is passed through a TCP/SPA tunnel, where this attribute acts as an independent TCP/SPA client and is connected to a TCP/SPA server. The TCP/SPA server is then responsible for forwarding the SPA messages to and from the SPA devices. The SPA/TCP client handles its own communication separately from other communication. No checks are done on command or reply contents they are simply passed on. This parameter is available only by configuration. This attribute must be enabled by setting the Transparent SPA Address, see Table 3.3.5-1. For example: SPA address = 1 SPA command RF must we written in format RF: and sent in format 1RF:. The reply is received in format >1D:REF543 :.

5.4. IEC 61850 File transfer

5.4.1. General about IEC 61850 File Transfer

This section defines how the IEC 61850 file transfer services between the IEC 61850 OPC Server and the IEC 61850 devices are used through OPC DA. Since it is not possible

to pass files through OPC, the IEC 61850 OPC Server is used as a file storage. The received and sent files are stored locally in the computer running the OPC server.

File transfer services are controlled by an OPC DA client through the OPC attributes under the IED\Attributes\File transfer node. For more information about the file transfer attributes, refer to 5.4.2, File Transfer attributes.

The supported file transfer services are GetFile, SetFile, DeleteFile, GetFileAttributes, GetFileAttributesEx, RenameFile and Cancel. For more information about the file transfer services, refer to 5.4.3, File Transfer services.

Make sure that the devices support the file transfer services.

5.4.2. File Transfer attributes

Table 5.4.2-1 File transfer attributes

Name	Value or Value range/ Default	Description
Remote file name		Data type: Text Access: No limitations File name of the remote file.
Remote file direct-ory		Data type: Text Access: No limitations File directory of the remote directory.
Local file name		Data type: Text Access: No limitations File name of the local file.
Local file directory		Data type: Text Access: No limitations File directory of the local directory.
File size in bytes		Data type: Text Access: No limitations The remote file’s size is received in bytes.

Name	Value or Value range/ Default	Description
Received bytes		Data type: Integer Access: No limitations Current remote file size is received in bytes. The IEC 61850 file transfer receives the file part by part in maximum size of the MMS messages. This attribute shows the size of the file that has been received. Value increases while the file transfer continues.
Status	1000 - 10000 For more information about valid status values, refer to 5.4.4, File Transfer service codes.	Data type: Integer Access: Read-only Status of the currently requested or last finished service.
Output		Data type: Text Access: Read-only The GetFileAttributeValues and GetFileAttributeValuesEx services print the requested file structure's output to this attribute. For more information about the output format, refer to 5.4.3, File Transfer services.
Control file reception	0 = Cancel 1 = GetFile 2 = GetFileAttributeValues 3 = GetFileAttributeValuesEx 4 = RenameFile 5 = SetFile 6 = DeleteFile	Data type: Text Access: Write-only This attribute controls the file transfer services. For more information about control codes for specific services, refer to 5.4.3, File Transfer services.

5.4.3. File Transfer services

The file transfer services are controlled through the OPC DA attributes, see Table 5.4.2-1. To initiate a service, first the required parameters are written to respective OPC attributes and then the service is started by writing the service control code to the file transfer control attribute.

The file transfer control attribute uses synchronous data access for OPC. When an OPC client writes a service request, the corresponding IEC 61850 file transfer service on the

device is called. When the service is finished or an error occurs, the OPC request is released.

The status of the latest service is available in the Status attribute. After a service is started, the status changes to the specific service status code. If the service is completed successfully, the status code is set to Ready (see Table 5.4.4-2). For more information about service failure status codes, refer to Table 5.4.4-3 and Table 5.4.4-4. Only one service can be called at a time.

GetFile

You can copy a specified file from a remote device to the local file storage with the GetFile service. Through IEC 61850, this is done in three phases. First, the remote file is opened, then read, and finally closed. Remote file parameters identify the remote file. During this operation, the Status, Received bytes and File size in bytes attributes are updated as the file is moved (in max MMS message size parts). The copied file is renamed and placed to the local file storage according to local file parameters.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	1
Service status codes:	1100
	1120
	1140
Failure status codes:	91xx
The remote file name:	Remote file directory + Remote file name
The local file name:	Local file directory + Local file name

GetFileAttributeValues

The GetFileAttributeValues service obtains the name of a file or group of files in the remote file storage. Received file attributes are printed to the Output attribute. This service prints only file names.

Required parameters:	Remote file name
	Remote file directory
Control code:	2
Service status codes:	1200
Failure status codes:	92xx

The remote file or directory name: Remote file directory + Remote file name

To request file attributes for a remote directory, set parameter Remote file name to empty. For example, space and tabulator are accepted as empty parameter.

