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SOFTWARE MANUAL

# **CODESYS IEC 61850 Server**

## Programming System

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# 1 IEC 61850 Server

## 1.1 IEC 61850 Server


The package CODESYS IEC 61850 Server is a configurator for creating an IEC 61850 Server according to IEC 61850. The IEC 61850 is the communication standard for switchgear automation of medium and high voltage technology.

The essential features of this package are::

- Configuration of data models for IEDs (Intelligent Electronic Device) with logical devices, logical nodes, data objects and data attributes
- Generation of the corresponding IEC 61131-3 code
- Mapping of data attributes to IEC 61131-3 variables
- Configuration of dynamic datasets
- Buffered and unbuffered Reports
- Protocols implemented: MMS and GOOSE
- Import /Export of different SCL formats

### Inserting the IEC 61850 Server into the device tree

The IEC 61850 Server is inserted below an Ethernet Adapter in the device tree. For this select the Ethernet Adapter in the device tree and activate the context menu command *"Add device..."*. In the opened dialog select the IEC 61850 Server in the *"Miscellaneous "* category and activate the *"Add device "* button .

The configuration of the IEC 61850 Server takes place in the  *Chapter 1.3.1 "IEC 61850 Editor" on page 11.*

## 1.2 Quickstart

Here, a project with an IEC 61850 Server is created as an example. After the configuration of the Server, a dataset is created and assigned to a Report. Subsequently the code is generated for the IEC 61850 Server and the project is loaded to the PLC. On the PLC the project can be connected with an IEC 61850 client.

### Step 1: Create a new project and insert the IEC 61850 Server

First create a new project. Select the *"Standard project "* template.

Subsequently the dialog opens for selecting the PLC and the implementation language. Select the CODESYS Control Win V3 PLC and the *"Structured Text (ST)"* implementation language.

Now the project is created displayed with its objects in the device tree.

In order to add the IEC 61850 Server to the PLC, first add an Ethernet Adapter:

1. Mark the PLC in the device tree and activate the context menu command *"Add Device..."*
2. In the *"Add Device"* dialog select the adapter *"Ethernet "* of the *"Fieldbusses → Ethernet Adapter"* category and confirm your selection by activating the *"Add Device "* button.

Subsequently, add the IEC 61850 Server to the Ethernet Adapter as follows:

1. Select the Ethernet Adapter in the device tree and activate the context menu command *"Add Device..."*.
2. In the *"Add Device"* dialog select the *"IEC 61850 Server"* of the *"Miscellaneous "* category and confirm your selection with the *"Add Device "* button.

