RELION® PROTECTION AND CONTROL

620 series ANSI
IEC 61850 Engineering Guide

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This product complies with the directive of the Council of the European Communities on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC Directive 2014/30/EU) and concerning electrical equipment for use within specified voltage limits (Low-voltage directive 2014/35/EU). This conformity is the result of tests conducted by ABB in accordance with the product standards EN 50263 and EN 60255-26 for the EMC directive, and with the product standards EN 60255-1 and EN 60255-27 for the low voltage directive. The product is designed in accordance with the international standards of the IEC 60255 series and ANSI C37.90. This product complies with the UL 508 certification.

Safety information

⚠️ Dangerous voltages can occur on the connectors, even though the auxiliary voltage has been disconnected.

⚠️ Non-observance can result in death, personal injury or substantial property damage.

⚠️ Only a competent electrician is allowed to carry out the electrical installation.

⚠️ National and local electrical safety regulations must always be followed.

⚠️ The frame of the protection relay has to be carefully grounded.

⚠️ When the plug-in unit has been detached from the case, do not touch the inside of the case. The relay case internals may contain high voltage potential and touching these may cause personal injury.

❗ The protection relay contains components which are sensitive to electrostatic discharge. Unnecessary touching of electronic components must therefore be avoided.

❗ Whenever changes are made in the protection relay, measures should be taken to avoid inadvertent tripping.

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Section 1   Introduction

1.1   This manual

The engineering guide provides information for IEC 61850 engineering of the protection relays with PCM600 and IET600. The guide can be used as a technical reference during the engineering phase, installation and commissioning phase, and during normal service. For more details on tool usage, see the PCM600 documentation.

1.2   Intended audience

This manual addresses the system engineers and installation and commissioning personnel.

The system engineer must have a thorough knowledge of protection systems, protection equipment, protection functions and the configured functional logic in the protection relays. The installation and commissioning personnel must have basic knowledge of how to handle the electronic equipment.

1.3 Product documentation

1.3.1 Product documentation set
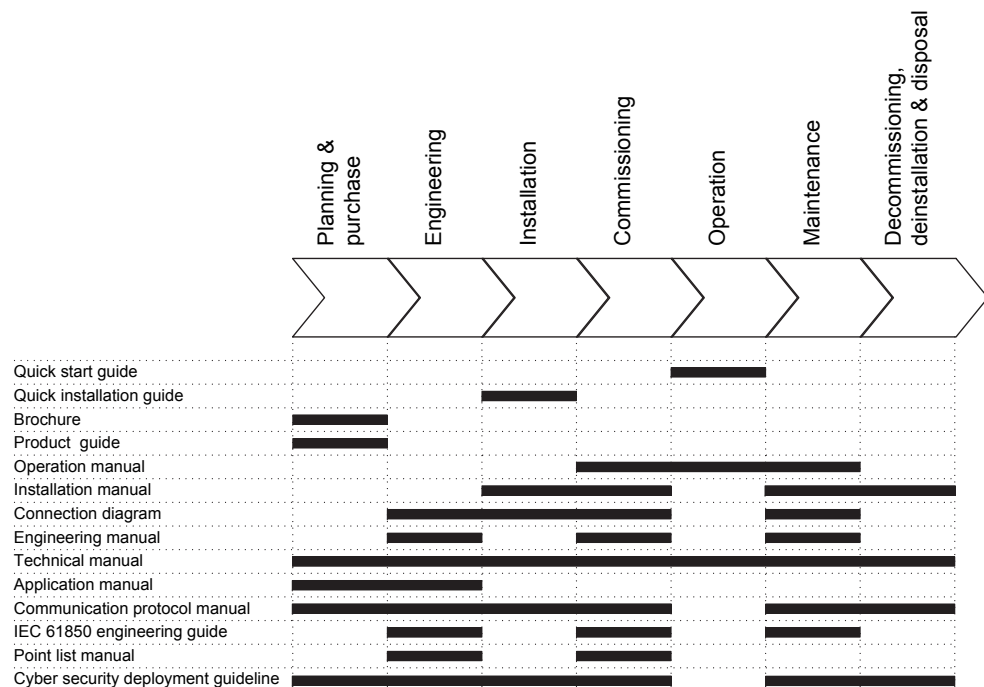
Figure 1:   The intended use of documents during the product life cycle

Product series- and product-specific manuals can be downloaded from the ABB Web site http://www.abb.com/relion.

1.3.2 Document revision history

Document revision/date	Product series version	History
A/2012-10-31	2.0	First release
B/2015-11-25	2.1	Content updated with release of REM620 Ver.2.1
C/2019-05-17	2.0 and 2.1	Content updated

> Download the latest documents from the ABB Web site
> http://www.abb.com/substationautomation.

1.3.3 Related documentation

Product series- and product-specific manuals can be downloaded from the ABB Web site
http://www.abb.com/substationautomation.

1.4 Symbols and conventions

1.4.1 Symbols

> 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 of important facts and conditions.

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

Although warning hazards are related to personal injury, it is necessary to understand that under certain operational conditions, operation of damaged equipment may result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warning and caution notices.

1.4.2 Document conventions

A particular convention may not be used in this manual.

- Abbreviations and acronyms are spelled out in the glossary. The glossary also contains definitions of important terms.
- Push button navigation in the LHMI menu structure is presented by using the push button icons.

To navigate between the options, use ⬆ and ⬇.
- Menu paths are presented in bold.
  Select **Main menu/Settings**.
- WHMI menu names are presented in bold.
  Click **Information** in the WHMI menu structure.
- LHMI messages are shown in Courier font.

  To save the changes in nonvolatile memory, select `Yes` and press ↵.
- Parameter names are shown in italics.
  The function can be enabled and disabled with the *Operation* setting.
- Parameter values are indicated with quotation marks.
  The corresponding parameter values are "Enabled" and "Disabled".
- Input/output messages and monitored data names are shown in Courier font.
  When the function picks up, the `PICKUP` output is set to TRUE.
- Dimensions are provided both in inches and mm. If it is not specifically mentioned, the dimension is in mm.

Section 2   IEC 61850 overview

The international IEC 61850 standard defines a framework for substation communications networks and systems. The standard consists of several parts ranging from the requirements on substation automation systems to the details of a communication protocol.

A major difference between the other communication protocols applied in substation automation and IEC 61850 is that the latter is not only a communication protocol, but a whole framework for specifying, engineering and operating substation automation systems. The communication part covers the connection between the IEDs and the substation clients, for example, SCADA and gateways.
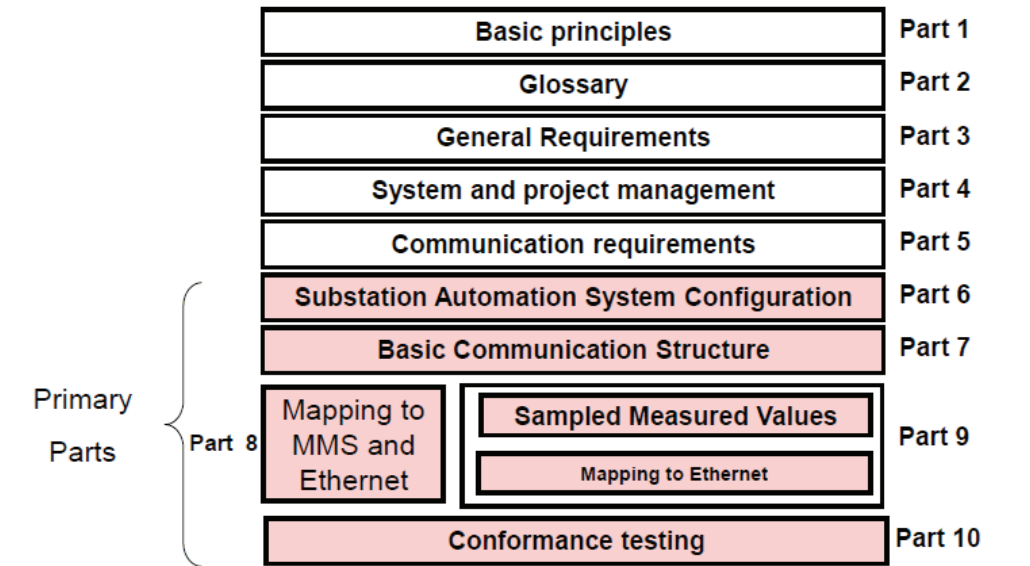
Figure 2:   *Structure and parts of the IEC 61850 standard*

The IEC 61850 standard specifies an expandable object-oriented data model and wide set of protocol services for substation automation (standard parts 7-x). The standard does not specify any protection or control functions, but specifies how the functions expose their information to a communication network.

The standard supports free allocation of functions to devices. With efficient communication facilities, the functions can be located anywhere in the system, that is, an interlocking function can reside in the IED or on the station level. Additionally, the

standard is open for different system implementations, that is, different integration levels and allocation of functions to different devices is supported.

The standard also defines an XML description language for substation automation systems. The language facilitates efficient integration of devices into systems in an automated fashion. Additionally the standard supports a comprehensive and consistent system definition and engineering, which makes not only the devices, but also their tools and systems interoperable (standard part 6).

The standard uses Ethernet and TCP/IP for communication. Since Ethernet and TCP/IP are widely accepted and used, the application of these technologies provide a broad range of features from mainstream communication.However, IEC 61850 is also open for possible new communication concepts in the future.

Figure 3:   Communication stacks and mapping used in IEC 61850
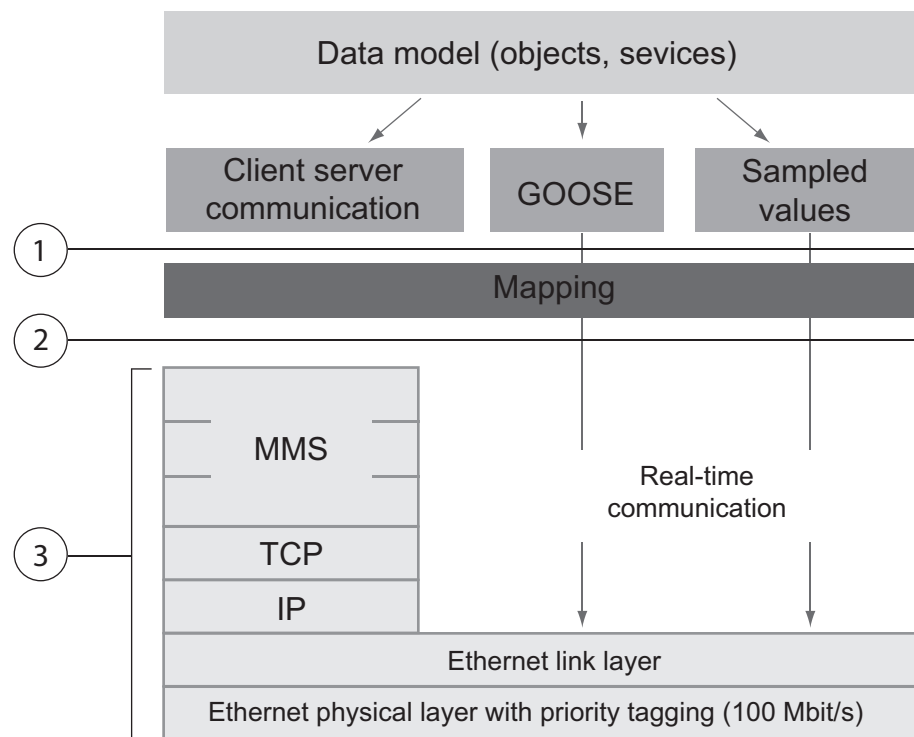
1   Abstract communication services interface (ACSI)

2   Stack interface

3   ISO/OSI stack

Section 3   PCM600 tool

Protection and Control IED Manager PCM600 offers all the necessary functionality to work throughout all stages of the protection relay life cycle.

- Planning
- Engineering
- Commissioning
- Operation and disturbance handling
- Functional analysis

The whole substation configuration can be controlled and different tasks and functions can be performed with the individual tool components. PCM600 can operate with many different topologies, depending on the customer needs.

PCM600 is used to conduct complete engineering and configuration activities needed for the bay level protection relays.

Connectivity Packages are separate software packages that provide type and version information to PCM600. Further Connectivity Packages assist the tool with communications.

PCM600 uses IEC 61850 over Ethernet to communicate with bay devices. This communication allows PCM600 to configure and monitor the devices. In addition to IEC 61850 the devices have optional communications protocols and hardware to connect to station engineering tools. PCM600 provides the ability to export the configuration of the devices or an entire substation in a standard file format which enables station engineering in separate IEC 61850 System Configuration tools.

A PC with PCM600 can be connected to any 620 series protection relay within a station by using the Ethernet connection. The connection can also be used for service and maintenance purposes. In addition, the connection is used to handle digital fault records from the protection relays.

The modern-day protection relays are designed using the concept of the IEC 61850 standard. This is primarily in regards to how functions within the protection relay are modelled and how the protection relay is represented in the substation. See the IEC 61850 parameter list for the list of logical nodes available in the protection relay and observe how they follow the structure and rules as defined in part 7 of the standard.

The engineering of the used communication protocols is a separate task and an addition to the engineering of protection and control functions.

PCM600 can be used for different purposes throughout the protection relay life cycle. A set of special tools is available for different applications.

The applications can be organized into groups.

- Relay engineering
- Communication engineering
- Record management
- Device monitoring and diagnostic

> The system settings must be set before a new PCM600 project is started. For more information, see PCM600 documentation.

3.1   Connectivity packages

A connectivity package is a software component that consists of executable code and data which enables system tools to communicate with a protection relay. Connectivity packages are used to create configuration structures in PCM600. The latest PCM600 and connectivity packages are backward compatible with older protection relay versions.

A connectivity package includes all the data which is used to describe the protection relay. For example, it contains a list of the existing parameters, data format used, units, setting range, access rights and visibility of the parameters. In addition, it contains code which allows software packages that use the connectivity package to properly communicate with the protection relay. It also supports localization of text even when it is read from the protection relay in a standard format such as COMTRADE.

Update Manager is a tool that helps in defining the right connectivity package versions for different system products and tools. Update Manager is included with the products that use connectivity packages.

3.2   PCM600 and relay connectivity package version

- Protection and Control IED Manager PCM600 Ver.2.6 or later
- IED Connectivity Package REF620 ANSI Ver.2.0 or later
- IED Connectivity Package REM620 ANSI Ver.2.1 or later
- IED Connectivity Package RET620 ANSI Ver.2.0 or later

| | Download connectivity packages from the ABB web site http://www.abb.com/substationautomation |

3.3 IET600

The Intergrated Engineering Toolbox IET600 is used to configure the devices for use in IEC 61850 horizontal communication and to edit client and event reporting properties.

IET600 acts as a system tool which is used to define and share the system-wide IEC 61850 parameters, such as communication addresses, horizontal communication data and its priorities and client/server (system level/device) connections. The actual configuration of the device and the downloading of configuration changes are done with PCM600.

Section 4   620 series data model

4.1   Product series implementation

The protection relays have been fully designed according to IEC 61850. This means that the functionality of the protection relay is represented in a data model in accordance with the standard and the protection relays support a wide range of the services provided by the standard.