Output

The format of the result string is printed to the Output attribute in the following format:

```
{} = optional
filename1{, filename2{, filename3{...}}}
```

Example:

```
StdOut.txt
```

```
StdOut.txt, Eventlog.log, config.icd
```

GetFileAttributeValuesEx

The GetFileAttributeValuesEx service obtains the name and the attributes of a file or group of files in the remote file storage. Received file attributes are printed to the Output attribute. This service prints the file names, file sizes and last modification dates if these are available.

Required parameters:	Remote file name
	Remote file directory
Control code:	3
Service status codes:	1300
Failure status codes:	93xx

The remote file or directory name: Remote file directory + Remote file name

To request file attributes for a remote directory, set parameter Remote file name to empty. For example, space and tabulator are accepted as empty parameter.

Output

The format of the result string is printed to the Output attribute in a following format:

```
{} = optional

filename1[size{;d.m.Y H:M:S}]{, filename2[size{;d.m.Y H:M:S}]
{ ,fn3[...]}}}
```

filename	= string
size	= bytes
d	= Day of month as decimal number (01 - 31)
m	= Month as decimal number (01 - 12)
Y	= Year with century, as decimal number
H	Hour in 24-hour format (00 - 23)
M	= Minute as decimal number (00 - 59)
S	= Second as decimal number (00 - 59)

Example:

```
StdOut.txt[12445;02.03.2004]

StdOut.txt[12445], Eventlog.log[53422], config.icd[2773]
```

RenameFile

You can rename or move a file in the remote file storage with the RenameFile service.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	4
Service status codes:	1400
Failure status codes:	94xx
The remote file name to be renamed:	Remote file directory + Remote file name
The new name for the remote file:	Local file directory + Local file name

SetFile

The SetFile service initiates the remote device to obtain a file from the local file storage to the remote file storage. The service triggers an IEC 61850 device to call the IEC 61850 clients GetFile service and during this, the IEC 61850 client acts as a file server. During this operation, the Status, Received bytes and File size in bytes attributes are updated as the file is moved (in max MMS message size parts). The local file parameters identify the local file and the copied file is placed to the remote file storage according to remote file parameters.

Required parameters:	Remote file name
	Remote file directory
	Local file name
	Local file directory
Control code:	5
Service status codes:	1500
	1520
	1540
	1560
Failure status codes:	94xx
The remote file name:	Remote file directory + Remote file name
The local file name:	Local file directory + Local file name

DeleteFile

You can delete a file from the remote file storage with the DeleteFile service.

Required parameters:	Remote file name
	Remote file directory
Control code:	6
Service status codes:	1600
Failure status codes:	96xx
The remote file name:	Remote file directory + Remote file name

Cancel

You can cancel the current service with the Cancel service. The Cancel service sets the status to Ready and clears for the following attribute values: File size in bytes, Received bytes and Status.

Control code: 0

5.4.4. File Transfer service codes

Status codes can be read from the Status attribute. The status indicates the current service status and the service result.

Table 5.4.4-1 Service control codes

0	Cancel
1	GetFile
2	GetFileAttributeValues
3	GetFileAttributeValuesEx
4	Rename File
5	SetFile
6	DeleteFile

In the service status codes, the first number indicates success (1) or failure (9). The second number indicates currently requested service (0 - 6). If a local service is requested in multiple parts for the remote device, the third number indicates the currently called remote service (1 - 3). The fourth number gives a detailed failure code (0 - 3).

Example:

9601 = parameters error, remote file delete error

9123 = remote service error, remote file read error

Table 5.4.4-2 Success

1000	Ready
1100	Opening remote file
1120	Reading remote file
1140	Closing remote file
1200	Requesting remote directory file details
1300	Requesting remote directory file details
1400	Renaming remote file
1500	Requesting remote device to obtain local file
1520	Remote device requested to open local file
1540	Remote device requested to read local file
1560	Remote device requested to close local file
1600	Deleting remote file
1000	Service done

The failure status code indicates a failure in requested service. The failure status code can also include a more detailed error code indicating the failure type, which can be local or remote failure (see Table 5.4.4-3).

Table 5.4.4-3 Failure

9000	Unspecified error
9100	Remote file open error
9120	Remote file read error
9140	Remote file close error
9200	Remote directory details error
9300	Remote directory details error
9400	Remote file rename error
9500	Error in remote obtaining local file
9520	Error in remote opening local file
9540	Error in remote reading local file
9560	Error in remote closing local file
9600	Remote file delete error

Table 5.4.4-4 Failure details

0	No error details
1	Service parameters error (user error) Reason: required name attribute is empty Recovery: check the attribute values and try again
2	Local service error (IEC 61850 OPC Server internal error) Reason: not connected, too much network traffic, etc. Recovery: check connection and try again
3	Remote service error (remote device error) Reason: remote device is not supporting service, wrong parameters, no such file, connection failed, etc. Recovery: check remote device services support, check parameters (file names), check connection and try again

5.5. ACSI conformance statement

5.5.1. General about ACSI conformance statement

This section defines the compliance to IEC 61850 in terms of service, modeling and engineering interfaces and gives detailed explanation of IEC 61850 capabilities of a

product. ACSI conformance statement describes the abstract services interfaces, which are normally mapped to certain SCSM (Specific communication service mapping) and therefore indirectly stated in PICS (Protocol Implementation Conformance Statement).