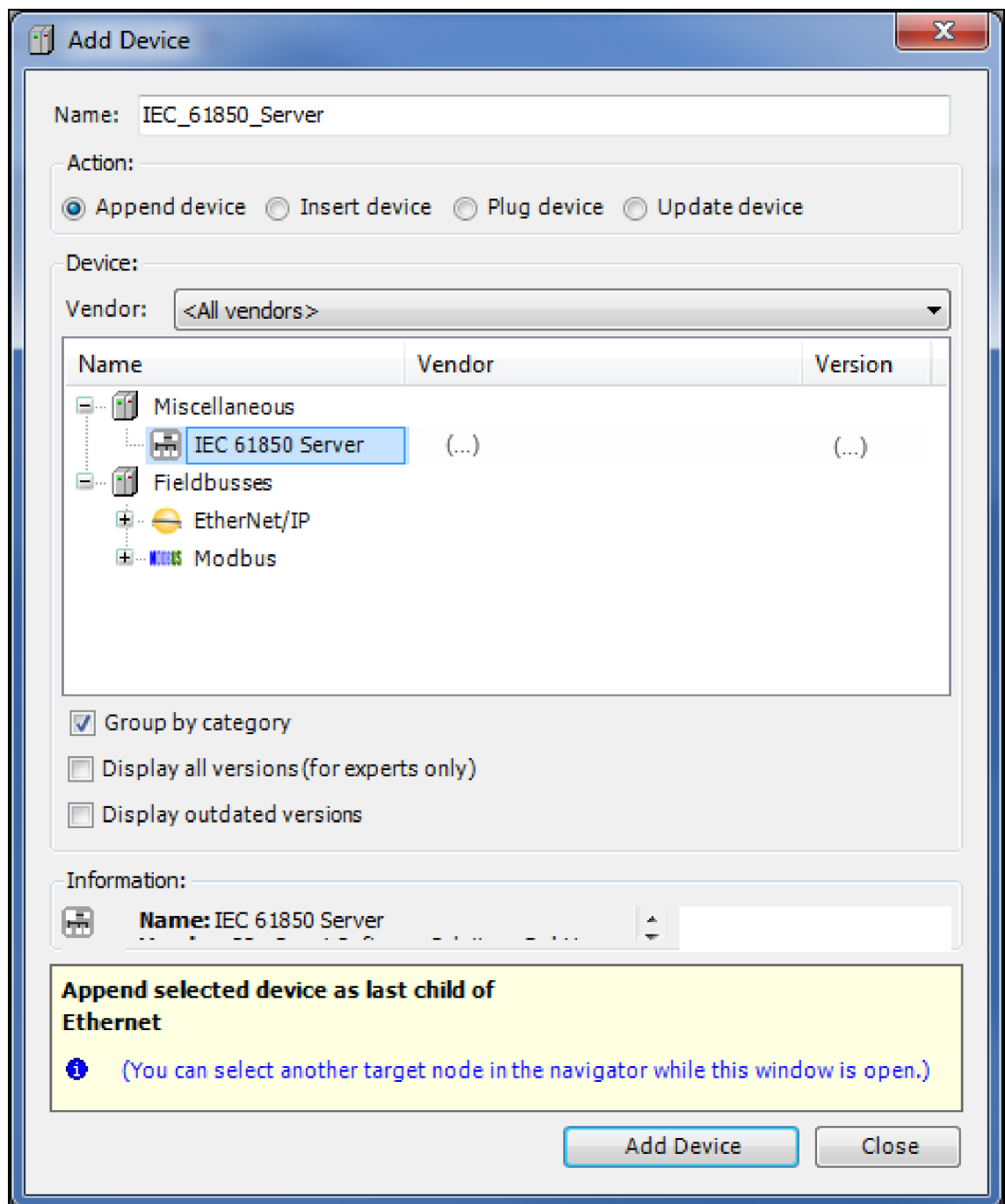


Fig. 1: 'Add Device' dialog

Now the IEC 61850 Server is inserted in the device tree.

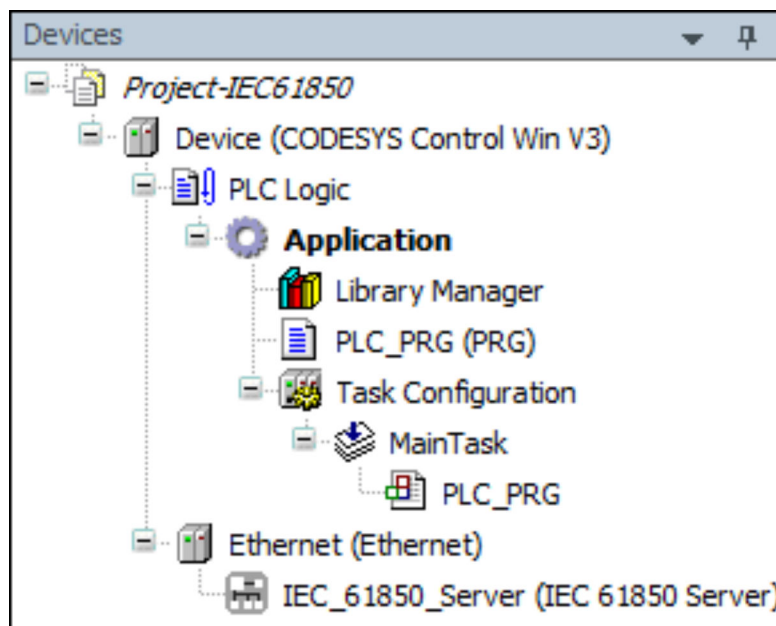


Fig. 2: Device tree with IEC 61850 Server

## Step 2: Add the Logical Device to the server

Open the editor for the configuration of the server via a double-click on the IEC 61850 Server in the device tree.