- Process data: monitoring of statuses and measurements
- Application data: protection activation, tripping, fault recordings
- Digital fault recorder files
- Control commands
- Protection settings
- Settings and setting groups
- Configuration data
- Diagnostics and self-supervision
- Fast horizontal communication between devices
- Time synchronization

4.2   Information model

The protection relays are modelled in IEC 61850 using three logical devices.

- Control logical device, CTRL
- Disturbance recorder logical device, DR
- Protection logical device, LD0

All generic functionality, such as modelling of physical inputs and outputs as well as the alarming LED functionality, resides under logical device LD0.

Different configurations have different data models.

During system engineering in the system configuration tool, do not delete
or rename logical devices, logical nodes, data objects or data attributes in
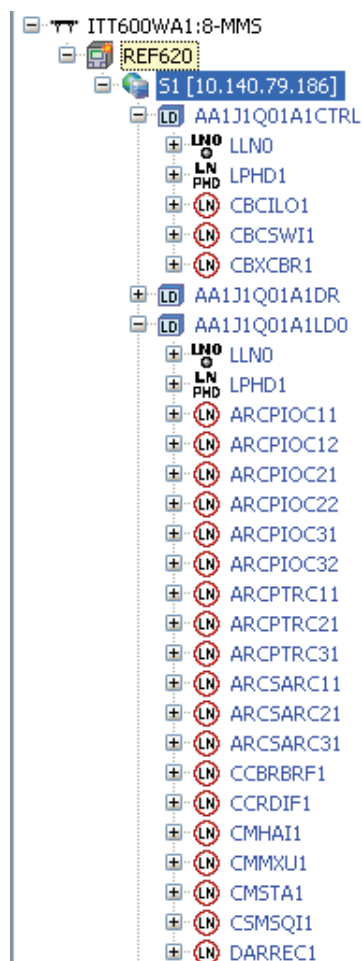the IEC 61850 data model.

```
☐ ·ᵀᵀ ITT600WA1:8-MMS
   ☐ 🖳 REF620
      ☐ 🌐 S1 [10.140.79.186]
         ☐ 🔲 AA1J1Q01A1CTRL
            ☐ LN0 LLN0
            ☐ LN PHD LPHD1
            ☐ LN CBCILO1
            ☐ LN CBCSWI1
            ☐ LN CBXCBR1
         ☐ 🔲 AA1J1Q01A1DR
         ☐ 🔲 AA1J1Q01A1LD0
            ☐ LN0 LLN0
            ☐ LN PHD LPHD1
            ☐ LN ARCPIOC11
            ☐ LN ARCPIOC12
            ☐ LN ARCPIOC21
            ☐ LN ARCPIOC22
            ☐ LN ARCPIOC31
            ☐ LN ARCPIOC32
            ☐ LN ARCPTRC11
            ☐ LN ARCPTRC21
            ☐ LN ARCPTRC31
            ☐ LN ARCSARC11
            ☐ LN ARCSARC21
            ☐ LN ARCSARC31
            ☐ LN CCBRBRF1
            ☐ LN CCRDIF1
            ☐ LN CMHAI1
            ☐ LN CMMXU1
            ☐ LN CMSTA1
            ☐ LN CSMSQI1
            ☐ LN DARREC1
```

Figure 4:   Example of an IEC 61850 data model of a protection relay

In the IEC 61850 standard, communication services are configured through a number of
data structures including data sets, report control blocks, GOOSE control blocks and
setting group control blocks. As these data structures pertain to the entire logical device,
the standard indicates that they are to be modeled under LLN0, which is a special logical
node that describes the common functionality of the logical device. All these data
structures are located in logical device LD0 logical node LLN0.

The full data model can be exported from PCM600 in the form of a SCL file, which is
defined in part 6 of the standard.

4.3 Vertical and horizontal communication

The protection relays are capable of vertical communication between the protection relay and monitoring and control systems (clients) such as PCM600 or MicroSCADA. Each protection relay can communicate to five separate clients to receive events, read or write data (an active PCM600 connection is considered to be a client). The protection relay can report data in either buffered or unbuffered mode and execute direct or select-before-operate control sequences according to the control commands sent by the client.

The protection relays are also capable of horizontal or peer-to-peer communication. They can be programmed to publish (send) information to and subscribe (receive) information from other devices according to the IEC 61850-8-1.

Table 1:   Maximum data sets and attributes for GoCB and RCB

Control block	Maximum data sets	Data attributes	Description
GoCB	4	20	The protection relays allow a maximum of four GOOSE control blocks, which effectively limits the protection relay to four data sets for GOOSE. The sending GOOSE data set can have a maximum of 20 data attributes to minimize the message-handling load in the receiving and sending devices.
RCB	18	256	The IEC 61850 configuration tool (IET600 or PCM600) allows a maximum of 14 data sets and a maximum of 256 data attributes or objects for the report control blocks.

4.3.1 Predefined vertical communication data sets

In vertical communications, the protection relay can generate events that are automatically reported to any listening clients. These communications are configured via a series of predefined data sets and corresponding report control blocks. The data sets are used to configure what data is sent and the report control block is used to configure when data is sent.

The data sets and report control blocks can be modified using IET600, however, this should only be done by individuals that are extremely familiar with both the protection relays and IEC 61850. Inappropriate modifications can result in misoperation of the protection relay.

- StatIed – generic status information of IEDs
- StatIo – inputs, outputs, LEDs
- StatUrg – measurement limit supervision, control feedback
- StatNrml – protection pickup and trip signals, autoreclosing status

- • StatDR – digital fault recorder status
- • MeasReg – registered measurement values at faults
- • MeasFlt – measurements

The protection relays support both buffered and unbuffered event reporting. In the predefined configuration all report control blocks are configured to use buffered reporting. The benefit of buffered reporting is that it buffers events during communication breaks and thus no events are lost. Further, a single data set can only be used by one report control block and the same data set entry cannot be used in different event reporting data sets.

The default values for the data sets and control blocks are suitable for most applications. Only users who have an in-depth understanding of the protection relay and IEC 61850 should modify the default configuration.

Vertical communication protocols, such as Modbus, rely on the data sets for event generation. Modification of the default configuration have an impact on vertical communication.

The protection relay allows free renaming and editing of report control blocks and data sets. However, it is mandatory to keep certain signals in data sets for the protection relays, as removing signals from data sets affects also the available events in the local HMI. Data objects PhyHealth, PhyHealth1 and PhyHealth2 from logical node LD0.LPHD1 give indications of the internal relay or system configuration faults and these must be available in some of the IEC 61850 data sets.

Data sets define also the status events which are available in the LHMI event list.

It is not recommended to mix status (FC=ST) and measurement (FC=MX) data to the same data set due to the protection relay's internal event handling.

A 620 series protection relay can have a maximum of 14 configured data sets and 10 report control blocks for event handling when the maximum number of four GOOSE control blocks are being used. If no GOOSE control blocks are used, the maximum length for a data set is 256 data attributes. Report data sets define the data in the data object level. The amount of data attributes within a data object varies.

i The protection relay does not support defining data on data attribute level for data sets used for vertical reporting. Only data object level is allowed.

4.3.2 Vertical communication diagnostic counters

The IEC 61850 data model of the IEDs includes a logical node LD0.MMSGGIO1 for IEC 61850 vertical communication diagnostic. The counters are available via the HMI or PCM600 path **Monitoring/Communication**.

Table 2:   *Diagnostic data objects*

Data object	Description	Diagnostic information
IntIn1	Successful connections	Number of succeeded client connection attempts
IntIn2	Failed connections	Number of failed client connection attempts
IntIn3	Concludes	Number of session concludes
IntIn4	Sent aborts	Number of association aborts sent by server
IntIn5	Received aborts	Number of received association aborts by server
IntIn6	Sent rejects	Number of sent rejects by server
IntIn7	Received request	Number of received client requests
IntIn8	Failed requests	Number of failed client requests
IntIn9	Reads	Number of variable reads
IntIn10	Failed reads	Number of failed variable reads
IntIn11	Writes	Number of succeeded variable writes
IntIn12	Failed writes	Number of failed variable writes
IntIn13	Reports	Number of sent reports
IntIn14	Active connections	Number of active client connections

To reset the vertical communication diagnostic counters, write `TRUE` to the *RstCnt.Oper.ctlVal* attribute under MMSGGIO1.

GOOSE communication has its own diagnostic counters.

4.4 Parameter setting and digital fault recorder

The protection function parameters can be set and the active setting groups changed by using the standard IEC 61850 services. Digital fault recorder files in COMTRADE format are retrieved by using PCM600.

When setting the parameter **Configuration/Communication/MMSGGIO1/Unit mode** to "Primary", the values sent over IEC 61850 are scaled according to the CT and VT settings.Restart the protection relay after changing the parameter. This feature is needed if the SCADA system or substation gateway does not handle scaling from nominal values.

Digital fault recorder files in COMTRADE format are also retrieved by using the IEC 61850 compatible services from the **\COMTRADE** directory.

Section 5   GOOSE

5.1   Horizontal communication

GOOSE is used in substation automation for fast horizontal communication between the protection relays. GOOSE can be used for direct data exchange, for example, of interlocking and blocking information between protection relays. According to the IEC 61850-8-1 standard, GOOSE uses a publisher/subscriber profile in which information is shared from one device to one or several devices by using Ethernet multicast messages. A message is an image of a sent IEC 61850 data set that is defined in the configuration.

IET600 is used to configure the vertical and horizontal communication properties of the protection relays.

The protection relay can send any type of status or measurement data in the GOOSE messages from its IEC 61850 data model. The status data response time, that is, the time it takes for the application to handle a received GOOSE message and to send the concerned data back to the network, is below 3 ms. The response time fulfils the tightest Type 1A, Class P2/3 requirements of the standard.

When the protection relay is configured to send measurements, the analog, integer or counter type data should be placed in its own data set to minimize the bandwidth consumption in the network and to avoid unnecessary publishing of unchanged status data. The triggering of analog data sending is controlled by deadband handling, zero-point clamping and limit supervision.

The horizontal communication configuration consists of the protection relays' GOOSE control block, data set and GOOSE input configuration. The result of the configuration work is a system configuration which is used for the protection relays. The used files in the workflow are IEC 61850 standard format SCL files.

5.1.1   Configuring horizontal communication

Below are the basic steps in configuring peer-to-peer communications. These steps are explained in greater detail in the corresponding chapters.

1. Add devices to a PCM600 project.
2. Export the SCD file.
3. Import the SCD file to IET600.

4.   Engineer the GOOSE connections between the devices.

    4.1.   Define the published GOOSE data and control blocks.
    4.2.   Define the subscribing devices for the GOOSE data.

5.   Export the SCD file back to PCM600.
6.   In PCM600, engineer the relay applications with GOOSE inputs.

> Before any configuration, create backups of the PCM600 and
> IET600 projects. For example, once an SCD file is imported into
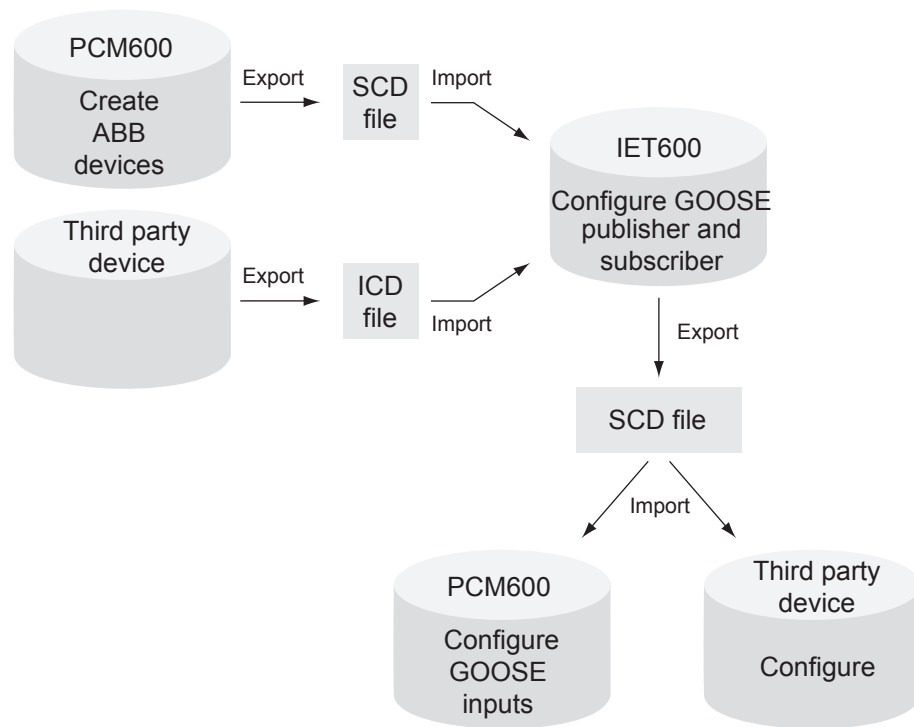> PCM600, the changes cannot be undone except by restoring the
> backup.

Figure 5:   *Horizontal communication configuration process*

5.2   GOOSE publishing properties

GOOSE data is transmitted at regular intervals in 802.1Q multicast frames over the LAN.
Peer devices can determine the state of the communications by listening for the
transmissions. When the data values change, the data is transmitted at an increased

frequency to ensure the timeliness of its reception. The transmission then gradually tapers off to the original frequency with the new data.

In GOOSE, data sending is based on data sets and GOOSE control blocks. The data set defines what device data is used in GOOSE service and sent to local Ethernet subnetwork in a GOOSE message. The GOOSE control block links the data set and its attributes to actual data.

Table 3:   *GOOSE control block attributes*

GoCB attribute	Description
Multicast address	A multicast addressing scheme is used when sending GOOSE messages. A multicast address can be shared by several sending devices, or it can be device specific. To keep the multicast message filtering of the devices working it is recommended to use unique multicast addresses.
Ethernet frame-specific information (802.1 Q tagging info: APPID, priority and VLAN id)	APPID is a GoCB-specific integer value identifying the sender GoCB and its data. The APPID must be unique for the GoCB in the system. The priority can be used according to the local network priority scheme, but normally the default value is sufficient. The VLAN group can be used when configuring the Ethernet network topology Virtual LANs for routing and filtering multicast messages. Configuration is done in managed Ethernet switches.
GoCB name	The name of the GoCB structure seen from the IEC 61850/MMS client. Some devices use this as a unique data reference.
GoID	A GOOSE control block specific string. The default value is the GoCB path in the 61850 namespace if nothing is set. It is recommended to always set a unique value in tool. Check the GOOSE Control block GoID name according to the system requirements of the receiving device. Although the protection relays use MAC address and APPID for receiving packet detection, some devices require additionally that the GOOSE control block GoID is named explicitly.
Data set definition	Data sent in GOOSE messages to the network.
ConfRev	ConfRev increases when the referenced data set is modified. Both the GOOSE sender and the receiver must have the same ConfRev value. This ensures that the both devices have the same configuration level in the substation configuration. ConfRev usage is done automatically by tools. If the latest system configuration is not downloaded to all required devices, the configuration revision may differ between the receiver and sender and data exchange does not work.

5.3   Configuring GOOSE

5.3.1   Defining devices and exporting the SCD file

Use PCM600 to define the substation and the devices. Before starting the system engineering, configure the device in PCM600.

For more information, see the PCM600 documentation.