5.5.2. ACSI basic conformance statement

Table 5.5.2-1 ACSI basic conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	Client-Server roles			
B11	**Server** side (of TWO-PARTY-APPLICATION-ASSOCIATION)	-	a	
B12	**Client** side of (TWO-PARTY-APPLICATION-ASSOCIATION)	a	-	Supported
	SCSMs supported			
B21	**SCSM**: IEC 6185-8-1 used			Supported
B22	**SCSM**: IEC 6185-9-1 used			Not supported
B23	**SCSM**: IEC 6185-9-2 used			Not supported
B24	**SCSM**: other			
	Generic substation event model (GSE)			
B31	**Publisher** side	-	O	
B32	**Subscriber** side	O	-	Not supported
	Transmission of sampled value model (SVC)			
B41	**Publisher** side	-	O	
B42	**Subscriber** side	O	-	Not supported

a. Will be M if support for LOGICAL DEVICE model has been declared.

5.5.3. ACSI models conformance statement

Table 5.5.3-1 ACSI models conformance statement

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	Server (If B1 side supported)			
M1	**Logical device**	a	a	Supported

		Client/ Subscriber	Server/ Publisher	Value/ Comments
M2	**Logical node**	b	b	Supported
M3	**Data**	c	c	Supported
M4	**Data set**	d	d	Supported
M5	**Substitution**	O	O	Supported
M6	**Setting group control**	O	O	Supported (through Transparent XSAT)
	Reporting			
M7	**Buffered report control**	O	O	Supported
M7-1	sequence-number			
M7-2	report-time-stamp			
M7-3	reason-for-inclusion			
M7-4	data-set-name			
M7-5	data-reference			
M7-6	buffer-overflow			
M7-7	EntryID			
M7-8	BufTim			
M7-9	IntgPd			
M7-10	GI			
M8	**Unbuffered report control**	M	M	Supported
M8-1	sequence-number			
M8-2	report-time-stamp			
M8-3	reason-for-inclusion			
M8-4	data-set-name			
M8-5	data-reference			
M8-6	BufTim			
M8-7	IntgPd			
	Logging	**O**	**O**	Not supported
M9	**Log control**	**O**	**O**	Supported (through Transparent XSAT)
M9-1	IntgPd			
M10	**Log**	**O**	**O**	Not supported
M11	**Control**	**M**	**M**	Supported

		Client/ Subscriber	Server/ Publisher	Value/ Comments
	GSE (if B31/B32 is supported)			
	GOOSE	**O**	**O**	Not supported
M12-1	EntryID			
M12-2	DataRefInc			
M13	**GSSE**	**O**	**O**	Not supported
	SVC (if 41/42 is supported)			
M14	Multicast SVC	**O**	**O**	Not supported
M15	Unicast SVC	**O**	**O**	Not supported
M16	**Time**	**M**	**M**	Supported (Time source with required accuracy will be available)
M17	**File transfer**	**O**	**O**	Supported

a. Will be M if support for LOGICAL NODE model has been declared.

b. Will be M if support for DATA model has been declared.

c. Will be M if support for DATA SET, Substitution, Report, Log Control, or Time model has been declared.

d. Will be M if support for Report, GSE, or SMV models has been declared.

5.5.4. ACSI service conformance statement

The ACSI service conformance statement will be as defined in Table 5.5.4-1 (depending on the statements in Table 5.5.2-1).

Table 5.5.4-1 ACSI service conformance statement

		AA: TP/MC	Client (C)	Server (S)	Comments
	Server				
S1	ServerDirectory	TP		M	
	Application Association				
S2	Associate		M	M	Supported
S3	Abort		M	M	Supported
S4	Release		M	M	Supported
	Logical device				