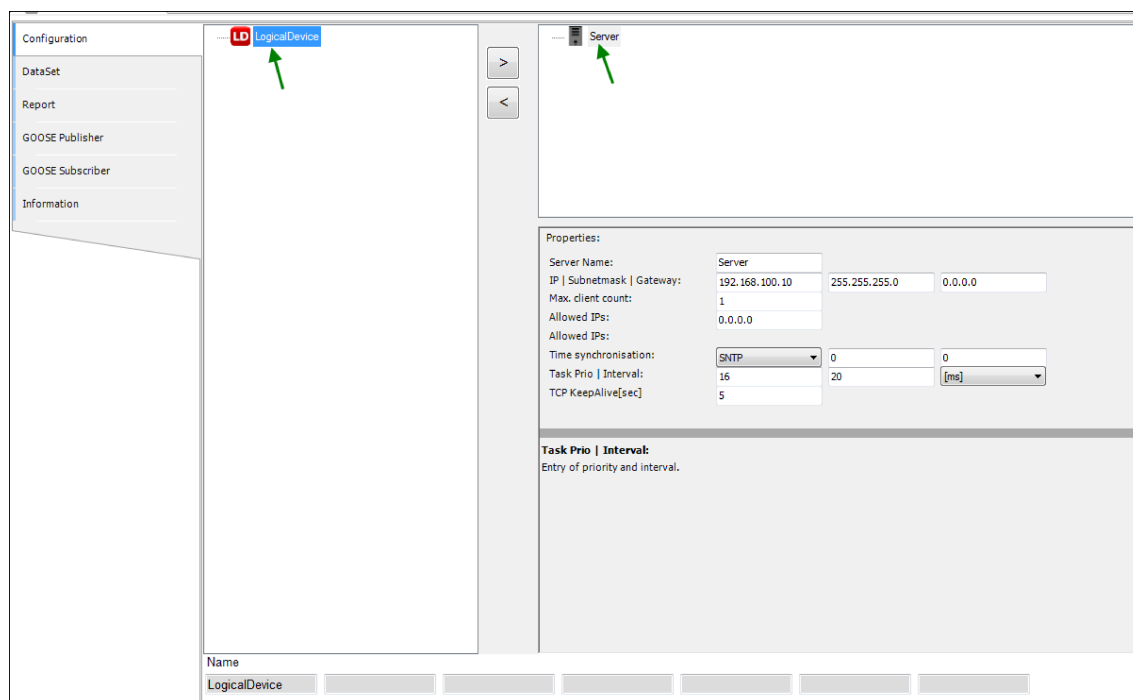


Fig. 3: editor of the IEC 61850 Server

First a "Logical Device" is added to the server. The **LD** "Logical Device" is the instance of an IED.

1. Select the "Logical Device"
2. Activate the ">" button

Together with the "Logical Device" the two LNC instances (**LN**) "LLN0" and "LPHD1" are added. These two information objects are elements of every IED and can not be removed.



Fig. 4: Server with Logical Device, LLN0 and LPHD1

### Step 3: Add another LNC instance to the Logical Device

1. Select the “Logical Device” below the server
2. On the left-hand side select the “XCBR” LNC instance below “LN [Xxxx]-Switchgear”
3. Activate the “>” button