1. Create a PCM600 project with all the needed devices.
2. To export the SCD file, click the **Plant Structure** tab, right-click the substation node in the submenu and select **Export**.
   The file includes the whole substation configuration in SCL format for other tools.
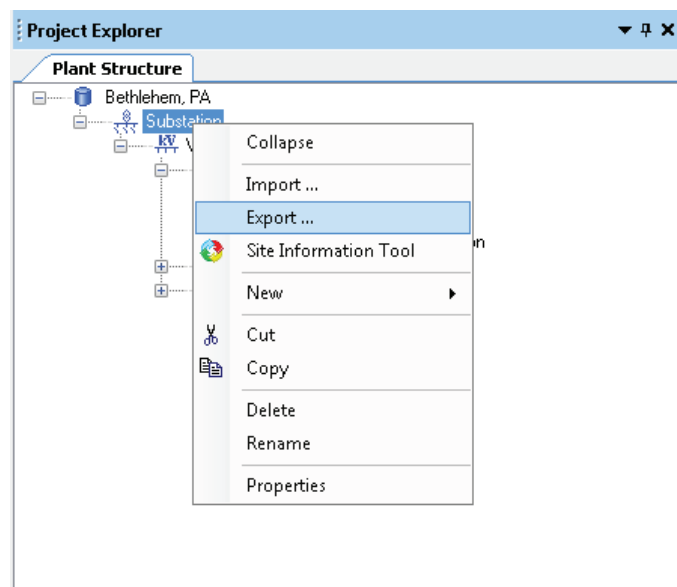

Figure 6: Exporting an SCD file from PCM600

3. Define the export options.
   A dialog box with several options opens. As IET600 does not use the private sections, this section is not important (other ABB tools such as COM600 and MicroSCADA do use the private sections). It is important to not export as a template and make sure that all of the other options to include sections are selected.
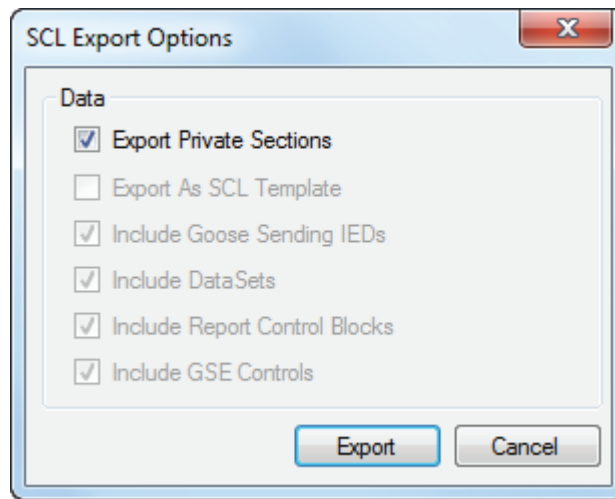
Figure 7:   *Export options for an SCL file*

4.   Click **Export**.

5.3.2   Creating an empty project

1.   Open IET600.
2.   To create an empty project, click the round button on the upper-left corner of the IET600 tool.
3.   Click **Manage Projects**.
4.   In the **Projects** dialog, click **New**.
5.   Name the project.
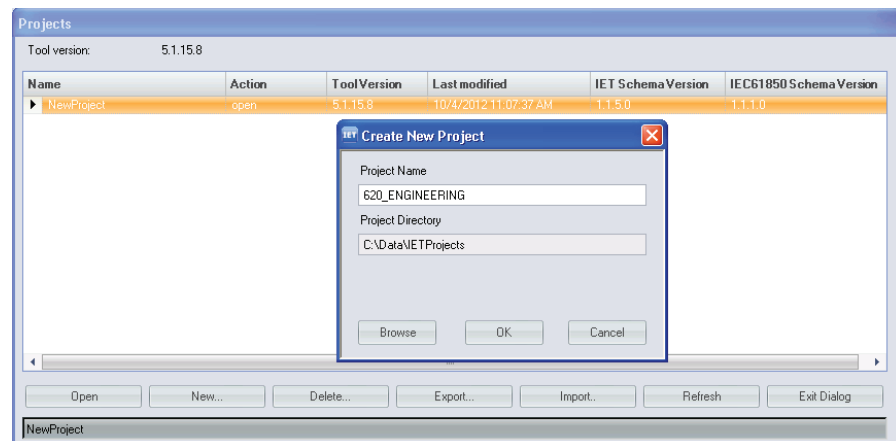
Figure 8:   Naming a project

6.   To select the destination folder for the project, click **Browse**.
7.   Click **OK**.

After creating an empty project, import the SCD file from PCM600 to the project.

5.3.3   Importing the SCD file

1.   Import the SCD file from PCM600 to the empty project.

    •   Click **Import SCL File** on the shortcut menu of the project object
    •   Click **Import** button
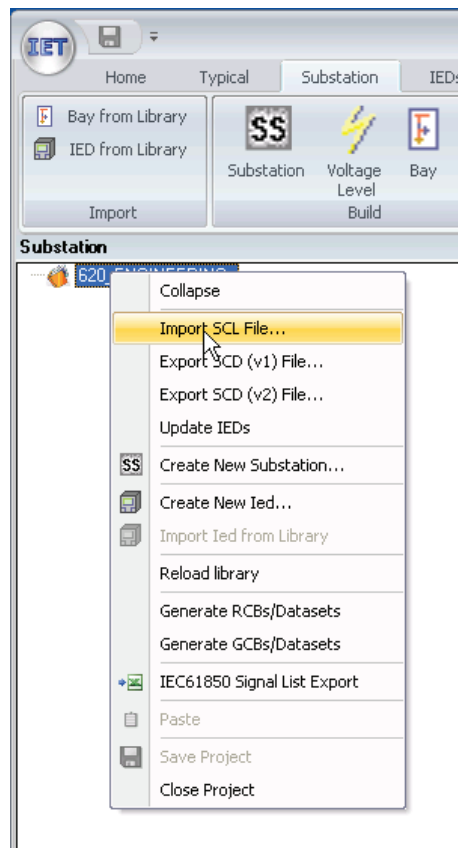
Figure 9: *Importing an SCL file*

2. Locate the SCL file and click **Open**.

> If the substation includes third-party devices which need to be configured for horizontal GOOSE communication, the SCL files holding the information from those devices must be imported as well. The third-party devices have separate tools for creating the ICD/CID/SCD file.

> SCD files can be imported to a project only once. If a new device needs to be later added to the configuration, it must be first created using the **Create New IED** function after which the **Update IED** function can be used to import the related CID or ICD file. Another alternative is to create a new project in IET600 and import the whole SCD file from PCM600. The existing IEC 61850 configuration including GOOSE remains if the changes made in IET600 have been already imported to PCM600.

5.3.4 Configuring a GOOSE publisher with IET600

To control the GOOSE data publishing, such as addressing, every publisher device must have at least one data set for GOOSE data and one GOOSE control block.

1. Group the data to a data set sent to IEC 61850 station bus.
2. Define the GOOSE control block.

> The protection relay can send single binary, double binary, integer and floating point data values with a quality attribute. A quality attribute is used at the receiver side to check data validity.

5.3.4.1 Creating a GOOSE data set

The sending data set used by the GOOSE control block must be defined. With the protection relays of this product series, the sending GOOSE data set can have at maximum 20 data attributes to minimize the message-handling load in receiving and sending devices.

All data sets must be configured under the logical node LLN0 and must be provided with names unique within the device. The protection relays allow a maximum of four GOOSE control blocks, which effectively limits the protection relay to four data sets for GOOSE as there is a one-to-one correspondence between the GOOSE control blocks and GOOSE data sets. Typically it is sufficient to define a single data set and control block for an application. However, it is recommended to use a separate data set and corresponding control block for analog values.

1. Select the **IEDs** tab in the navigation pane.
2. Click the IED node.
3. Click the **Datasets** tab in the editor pane.
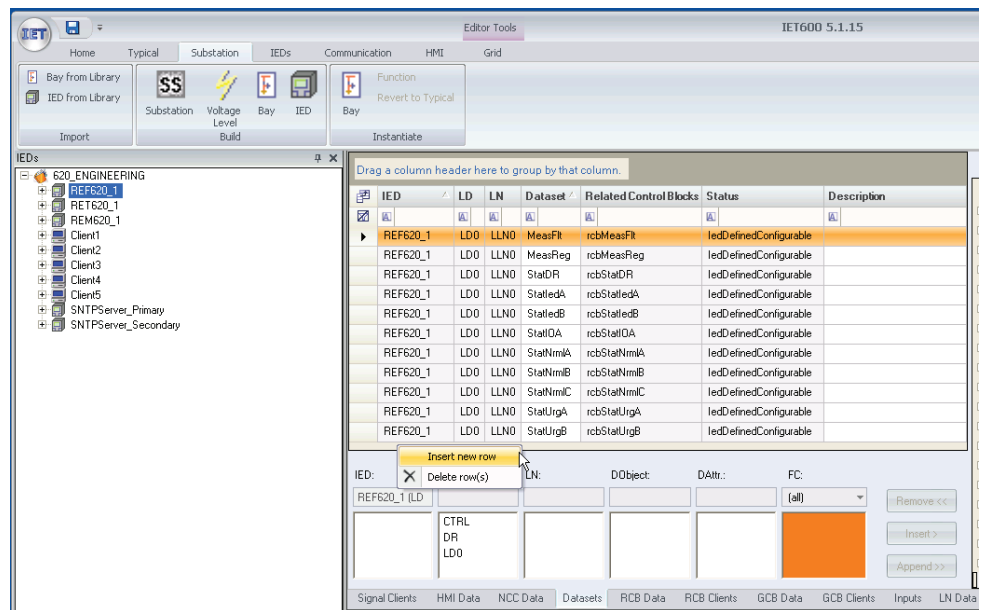
Figure 10:   Creating a data set in IET600

4.   To add a new data set, right-click the area containing the data set names and select **Insert new row** the shortcut menu.
5.   Define the LN where the data set is to be placed (accept preselected "LD0/LLN0") and give the data set a unique name.
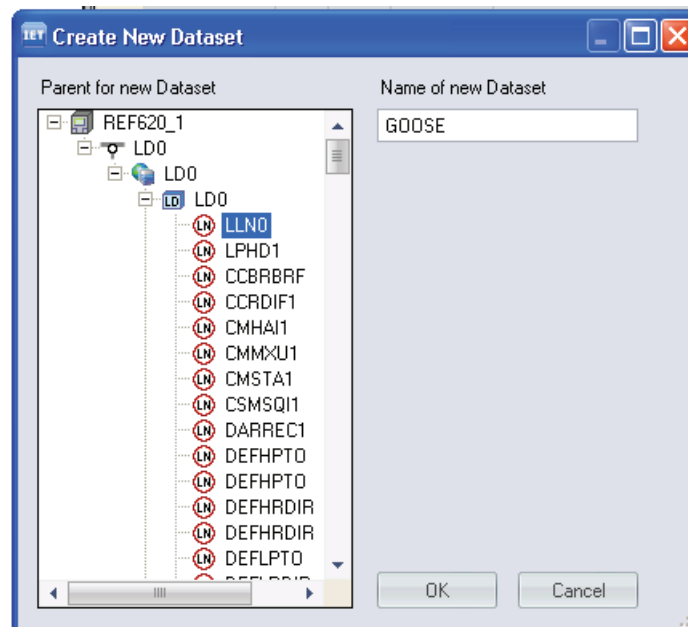
Figure 11:   Naming a data set in IET600

> If quality data attributes are added to a data set, they must be located after the status value of the corresponding data object.

Defining data attributes

1. Select the **Datasets** tab on the editor pane.
2. Select a GOOSE data set.
3. Using the selection lists below the data set grid, select a data attribute to be used.

    -   Click **Append >>** to add the data attribute to the end of the data set.
    -   Click **Insert >** to add the data attribute above the selected row in the data set entries list.

A maximum of 20 data attributes can be added to a single GOOSE data set. If the configured published data set is larger, it is not accepted by the protection relay.
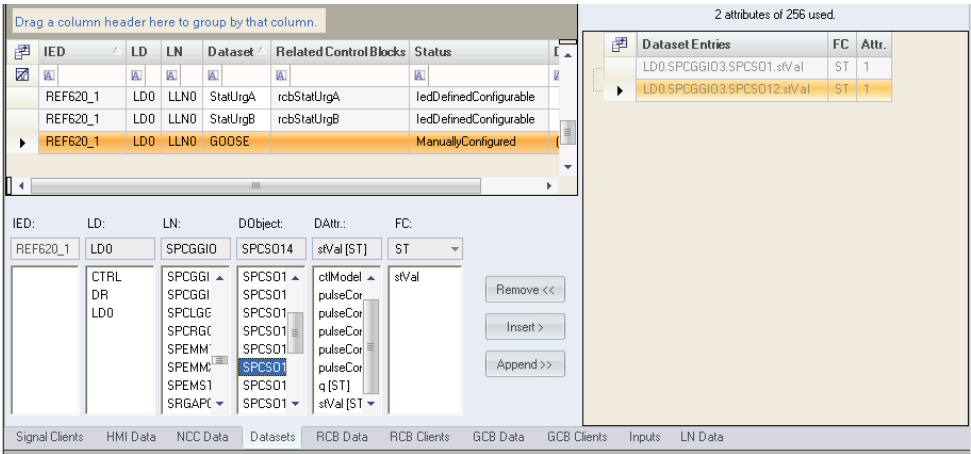
Figure 12:   *Adding data set entries*

The possible amount of attributes that can be added to a data set and the amount of already added attributes are shown above the data set entries list. However, since IET600 cannot make a difference between the maximum data attribute count of a data set for vertical reporting and a GOOSE data set, too high a maximum value is shown for a GOOSE data set.

If a data set has quality attributes, the attributes must be located after the status value of the same data object.

Data set entries for vertical reporting are selected using the data object level, and entries for GOOSE using the data attribute or data object level.

The data set entries must be single data attributes, such as stVal and q.

A full list of the available signals with descriptions and IEC 61850 names is available in a file in the connectivity package installation directory, such as `C:\Program Files\ABB \Connectivity Packages\REM620\2.1\Documents`

```
\EN\ANSI\RE_620 ANSI
Parameters_1MRS756606x.htm.
```

After defining the data entries for the data sets, configure the GOOSE control block properties.