		AA: TP/MC	Client (C)	Server (S)	Comments
S5	LogicalDeviceDirectory	TP	M	M	Supported
	Logical node				
S6	LogicalNodeDirectory	TP	M	M	Supported
S7	GetAllDataValues	TP	O	M	Not supported
	Data				
S8	GetDataValues	TP	M	M	Supported
S9	SetDataValues	TP	O	O	Supported
S10	GetDataDirectory	TP	O	M	Supported
S11	GetDataDefinition	v	O	M	Supported
	Data set				
S12	GetDataSetValues	TP	O	M	Supported
S13	SetDataSetValues	TP	O	O	Not supported
S14	CreateDataSet	TP	O	O	Supported
S15	DeleteDataSet	TP	O	O	Not supported
S16	GetDataSetDirectory	TP	O	O	Supported
	Substitution				
S17	SetDataValues	TP	M	M	Supported
	Setting up control				
S18	SelectActiveSG	TP	O	O	Supported (through Transparent XSAT)
S19	SelectEditSG	TP	O	O	Supported (through Transparent XSAT)
S20	SetSGValues	TP	O	O	Supported (through Transparent XSAT)
S21	ConfirmEditSGValues	TP	O	O	Supported (through Transparent XSAT)
S22	GetSGValues	TP	O	O	Supported (through Transparent XSAT)

		AA: TP/MC	Client (C)	Server (S)	Comments
S23	GetSGCBValues	TP	O	O	Supported (through Transparent XSAT)
	Reporting				
	Buffered report control block (BRCB)				
S24	Report	TP	a	a	Supported
S24-1	data-change (dchg)				
S24-2	qchg-change (qchg)				
S24-3	data-update (dupd)				
S25	GetBRCBValues	TP	a	a	Supported
S26	SetBRCBValues	TP	a	a	Supported
	Unbuffered report control block (URBC)				
S27	Report	TP	a	a	Supported
S27-1	data-change (dchg)				
S27-2	qchg-change (qchg)				
S27-3	data-update (dupd)				
S28	GetURCBValues	TP	a	a	Supported
S29	SetURCBValues	TP	a	a	Supported
	Logging				
	Log control block				
S30	GetLCBValues	TP		M	Supported (through Transparent XSAT)
S31	SetLCBValues	TP		M	Supported (through Transparent XSAT)
	Log				
S32	QueryLogByTime	TP	b	M	Not supported
S33	QueryLogByEntry	TP	b	M	Not supported
S34	GetLogStatusValues	TP		M	Supported (through Transparent XSAT)
	Generic substation event model (GSE)				

		AA: TP/MC	Client (C)	Server (S)	Comments
	GOOSE-CONTROL-BLOCK				
S35	SendGOOSEMessage	MC	c	c	Not supported
S36	GetReference	TP	O	d	Not supported
S37	GetGOOSEElement-Number	TP	O	d	Not supported
S38	GetGoCBValues	TP	O	O	Supported (through Transparent XSAT)
S39	SetGoCBValues	TP	O	O	Supported (through Transparent XSAT)
S40	SendGSSEMessage	MC	c	c	Not supported
S41	GetReference	TP	O	d	Not supported
S42	GetGSSEElementNum-ber	TP	O	d	Not supported
S43	GetGsCBValues	TP	O	O	Supported (through Transparent XSAT)
S44	SetGsCBValues	TP	O	O	Supported (through Transparent XSAT)
	Transmission of sampled value model (SVC)				
	Multicast SVC				
S45	SendMSVMessage	MC	e	e	Not supported
S46	GetMSVCBValues	TP	O	O	Supported (through Transparent XSAT)
S47	SetMSVCBValues	TP	O	O	Supported (through Transparent XSAT)
	Unicast SVC				
S48	SendUSVMessage	TP	e	e	Not supported

		AA: TP/MC	Client (C)	Server (S)	Comments
S49	GetUSVCBValues	TP	O	O	Supported (through Transparent XSAT)
S50	SetUSVCBValues	TP	O	O	Supported (through Transparent XSAT)
	Control				
S51	Select		M	M	Supported
S52	SelectWithValue	TP	M	M	Supported
S53	Cancel	TP	O	M	Supported
S54	Operate	TP	M	M	Supported
S55	Command-Termination	TP	M	M	Supported
S56	TimeActivated-Operate	TP	O	O	Not supported
	File transfer				
S57	GetFile	TP	O	M	Supported
S58	SetFile	TP	O	O	Supported
S59	DeleteFile	TP	O	O	Supported
S60	GetFileAttributeValues	TP	O	M	Supported
	Time				
T1	Time resolution of internal clock				(nearest negative power of 2 in seconds)
T2	Time accuracy of internal clock			T0	
				T1	
				T2	
				T3	
				T4	
				T5	
T3	supported TimeStamp resolution			(nearest negative power of 2 in seconds)	

a. Will declare support for at least one (BRCB or URCB).

b. Will declare support for at least one (QueryLogByTime or QueryLogByEntry).

c. Will declare support for at least one (SendGOOSEMessage or SendGSSEMessage).

d. Will declare support if TP association is available.

e. Will declare support for at least one (SendMSVMessage or SendUSVMessage).

Index

A

B

C

D

F

G

I

L

M

O

P

Q

R

S

T

U

V

W

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