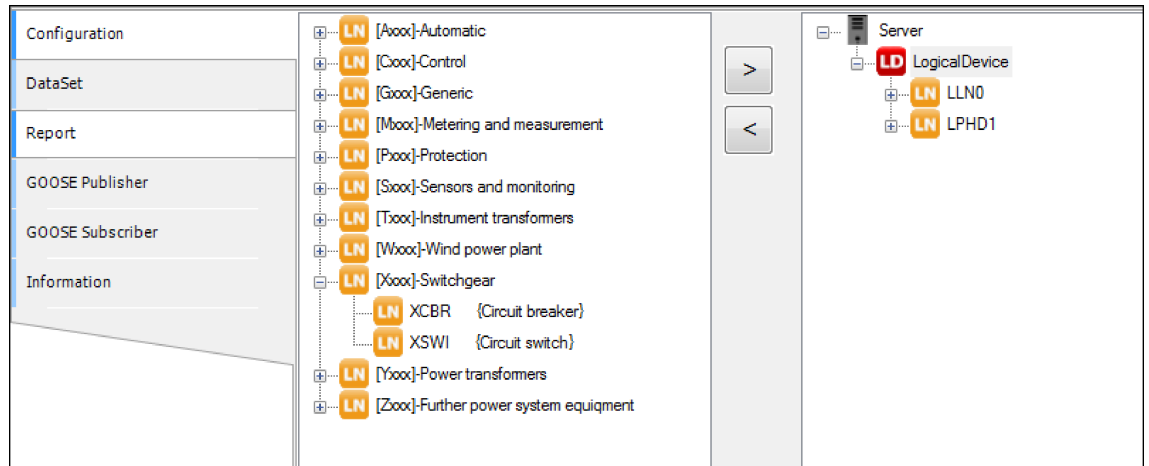


Fig. 5: Adding the LNC instance 'XCBR'

### Step 4: Expand the “XCBR” LNC instance with the optional “MaxOpCap” CDC instance

If you select the LNC instance on the right-hand side, all of the optional and obligatory CDCs (data objects **DO**) will be displayed on the left-hand side. .

1. Select the “XCBR” LNC instance on the right-hand side
2. Select the “MaxOpCap” CDC instance on the left-hand side
3. Activate the “>” button

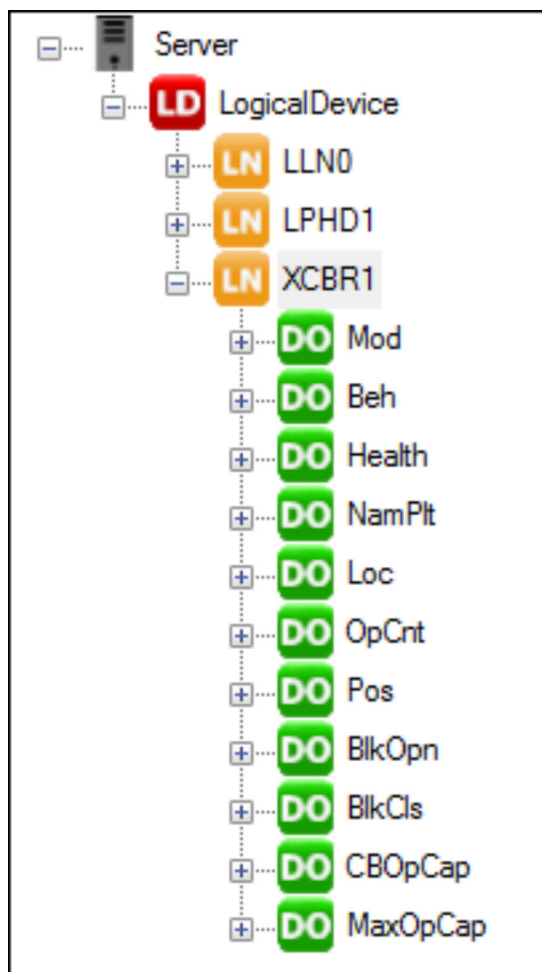


Fig. 6: XCBR1 with 'MaxOpCap' CDC

**Step 5: Link an attribute (DA) of the IEC 61850 Server with a CODESYS variable**

1. Select the desired attribute (in the example: "Server → LogicalDevice → XCBR1 → MaxOpCap → DA (ST I INT32) StVal")
2. Edit the CODESYS variable name in the input field "Monitoring Var" (in the example Var\_stVal) in the "Properties" section

The "Autom. declare" option must be activated, thus the variable is declared automatically as global variable by the IEC 61850 Server. You can edit the initial value in the input field next to the "Monitoring Var" field.