5.3.4.2 Configuring a GOOSE control block

1. Select the IED node on the **IEDs** tab in the navigation pane.
2. Select the **GCB Data** tab in the editor pane.
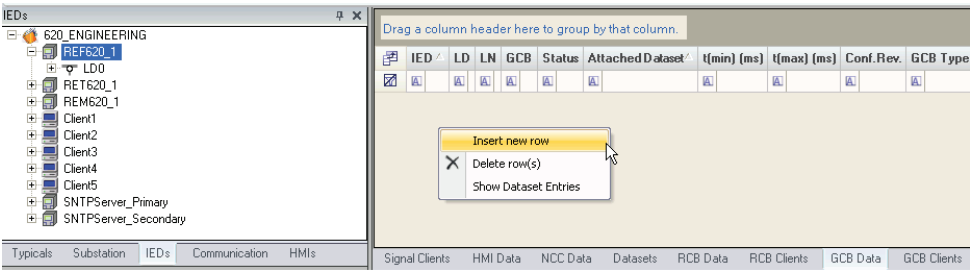
Figure 13:   Creating a GOOSE control block

3. To add a new GOOSE control block, right-click the area containing the existing GOOSE control blocks and select **Insert new row**.
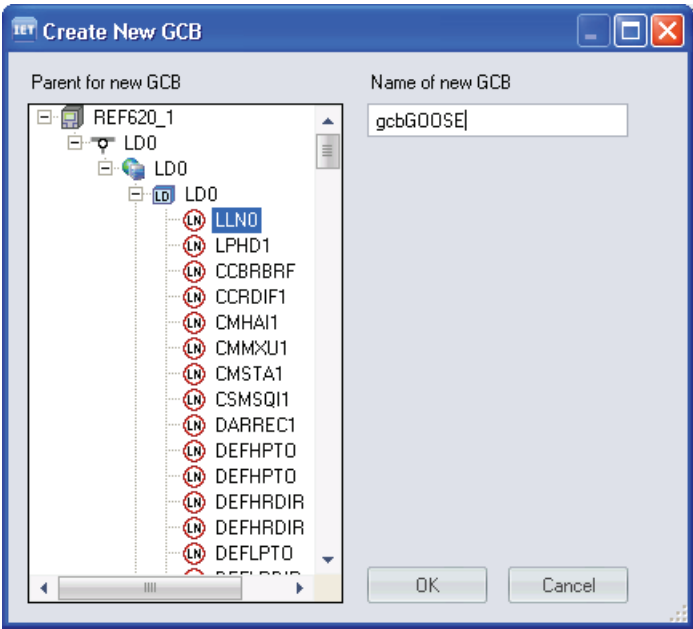
Figure 14:   Naming a GOOSE control block

4.   Browse to LLN0 under LD0 to define where the GOOSE control block is to be placed.
5.   Give a unique name to the GOOSE control block.
6.   In the **Attached Dataset** drop-down list, select the previously created data set. After creating the GOOSE control block, edit its properties and addresses. Edit at least **MAC Address** and **APP-ID**.

IED	LD	LN	GCB	Status	Attached Dat▽	t(min)	t(max) (ms)	Conf.Rev.	GCB Type	MAC Address	APP-ID
A	A	A	A	A	A	A	A	A	A	A	A
REF620_1	LD0	LLN0	gcbGOOSE	ManuallyConfigured	GOOSE	4	10000	100	GOOSE	01-0C-CD-01-00-0	3001

Figure 15:   GOOSE control block properties

To set the visibility of the GoCB columns, click the upper-left icon of the table and select or clear the check boxes in the **Field Chooser** dialog.
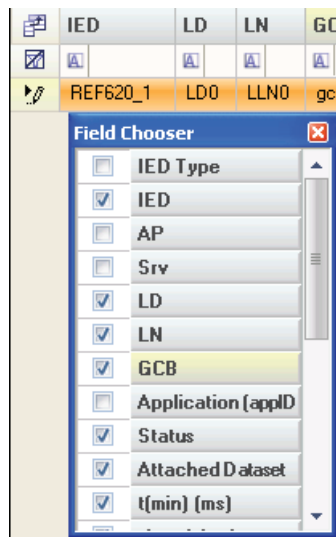
Figure 16:   Field Chooser dialog

Table 4:   Selected GOOSE control block properties

GoCB property	Description
GCB	GOOSE control block name
Application (appID)	A unique GoID for each GoCB in the system. Recommendation is to define a device-specific value and not to use the default empty value.
t(min) (ms)	Indicates the maximum response time in milliseconds to data change. This time can be used by the receiver to discard messages that are too old. In principle, t(min) can vary depending on the data type, but for the protection relays, the value is always "10 ms" for sent data.
t(max) (ms)	Indicates the background "heartbeat" cycle time in milliseconds; the default value is "10 000 ms". If there are no data changes, the protection relay still resends the message with the heartbeat cycle to enable the receiver to detect communication losses, that is, the communication is supervised.
Conf.Rev.	Contains an integer value that is sent in every GOOSE message. The integer indicates the amount of changes in the data set. The receiver checks the message for configuration mismatches. "Configuration Revision" cannot be edited manually in IET600.
MAC Address	Multicast MAC address to which the specific GOOSE data is sent. The receiving device filters the frames and starts to process them if a specific multicast address is defined in the configuration. It is recommended to have one unique multicast address per GoCB. The address range for GOOSE Multicast addresses is 01-0C-CD-01-00-00...01-0C-CD-01-01-FF.
Table continues on next page	

GoCB property	Description
APP-ID	Unique HEX value application identifier for sending the GoCB within the system. It identifies the purpose of this particular data set. The value range is 0000...3FFF.
VLAN-ID	Used if the Ethernet switches in a station bus support VLAN. If static VLAN identifiers are defined, it also affects the switch port configuration. Value "000" indicates a non-configured VLAN and switches do not filter these messages on a port basis. This is the recommended if there is no need to split the logical network. The VLAN identifier is a 3-character HEX value with range 000...FFF. Recommended values are 2...1001.
VLAN Priority	Used in networks supporting VLANs. The priority is used with network switches. The default value for GOOSE is "4" and the value range is 0...7.

With the protection relays of this product series, only *t(max)* is configurable, not *t(min)*.

Conf.Rev. cannot be manually edited. IET600 updates it automatically to the next multiple of 100 when the configuration changes.

The multicast *MAC address* is usually unique, and *APP-ID* must be unique.

5.3.5   Configuring a GOOSE subscriber

The relay application can receive and use single binary, double binary, integer and floating point values with attached quality information. A quality attribute is received and processed automatically.

5.3.5.1   Configuring GOOSE inputs

1. Select the root node on the **IEDs** tab in the navigation pane.
2. Click the **GCB Clients** tab in the editor pane.
    The rows of the GCB client editor show GoCBs, that is, "senders", and the columns show the devices available as GOOSE clients, that is, "receivers". If the client device is not on the same subnetwork as the GoCB sender, it cannot be configured as a client.
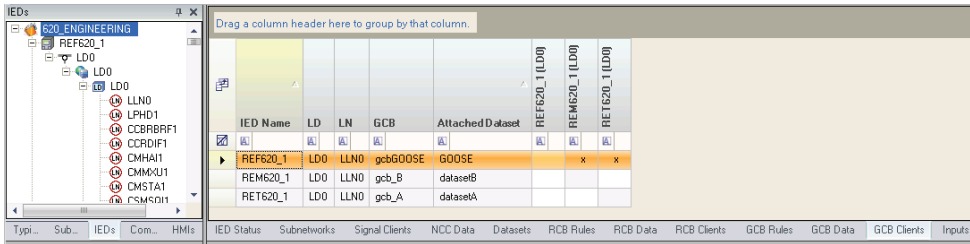
Figure 17: GCB client editor

3. To add or to delete clients, double-click the cell.
Upon adding or removing clients, the corresponding input sections are updated.

Figure 18: GOOSE inputs

5.3.6 Finalizing GOOSE configuration

5.3.6.1 Exporting the SCL file

1. Export the SCL file in one of the alternative ways.

- Click **Export SCD File** on the shortcut menu of the project object
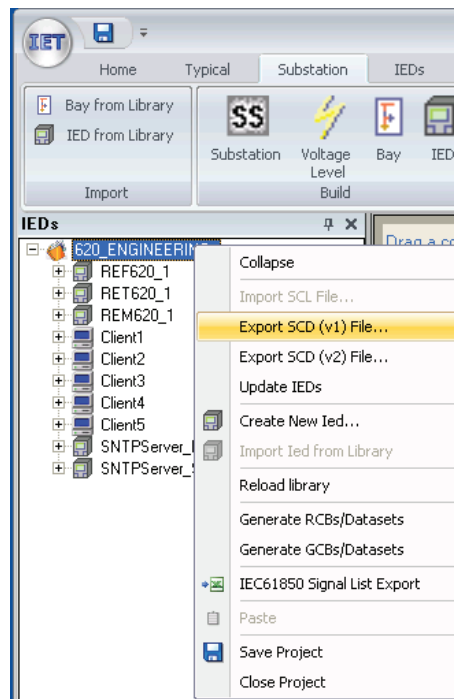- Click **Export** button.

Figure 19:   *Exporting an SCD file*

2.   Select the file destination and click **Save**.
     It is recommended to leave the SCD file exported from PCM600 as a backup.

5.3.6.2   Importing the SCL file

1.   Open PCM600 and ensure the original project is open.
2.   Go to the **Project Explorer** view and select the **Plant Structure** tab.
3.   Right-click the project and select **Import**.
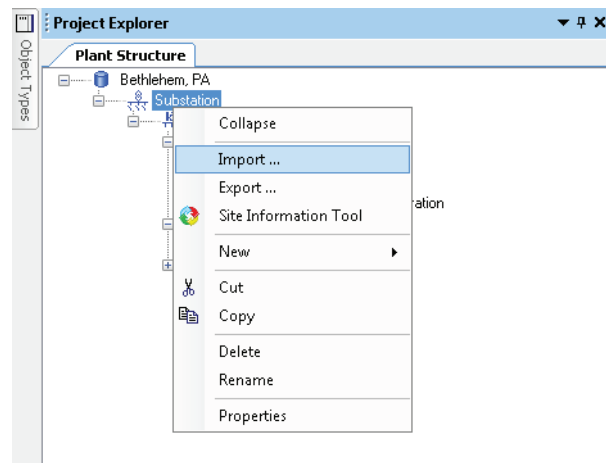
Figure 20:   Importing an SCD file to PCM600

4.   Open the SCL file exported from IET600.
5.   In the **SCL Import Options** dialog box under IED Types, select **Don't import IEDs of unknown type** if the GOOSE configuration does not include third-party devices.
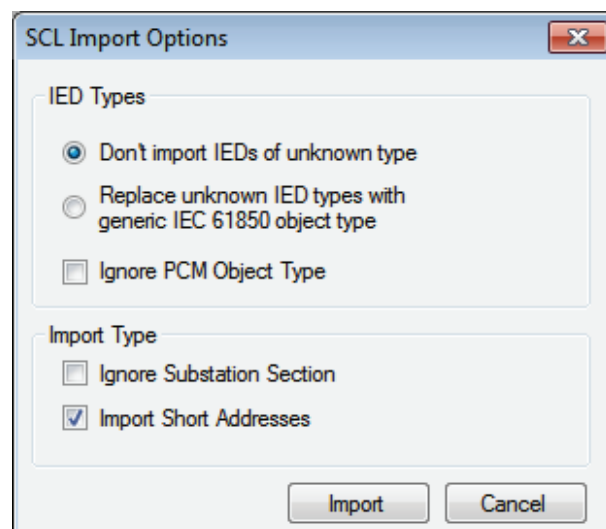
Figure 21:   SCL import options in PCM600

6.   Click **Import**.

For more information, see the PCM600 documentation.

5.3.6.3   Connecting GOOSE inputs to a relay application

1. In PCM600, open **Project Explorer** and select the **Plant Structure** tab.
2. Add the GOOSERCV function block with the Application Configuration tool.

> ℹ️ The GOOSERCV function block can only be added with the Application Configuration tool.

> 💡 Give the GOOSERCV block application-specific user-defined names to distinguish between different blocks when making GOOSE connections in the Signal Matrix tool.
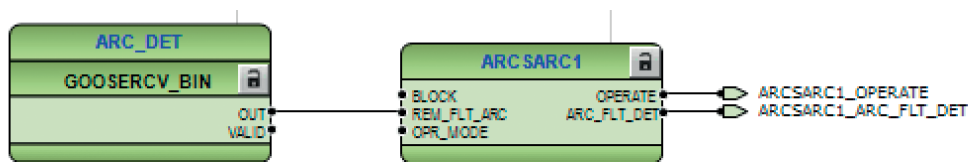
Figure 22:   Adding the GOOSERCV function block

3. Create the connection into the application.

    3.1. Create the connection.
    3.2. Click **Calculate execution order**.
    3.3. Click **Validate configuration**.
    3.4. Save the connection to the application.

4. To open the Signal Matrix tool, right-click the protection relay, and select **Signal Matrix**.
5. To map the input points to the receiving input data, click the cell.
   To expand the source field, drag the edge of the field to expand it until the whole GOOSE source address is visible.
6. In Signal Matrix in the GOOSE sheet, map the GOOSE publisher data into the corresponding GOOSERCV function block.
   The columns in the GOOSE sheet represent publisher data and the rows represent the possible subscriber input point.

Figure 23: GOOSE sheet in Signal Matrix

> The GOOSE receiver block output VALID defines the validity for the received data. The value is based on the received quality attribute value or communication status. This validity information can be used in the application to build the validity logic in addition to the GOOSE default supervision information.

> During the protection relay start-up phase, the protection relay keeps the value of the output VALID as "1" until the communication is activated. After the communication is activated, the value of the output VALID is updated by the value received via the communication.

> If the data type does not match with the GOOSERCV function block, the attribute cell is red.

In Signal Matrix, the received GOOSE data can be directly connected to the relay application. The GOOSE inputs are shown on the Binary or Analog Inputs sheets and they can be connected to the application receiver function blocks. The columns represent publisher data and the rows represent the possible subscriber input points.

If the data type, for example timestamp, is not supported by the relay application, the attribute column is red. The quality attribute is automatically incorporated in the application with the status value, and it is not seen in Signal Matrix.

7. Save the changes made in Signal Matrix.
8. Write to the IED.

5.4 Received GOOSE message handling

A GOOSE frame is not accepted if the Needs Commission bit is set. A frame with the Test bit set is only accepted if the receiving device is also in the test mode.

> When the GOOSE sender is in test mode and the GOOSE receiver is not, the GOOSE receiver freezes to its previous valid state.

The Test bit is active in the sender if the protection relay is set to test mode.

> See the technical manual for more information on the test mode.

The GOOSE frame is also not accepted if ConfRev deviates from the one in the configuration. These error situations can be observed in the GSEGGIO1 diagnostic counters.

The default GOOSE input value is "0" for all the data types. The functionality is analogous to physically wired galvanic Normally Open (NO) contacts where the disconnected signal gives value "0" of FALSE to relay application. The application must be designed to withstand the default value. This value is used when the subscribed GOOSE data is not valid, or it is not received from the network and the peer device is considered to be in a time-out state.

If a peer device sends the data including the quality attribute, the receiver device input object is not updated according to the received status value if the data quality is bad, questionable or blocked. The default value is also used in this case.

5.5 GOOSE supervision

5.5.1 Background sending

To ensure reliability and availability of the application, the GOOSE communication must be supervised. Design the application so that it can handle communication losses, for example, when a peer device is not available or there are communication time-outs.

If there are no GOOSE-related data changes, the protection relay resends the last GOOSE message with a heartbeat cycle to enable the receiver to detect communication losses. The heartbeat cycle is defined by modifying the *MaxTime* property on GOOSE control block.

Every GOOSE frame has a TAL field which shows how long the frame is valid until the next heartbeat frame. Other devices may have their own TAL values. Nevertheless, all the TAL values under 1000 ms are rounded up to 1000 ms on the receiving side.

If no frames are received during 2xTAL, that is, if at least two consecutive frames are lost, then the receiver considers the whole data set as invalid. The quality attribute for the entire data set is set to "bad" and the values are set to their default values. This is an important consideration when designing the application as the default values need to be "fail-safe" values. For example, the protection relay should use an enabled signal for interlocking and a blocking-type signal for protection.

5.5.2 Default value handling

The information is of point-to-point type which means that there is only one signal connected to the function block input. The default value of the input, FALSE (0), is taken into use when there is a communication error on the receiver side. If one relay application function block input receives several signals from several protection relays, the input value is calculated in OR or AND operation from several inputs. In this case, one default signal is treated as logical FALSE (0), but the other signals can keep the function block input value active. It works similarly as copper cables connected between protection relays having no detection of single data loss. In all cases, however, a separate alarm event is always generated by the GSEGGIO1.Alm data object for IEC 61850 event clients.

GSEGGIO1.Alm can also be used on the application side as an input in the Signal Matrix Tool's Binary Outputs sheet (signal GSEGGIO ALARM). For example, it is possible to change the setting group in case one or several protection relays are disconnected from the network.

5.5.3   Alarm supervision in application

In a communication time-out situation, all the peer devices receive information about the problem. The system does not tolerate single failures or non-existing devices, for example, in service situations. Take this into account when designing an application.

> Disable GOOSE sending by writing "false" from IEC 61850 clients to the GoEna attribute under the GOOSE control block. Use this feature carefully, and for test purposes only.

5.5.4   Diagnostic counters

The IEC 61850 data model of the protection relays includes a logical node LD0.GSEGGIO1 for the GOOSE communication diagnostic. The counters are also available via the HMI or PCM600 path **Monitoring/I/O Status/Communication/ GSEGGIO1/Monitoring**.

It is possible to reset the counters via **Monitoring/I/O Status/Communication/ GSEGGIO1/Monitoring/Reset counters** and via the IEC 61850 communication by writing TRUE to the GSEGGIO1.RstCnt.Oper.ctlVal data attribute.

Table 5:   *Diagnostics data objects*

Data object	Description	Diagnostics information
Intln1	Received messages	When increasing, the protection relay is receiving GOOSE messages.
Intln2	Transmitted messages	When increasing, the protection relay is sending GOOSE messages.
Intln3	Received state changes	Received GOOSE messages with a new stNum value.
Intln4	Received sequence number	Received GOOSE retransmissions or heartbeat cycle messages with a new sequence number.
Intln5	Received frames with test bit	Received GOOSE frames with the test flag on.
Intln6	State or sequence number errors	Number of notified sequence number jumps.
Intln7	Receiver time-outs	Number of notified peer device time-outs.
Intln8	Received ConfRev mismatches	When increasing, there is a mismatch between the received GOOSE frame information and the used GOOSE configuration.
Intln9	Received frames with Needs Commissioning	One peer device Indicates that its configuration is not valid or up-to-date.
Intln10	Errors in received data set	Received data are syntactically wrong, or there are less data in received data set than expected.
Alm	Receiver alarm	Alarm signal value connected to the event and application logic. It is active when one peer device is in time-out.

GOOSE Alarm is activated in the receiver device in certain situations.

- Time-out
- Configuration revision mismatch
- Error in the received data set
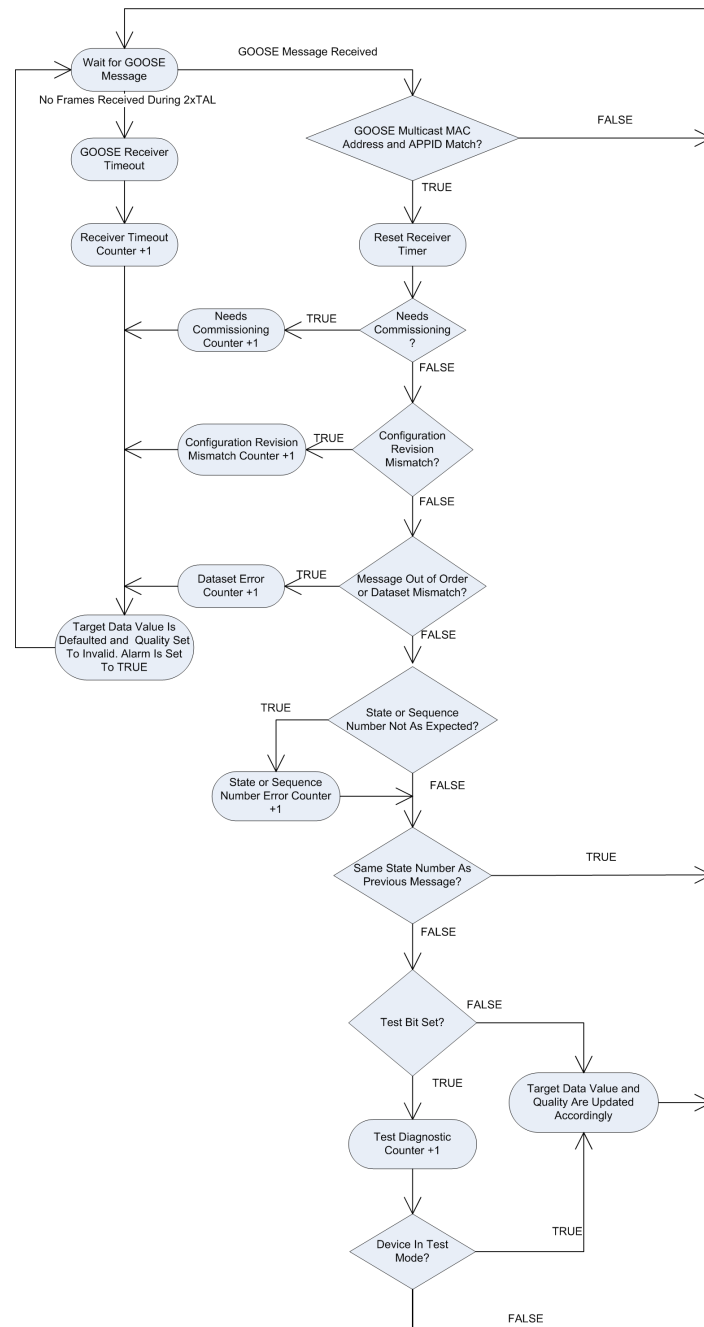- The Needs Commissioning bit is active in the received message

Figure 24:   Receiving GOOSE data in the protection relays

Section 6   Engineering with IEC 61850 Configuration tool

6.1   Managing IEC 61850 clients with the IEC 61850 Configuration tool

The default IED SCL contains five default client definitions, "Client1"..."Client5", which are used by all the RCBs. PCM600 does not show these clients in the plant structure, but the IEC 61850 Configuration tool shows the clients in the client-server communication.

MicroSCADA and COM600S clients can use the client definitions directly. If other clients need to be added to the project, import the ICD file describing the client data model to PCM600.

6.1.1   Adding new IEC 61850 clients for the IEC 61850 Configuration tool

Adding a new IEC 61850 client to a PCM600 project is a two-step operation. First, a new generic IEC 61850 IED object must be created under the plant structure and the relevant client ICD or CID file must be imported to the generic IEC 61850 IED.

1. Right-click a bay node in the project plant structure, point to **New**, then point to **Generic IEC61850 IEC** and select **IEC61850 IED**.
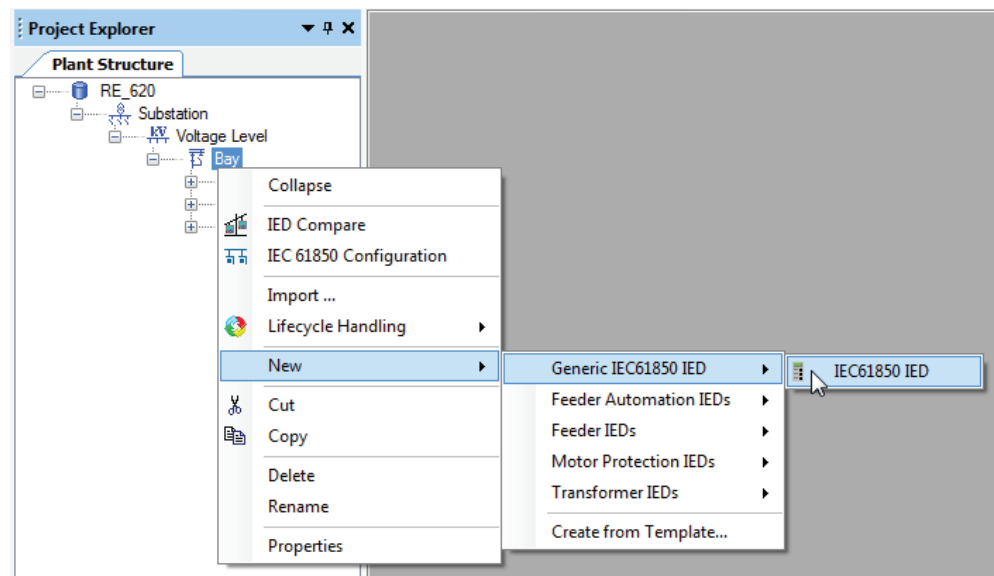
Figure 25: Creating a generic IEC 61850 IED

2. Rename the IED object as "Client_G".
3. Right-click the **IED** and then select **Import**.
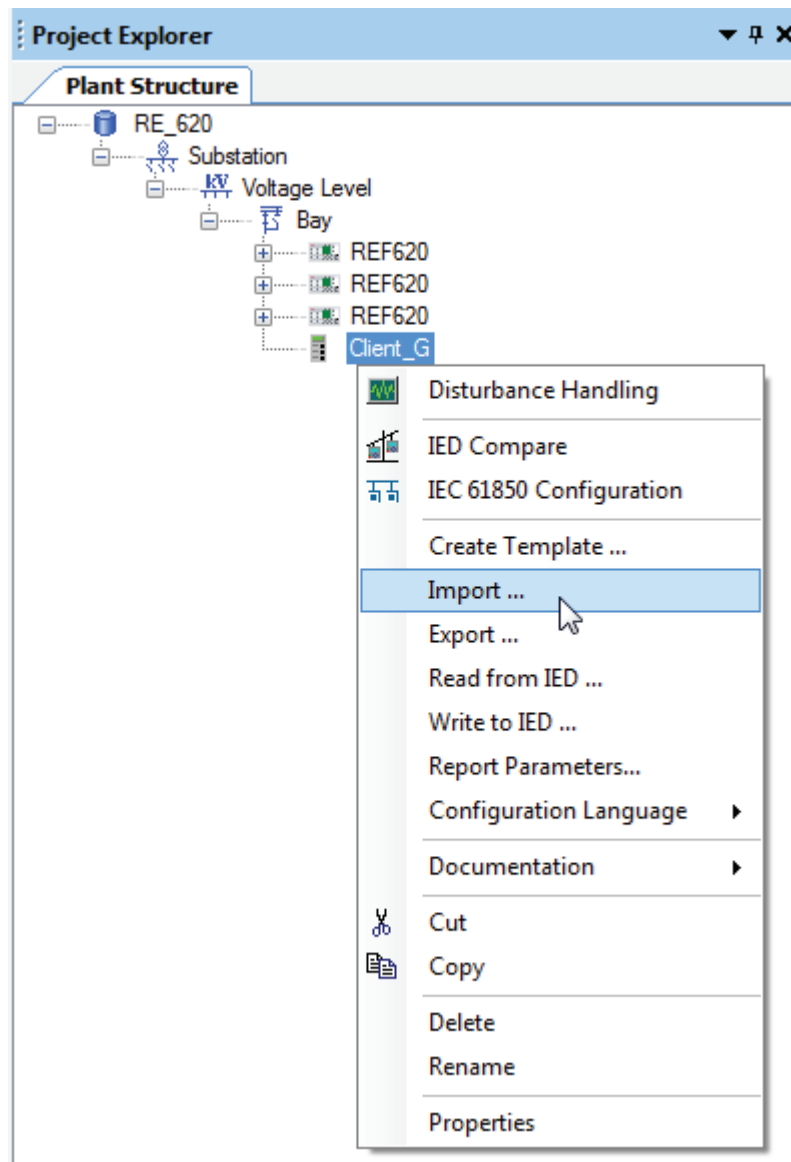
Figure 26:   Selecting Import on the shortcut menu

4.   Select a valid Client SCL file (ICD or CID) and click **Open** in the file selection
      dialog box.

5.   Select **Ignore PCM Object Type** and then click **Import** in the **SCL Import
      Options** dialog box.
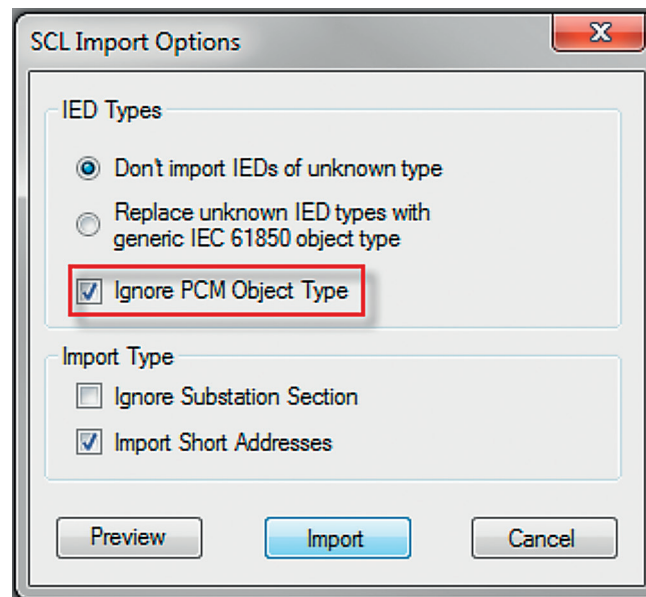
Figure 27:   Defining SCL import options

6.   Start the IEC61850 Configuration tool and select **Client-Server communication** as engineering mode.

The newly added client should be present in the **Clients** column along with other clients in both the **Data Set** tab and the **Report Controls** tab.

6.2　IEC 61850 Configuration tool user interface
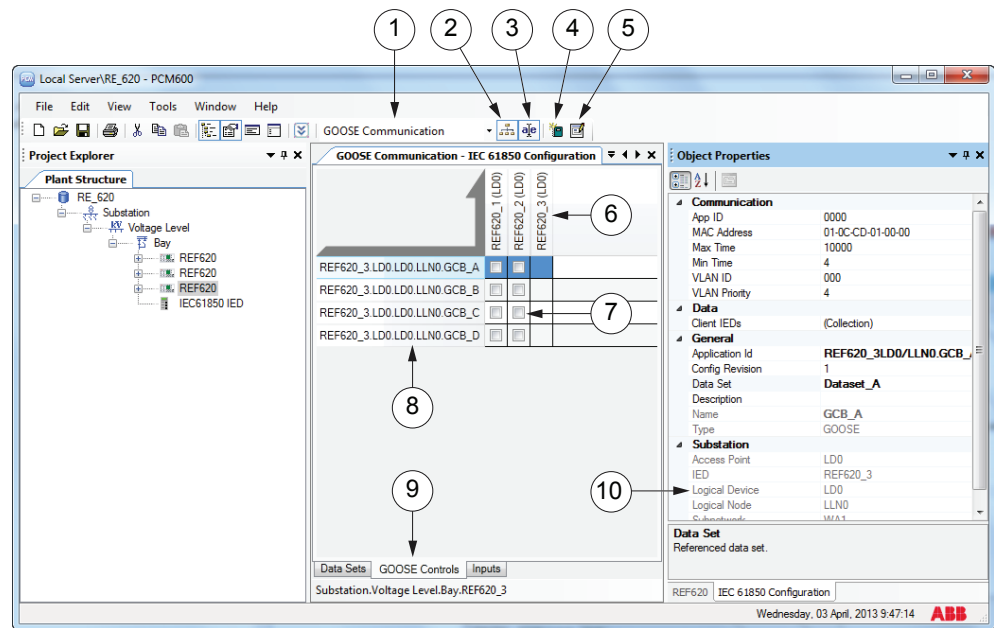
Figure 28:　IEC 61850 Configuration tool user interface

1　Engineering mode selection

2　Switch engineering mode on and off

3　Switch IEC 61850 IED naming on and off

4　Create new object

5　Selection details

6　Receiving access points

7　Mapping grid

8　Data to send/receive

9　Engineering type selection

10　Object properties

1.　Engineering mode selection
The communication mode can be selected from the drop-down list on the toolbar. Three modes are available: "GOOSE Communication", "Client-Server Communication" and "Process Bus Communication".

2.　Switching engineering mode on and off

The button switches between engineering and view mode. The configuration can be edited only in the engineering mode.

Figure 29:   Engineering mode selection button

> When the engineering mode is enabled, SCD files from external IEC 61850 engineering tools cannot be imported into PCM600.

3. Switching IEC 61850 IED naming on and off
    The button switches between IEC 61850 and PCM600 IED naming.
4. Create new object.
    The button opens a window to create a new object. The type of object depends on the currently selected engineering type.
5. Selection details
    The button opens the Editor window for the data currently selected in the mapping grid. The same editor can also be opened by double-clicking the data.
6. Receiving access points
    All IEDs that have access points capable of receiving the kind of data according to the currently selected engineering type and engineering mode are displayed as columns in the mapping grid. A check mark in a column means that the access point is receiving the data.
7. Mapping grid
    Mapping grid consists of check boxes for configuring what data is sent to or received by an access point. A check mark in the grid means that the data on the row is sent to the receiver in the column.
8. Data to send/receive
    The data available for sending/receiving in the selected engineering mode and type is displayed as rows in the mapping grid. The data is context-sensitive, with the current selection in the PCM600 plant structure. A check mark in the row means that the data is sent to or received by an access point. Double-click a data to open the data editor.
9. Engineering type selection
    Each engineering mode has several engineering types. Engineering type means the type of data to configure. The types can be selected by clicking the tab page on the bottom of the tool window. The available engineering types depend on the selected engineering mode.

- • Data sets: Create, delete, modify or send data sets
- • GOOSE controls: Create, delete, modify or send GOOSE controls
- • Sampled value controls: Create, delete, modify or send GOOSE controls
- • Report controls: Create, delete, modify or send report controls
- • Inputs: View inputs (external references)

10. Object properties
   The Object Properties window displays the properties of the currently selected data. Different data properties are edited in this window.

6.3 Creating data sets with the IEC 61850 Configuration tool

1. Select **Plant Structure** in the **Project Explorer** window.
2. Right-click the IED node.
3. Select **Client-Server Communication** in the drop-down box on the toolbar.
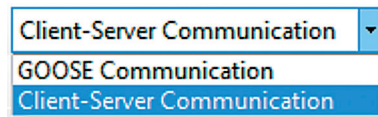
Figure 30: *Selecting Client-Server Communication*

4. Select the **Data Sets** tab.
5. Right-click the area containing the data set names and select **New** to add a new data set.
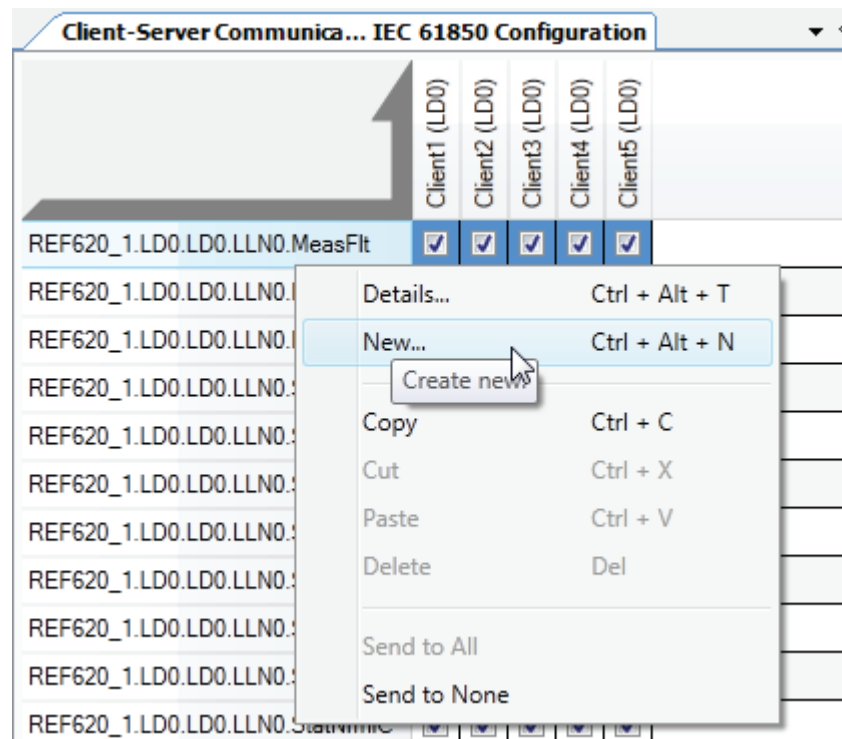
Figure 31:   *Creating a new data set*

6. In the **Create New Data Set** dialog box, define the LN where to place the data set (accept preselected "LD0/LLN0") and give the data set a unique name.
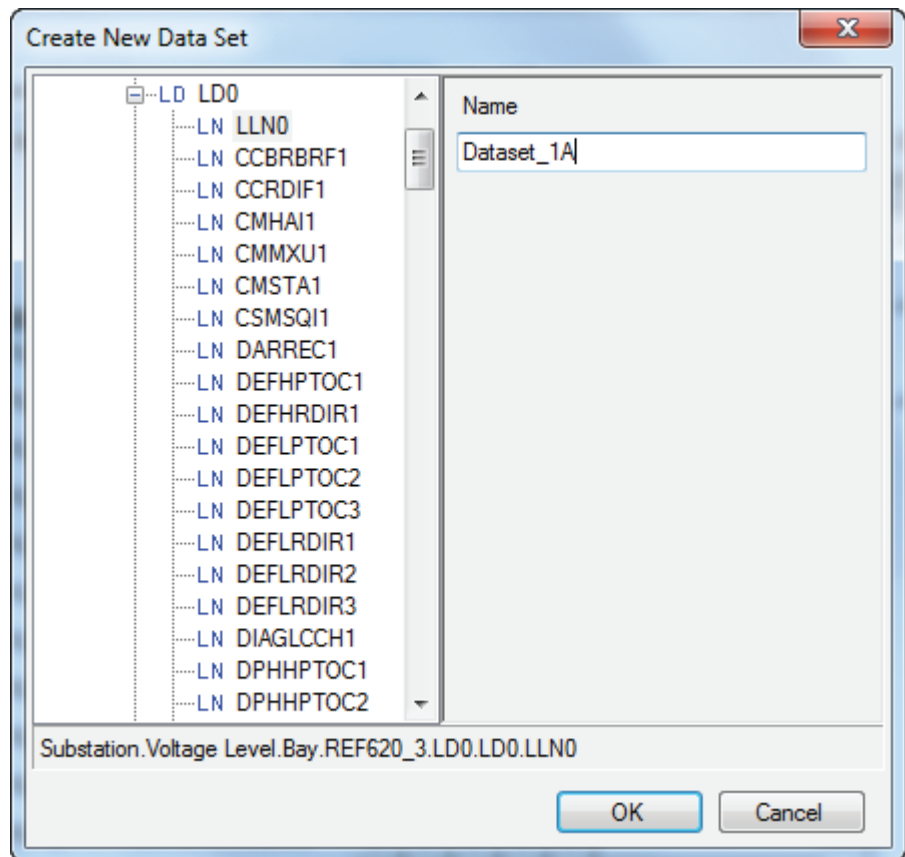
Figure 32:   *Naming the data set*

After creating the GOOSE data sets, define the data set entries (data attributes or data objects) for the data sets.

6.3.1   Defining data set entries with the IEC 61850 Configuration tool

1. Select the **Data Sets** tab.
2. Right-click a data set and select **Details** to add data attributes.
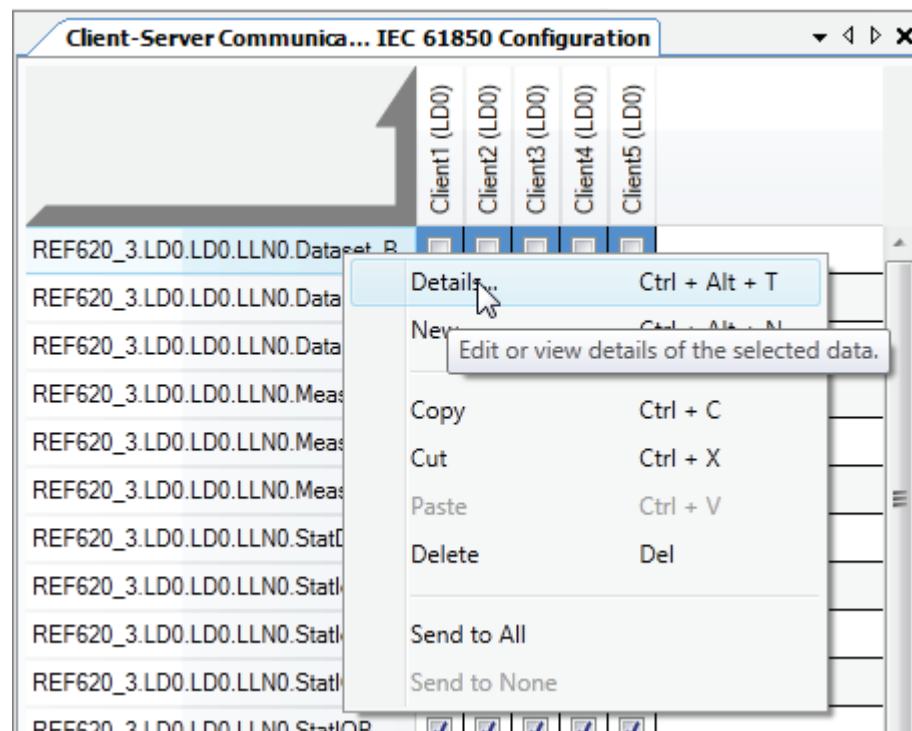
Figure 33:   *Adding data attributes*

3.   In the data set entry window, select the data attribute to be contained in the data set.

- • Click **Append selected** to add the data attribute to the end of the data set.
- • Click **Insert selected** to add the data attribute above the selected row in the data set entries list.
- • To remove a data attribute from the data set, select the data attribute in the data set entries pane and click **Removed selected**.

Reporting datasets can include status and measurement type of data. Also configuration and setting values can be added to datasets in case required.

Data set entries for vertical reporting are selected using the data object level, and entries for GOOSE using the data attribute or data object level.

The default data set for SMV sending is fixed and may not be modified.

6.4 Creating report control blocks with the IEC 61850 Configuration tool

1. Select the **IED** node in **Plant Structure** in **Project Explorer**.
2. Click the **Report Controls** tab.
3. Right-click the area containing the existing report control blocks and select **New** to add a new report control block.
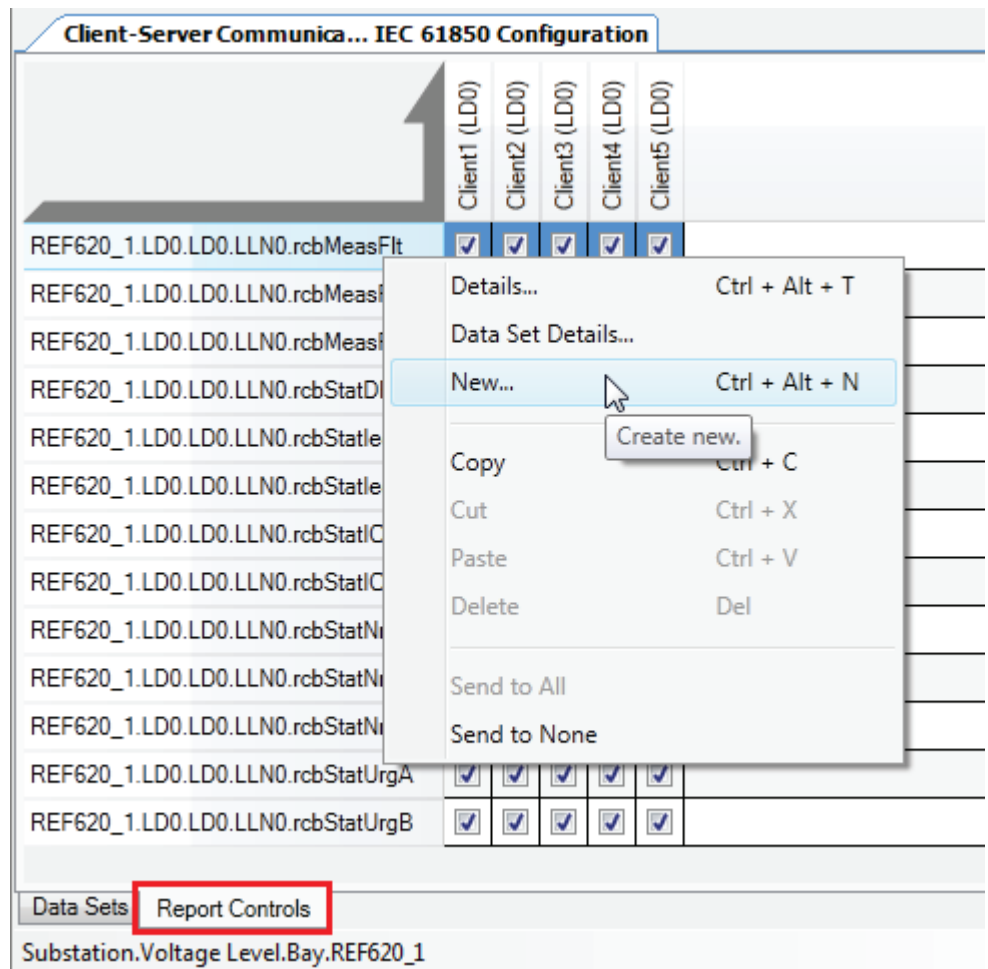
Figure 34:   Adding a new report control block

4. Browse to LLN0 under LD0 to define where to place the report control block.
5. Give a unique name to the report control block.
6. In the drop-down list, select the previously created data set to link with the GCB.
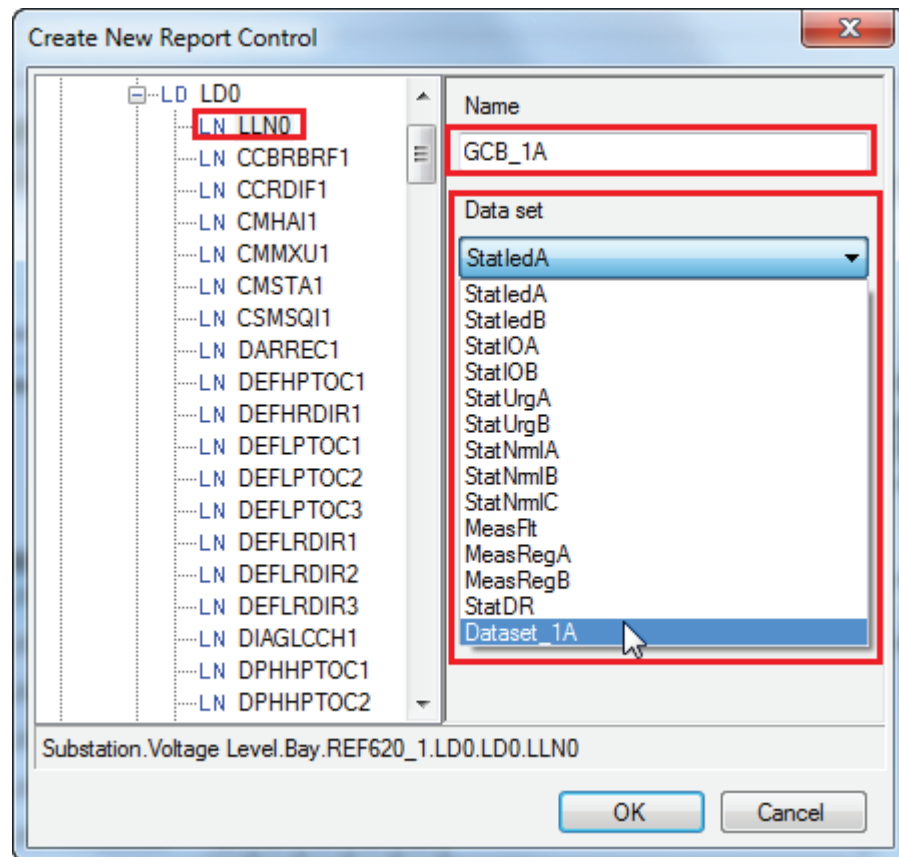
Figure 35:   Data set drop-down list

7.   Edit the properties and options of the created report control block.

Figure 36:   *Report control block properties*

Data set entries in a data set linked to the GCB can be modified from the **GCB Control Block** tab by selecting the **Data Set Details** in the shortcut menu.

6.5 Configuring RCB clients with the IEC 61850 Configuration tool

Add and configure the IEDs before configuring the RCB client. The potential clients and their communication configuration should be known for a successful RCB client configuration.

The RCB name is limited to 14 characters or 30 charactecters (without two-digit index number) depending on which IEC 61850 version is in use.

1. In the **Plant Structure**, click the IED node which is RCB server.
2. Click **Report Controls** tab.
   The rows of the **Report Controls** window show RCBs configured for the IED.
   The columns of the **Report Controls** window show the RCB clients configured in the PCM600.
3. To add or remove clients for a report control block, click the check-box in the grid, corresponding to the client and RCB.
   Five clients at the maximum can be connected to a RCB.

Figure 37:   RCB clients

1   RCBs configured for the IED

2   RCB clients

The clients are added or removed automatically to the corresponding data sets in the **Data Sets** tab. Date sets are based on the configuration done in the **Reports Controls** tab and vice-versa.

Section 7　　Engineering with IET600

7.1　　Managing IEC 61850 clients

When the relay configurations are changed using IET600, some preparations are required when a project is started and the protection relay's data model is imported to the tool for the first time.

- The default IED SCL export from PCM600 contains five default client definitions, "Client1"..."Client5", which are used by all the RCBs.MicroSCADA and COM600S clients can use the client definitions directly. If other clients need to be added to the IET600 project, import the ICD file describing the client data model to the project and attach the file to the same IEC 61850 subnetwork in the **Communication** tab.
- Create the bus connections for the IEC 61850 clients.

7.1.1　　Importing a new IEC 61850 client

Adding a new IEC 61850 client to an IET600 project is a two-step operation. The client must be first created using the **Create New IED** function, after which the **Update IED** function can be used to import the related ICD or CID file.

1. To create an IED, click the **IEDs** tab in the navigation pane.
2. Click the root node in the IED tree.
3. Right-click the node and click **Create New IED**.
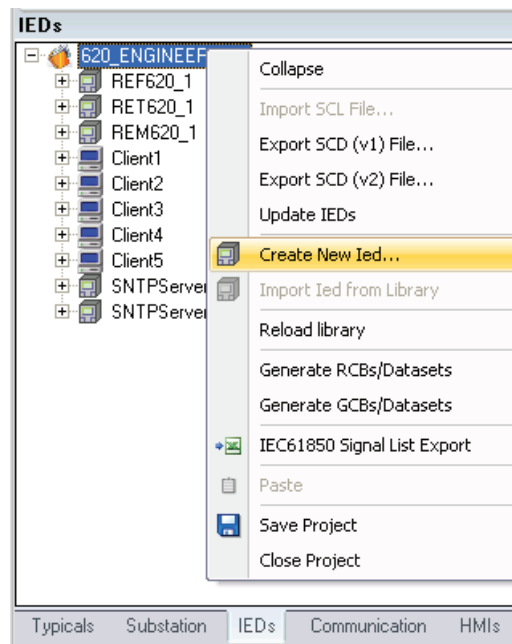
Figure 38:   Creating a new IED

4.   Type the name of the client IED as it is in the file to be imported. Click **OK**.
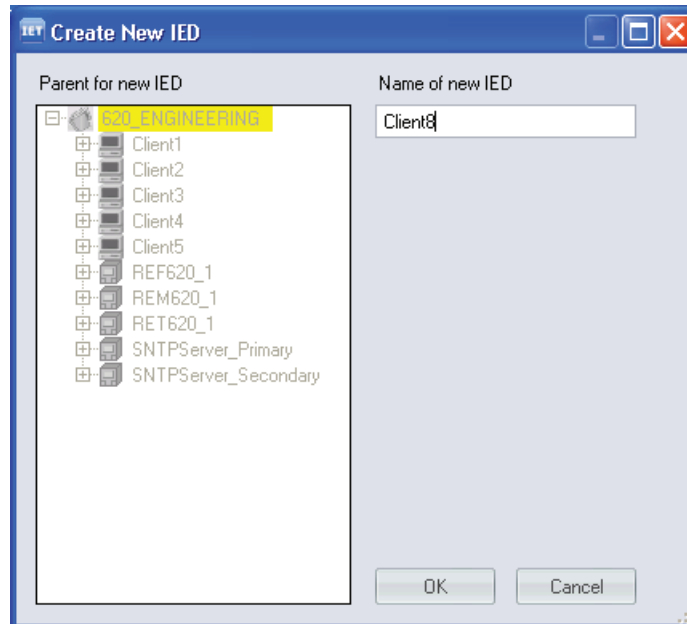
Figure 39:   Naming the new IED

5.   Right-click the created IED and click **Update IED**.
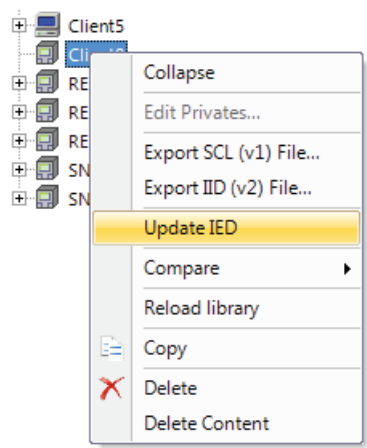
Figure 40:   *Choosing an SCD file for updating the IED*

6.   Select any valid SCL file that is SCD, ICD, CID or IID, and click **Open** from the file
      selection dialog box.
      IET600 automatically matches IEDs with the same name in IET600 and in the file.
7.   To import the IED from the file, click **OK**.
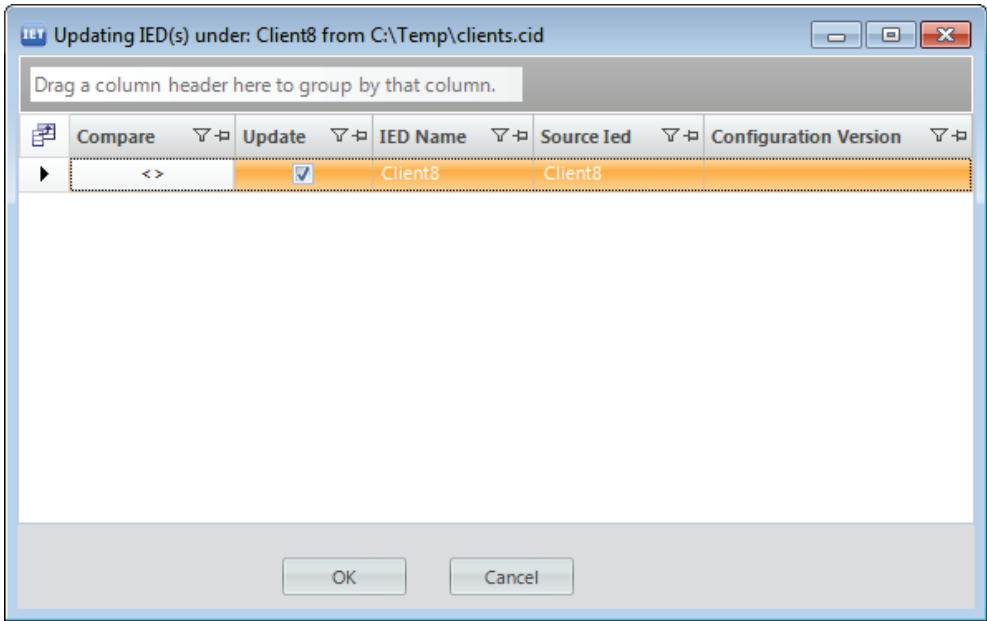
Figure 41:   *Updating the IED*

> ℹ The procedure used in configuring IEC 61850 clients can be used to create or update any IED, also several IEDs at the same time.

7.1.2 Attaching IEC 61850 clients to a bus

1. Click the **Communication** tab in the navigation pane.
2. Click the **Subnetworks** tab in the editor pane.
3. In the Subnetworks grid, select the bus from the Subnetwork list to attach the IEC 61850 client to the bus.
   An alternative way is to drag the client in the **Communication** tab to the correct subnetwork.
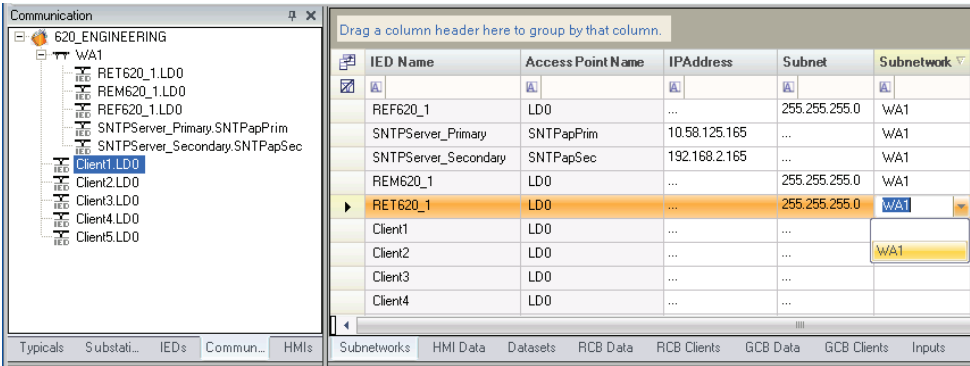
Figure 42: *Defining bus connection properties for IEC 61850 clients*

4. Repeat the steps to attach all five default clients in the project to the bus.

By default, the IEDs' bus connections are ready-made when the configuration work is started and need not to be set separately. After the client bus connections are created, the event clients appear in the **RCB Clients** tab.

7.2 IET600 user interface

IET600 user interface is divided into sections, that is, panes for navigating and displaying the project data.
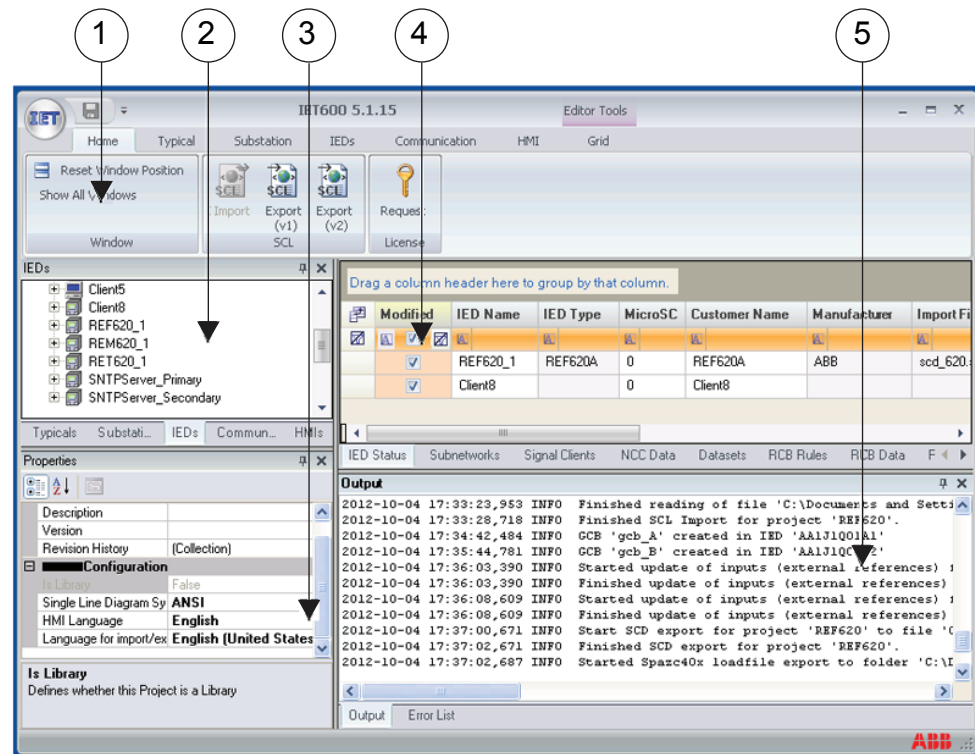
Figure 43:   *IET600 user interface*

1   Menu on the top of the user interface

2   Navigation pane for context-oriented navigation and filtering the various editors

3   Properties pane for detailed properties of the selected element in the navigation pane

4   Editors for detailed design and engineering of the substation, IEDs and IEC 61850 communication

5   Logging and messaging (output) pane

The navigation pane provides context-oriented navigation of the editors. It has three tabs, which correspond to three different context views.

- **Substation** – Full substation topology and primary equipment nodes
- **IEDs** – IED nodes and corresponding functionality
- **Communication** – Subnetworks and connected IED access points

The editor pane is the main working area of the IET600 user interface. It is organized to various tabs for detailed substation design and engineering. The visible tabs depend on the node type selected in the navigation pane.

Available editor tabs depend on the selected node type, not on the selected navigation tab. Choose any available context view to do the needed engineering tasks.

Choose upper or lower level in the structure to see the data of single, many or all IEDs at the same time in the editor pane.

7.2.1 Setting visibility of columns in grid editors

Most editors are implemented as tables. These grid editors provide features like setting column visibility, filtering, sorting, automatic data filling, copying and pasting, finding and replacing and exporting to Excel.

Most tables include columns which are hidden by default.
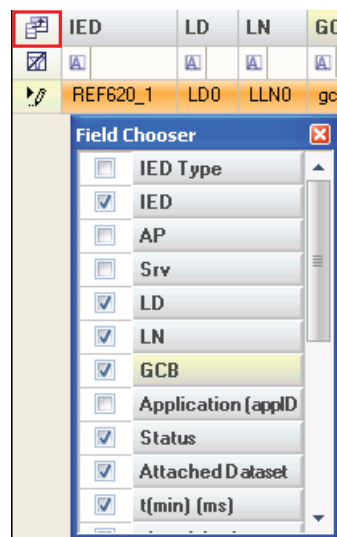
Figure 44: Setting column visibility in a grid editor

1. To set the visibility of the columns, click the upper-left icon of the table.
2. Select or clear the check boxes from the **Field Chooser** dialog box.

7.3 Substation section configuration

Substation topology consists of the substation, voltage level and bay nodes. Bay nodes include also the conducting (primary) equipment, which corresponds to the switches, that is, the circuit breakers, disconnectors, earth switch, of the configured protection relay. Substation topology is initially built by importing the SCD file from PCM600.

The SLD editor is a graphical editor for the configuration of the substation section in IET600. It provides tools to draw the primary equipment and the interconnection between the equipment in the bay.
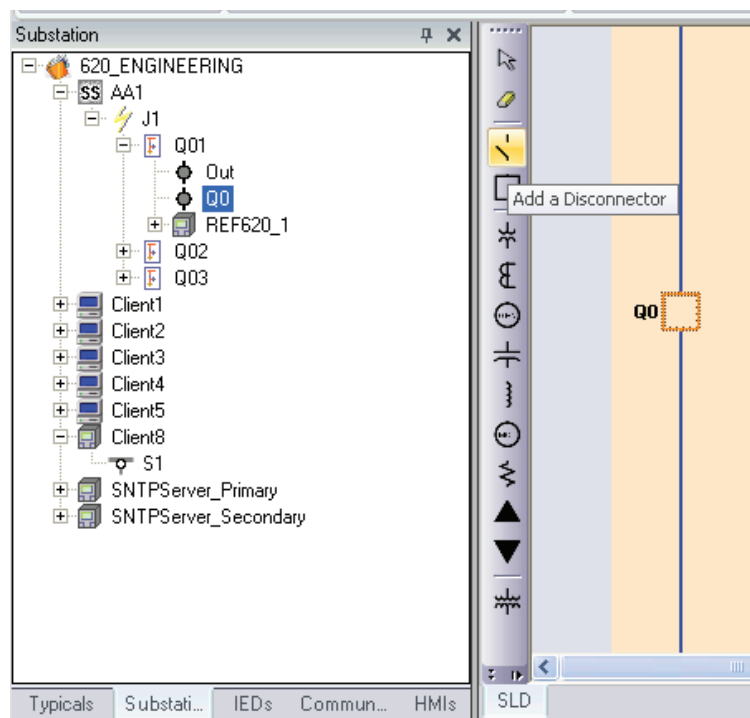
Figure 45:   *SLD Editor*

SLD in the protection relay is configured using the Graphical Display Editor of PCM600, not in IET600

In addition to the substation topology configuration, logical nodes of IEDs need to be mapped to proper objects, for example, to support the automatic bay configuration via SCL files in the SCADA system. Logical nodes are mapped with the LN Mapping Editor.
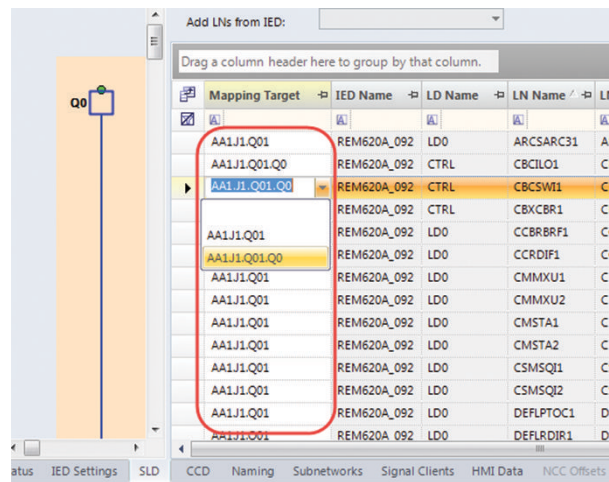
Figure 46:   LN Mapping Editor

7.4   Creating data sets

Data sets are created or modified using the Dataset editor, which consists of three parts.

- Grid for existing data sets (data set creating, deleting and renaming)
- Selection lists for adding new entries to a selected data set
- List of data set entries for selected data set (viewing, deleting)
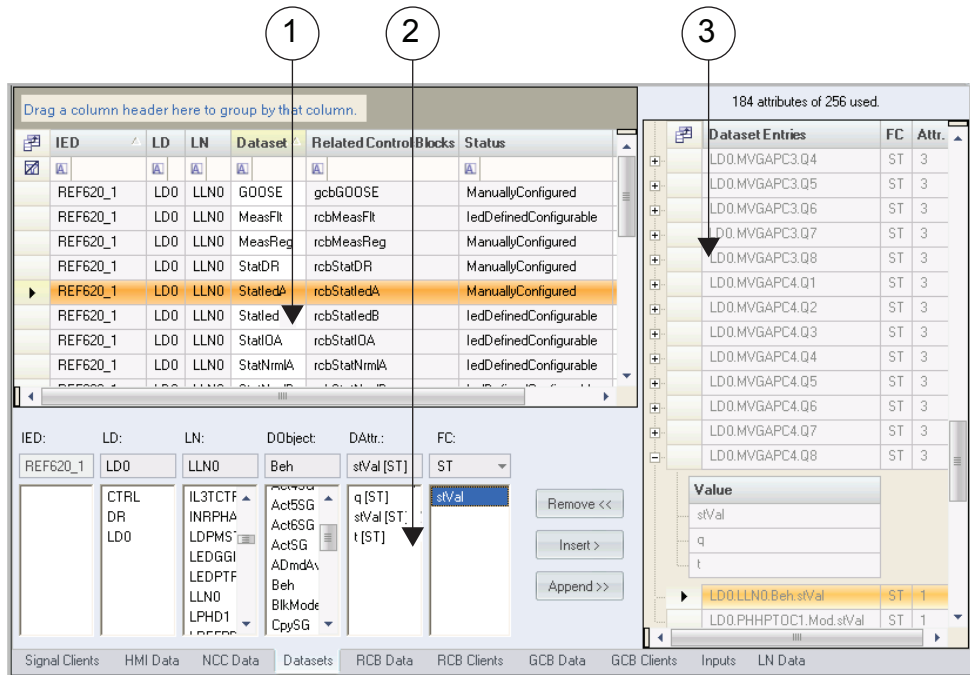
Figure 47:   *Data set editor*

1   Grid

2   Selection lists

3   List of data entries

1.   Select an IED node in the IEDs navigation pane.
2.   Click the **Datasets** tab in the editor pane.
3.   Right-click the area containing data set names and select **Insert new row**.
4.   Define the LN where the data set is to be placed (preselected **LD0/LLN0** is recommended) and the name for the new data set.
5.   Click **Append>>** to add data items to the end of the data set or click **Insert>** to add data items above the selected row in the data set entries list.

> Above the data set entries list is shown how many attributes it is possible to add to the data set and how many are already added.

ℹ️ Select a proper FC (functional constraint) value for the data attributes to be added to a data set. If none is selected, that is "(all)" is shown on the list, it is not possible to add attributes to the data set.

ℹ️ Data set entries for vertical reporting are selected using the data object level, and entries for GOOSE using the data attribute level.

7.5 Creating report control blocks

Configuration properties, such as the attached data set and the buffering and triggering options of the RCBs are are defined in the RCB editor. A predefined RCB configuration of a preconfigured IED is a proposed default configuration which can be adapted according to the requirements.

1. Click an IED node in the IEDs navigation pane.
2. Click the **RCB Data** tab in the editor pane.
3. Right-click the area containing RCB names and select **Insert new row**.
4. Define the LN where the RCB is to be placed (preselected **LD0/LLN0** is recommended) and the name for the new RCB.
   Use the field chooser to show or hide the properties. For example, the **SeqNum**, **Entry ID** and **Reason Code** options (set by default in the IED) are hidden by default.
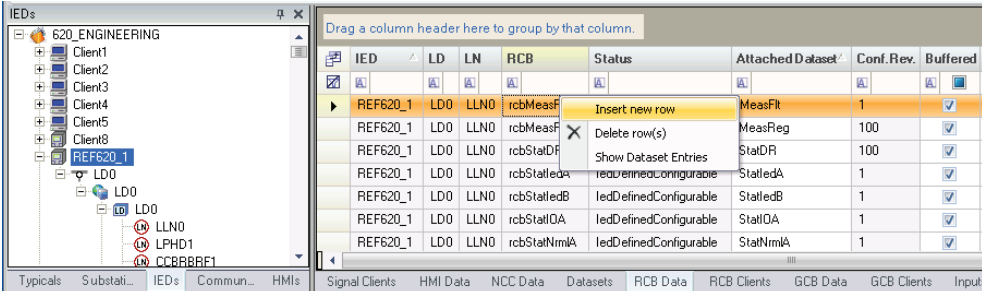
Figure 48:   *RCB editor*

ℹ️ *Conf.Rev* cannot be manually edited. IET600 updates it automatically to the next multiple of 100 when the configuration changes.

Deleting an RCB does not totally remove it from IET600. Instead, its status is set to "Deleted" and it is not exported to SCL files. Removing a data set automatically puts the related RCB to the "Deleted" state.

An RCB cannot be renamed. To rename an RCB, delete it and create a new RCB with a new name.

7.6 RCB client configuration

To succeed with an RCB client configuration, the potential clients and their communication configuration should be known. Therefore, the IEDs must be added and configured to the subnetwork before configuring the RCB client.

The rows of the RCB client editor show IEDs and RCBs and the columns show the available client IEDs.

If a client IED is not on the same subnetwork as a server IED or RCB, it cannot be configured as a client.

	IED Name	LD	LN	RCB	Attached Dataset	Client1 (LD0)	Client2 (LD0)	Client3 (LD0)	Client4 (LD0)	Client5 (LD0)
	A	A	A	A	A	A	A	A	A	A
	REF620	LD0	LLN0	rcbStatDR	StatDR	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatIedA	StatIedA	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatIedB	StatIedB	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatIOA	StatIOA	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatIOB	StatIOB	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatNrmIA	StatNrmIA	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatNrmIB	StatNrmIB	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatNrmIC	StatNrmIC	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatUrgA	StatUrgA	1	2	3	4	5
	REF620	LD0	LLN0	rcbStatUrgB	StatUrgB	1	2	3	4	5
	REM620									

IED Status   Subnetworks   Datasets   RCB Data   RCB Clients   GCB Data   GCB Clients   Inputs

Figure 49:   RCB client editor

Different keys can be used when editing the cells.

- PLUS SIGN (+), asterisk (*) or X to add an additional client to the existing ones
- Numbers to change the client sequence or add clients
- MINUS SIGN (-), SPACEBAR or DELETE to delete existing clients
- Double-clicking with the mouse to add or delete clients

RCB client editor supports both manual and semi-automatic client configuration.

7.6.1   Configuring RCB clients semi-automatically

On the right in the RCB client editor there are option buttons to choose whether to show IEDs (for defining default clients) or RCBs or both together.

There are also buttons to allow semi-automatic configuration of default clients and RCB clients.
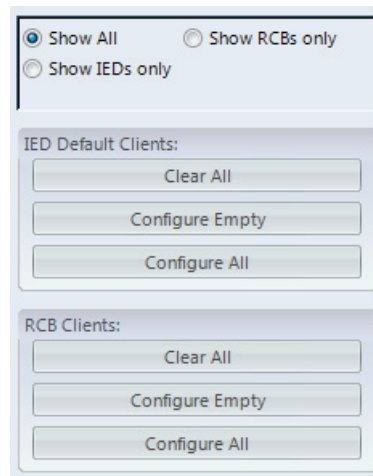
Figure 50:   Semi-automatic configuring of RCB clients

1. Configure the default clients which are used by the rule-based RCB generation to automatically configure RCB clients.
    Use buttons on the RCB client editor.

    •   **Clear All** removes all default clients
    •   **Configure Empty** fills out only default clients for those IEDs that have no clients configured yet
    •   **Configure All** deletes all existing default clients and fills them out afterwards

2. Configure the RCBs clients.
    The default clients must be configured before configuring RCB clients otherwise the automatic RCB client configuration does not work. Use buttons on the RCB client editor.

    •   **Clear All** removes all RCB clients
    •   **Configure Empty** copies the default client configuration of this IED to its RCBs (only for those RCBs that have no clients configured yet)
    •   **Configure All** deletes the existing RCB clients and copies the default client configuration of this IED to its RCBs

> IET600 updates the *Enabled Clients* configuration value of the RCBs automatically based on the configuration made in the RCB client editor. In addition, IET600 always reserves one extra engineering client. For example, when configuring three RCB clients, the *Enabled Clients* value of that RCB is "4".

Section 8   Glossary

620 series	Series of numerical protection and control relays for high-end protection and supervision applications of utility substations, and industrial switchgear and equipment
ACSI	Abstract communication service interface
ANSI	American National Standards Institute
APPID	Application identifier
CID	Configured IED description
COM600S	Substation Management Unit. An all-in-one communication gateway, automation platform and user interface solution for utility and industrial distribution substations.
COMTRADE	Common format for transient data exchange for power systems. Defined by the IEEE Standard.
Connectivity package	A collection of software and information related to a specific protection and control IED, providing system products and tools to connect and interact with the IED
CT	Current transformer
CTRL	Control logical device
Data attribute	Defines the name, format, range of possible values and representation of values while being communicated
Data set	The content basis for reporting and logging containing references to the data and data attribute values
DR	Disturbance recorder
EMC	Electromagnetic compatibility
Ethernet	A standard for connecting a family of frame-based computer networking technologies into a LAN
FC	Functional constraint
GCB	1. GOOSE control block 2. Generator circuit breaker
GoCB	GOOSE control block
GoID	GOOSE control block-specific identifier

GOOSE	Generic Object-Oriented Substation Event	
HMI	Human-machine interface	
ICD	IED capability description	
IEC 61850	International standard for substation communication and modeling	
IEC 61850-8-1	A communication protocol based on the IEC 61850 standard series	
IED	Intelligent electronic device	
IET600	Integrated Engineering Toolbox	
IID	Instantiated IED description	
LD0	Logical device zero (0)	
LED	Light-emitting diode	
LHMI	Local human-machine interface	
LLN0	Logical node zero (0)	
LN	Logical node	
MAC	Media access control	
MicroSCADA	Substation automation system	
MMS	1. Manufacturing message specification	
	2. Metering management system	
Modbus	A serial communication protocol developed by the Modicon company in 1979. Originally used for communication in PLCs and RTU devices.	
Multicast address	An identifier for a group of hosts that have joined a multicast group	
PCM600	Protection and Control IED Manager	
RCB	Report control block	
SCADA	Supervision, control and data acquisition	
SCD	Substation configuration description	
SCL	XML-based substation description configuration language defined by IEC 61850	
SMV	Sampled measured values	
TAL	Time allowed to live	
TCP/IP	Transmission Control Protocol/Internet Protocol	

UL	Underwriters Laboratories
VLAN	Virtual LAN
VT	Voltage transformer
WHMI	Web human-machine interface
XML	Extensible markup language

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