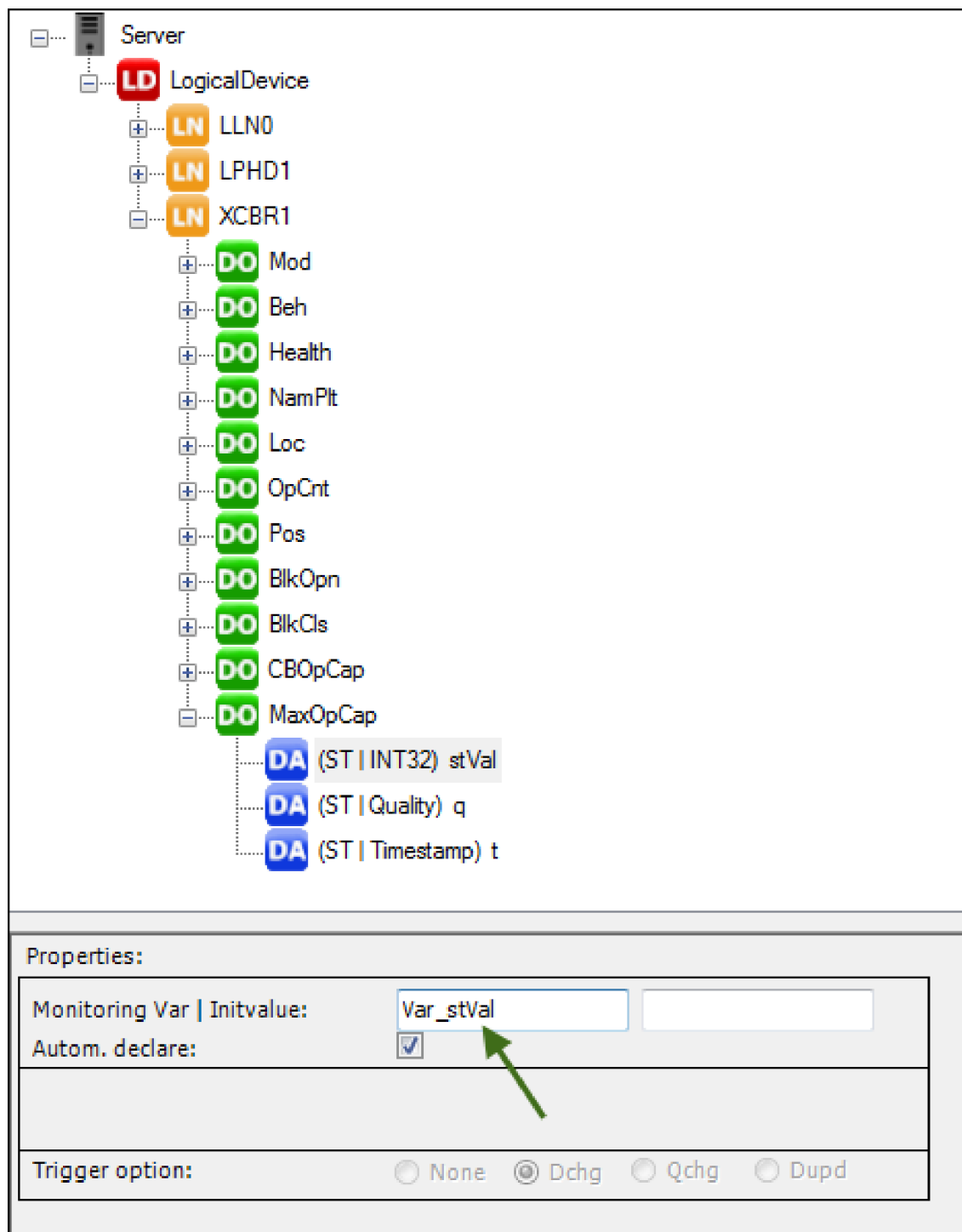


Fig. 7: Link of the attribute 'stVal' to the monitoring variable 'Var\_stVal'

## Step 6: Create a dataset

In this step you create a dataset (Compilation of data) for the IEC 61850 configuration created in the previous steps.

1. Open the "DataSet" tab
2. Activate the "New" button. The created "LLN0.dataSet\_0" dataset is displayed in the "DataSets" section.
3. Select the "LLN0.dataSet\_0" DataSet
4. Select the "MaxOpCap" data object on the left-hand side ("Server → LogicalDevice → LN XCBR1 → FC ST → DO MaxOpCap")
5. Activate the ">" button.



Now the DataSet contains the data object “*LogicalDevice/XCBR1.ST.MaxOpCap*”

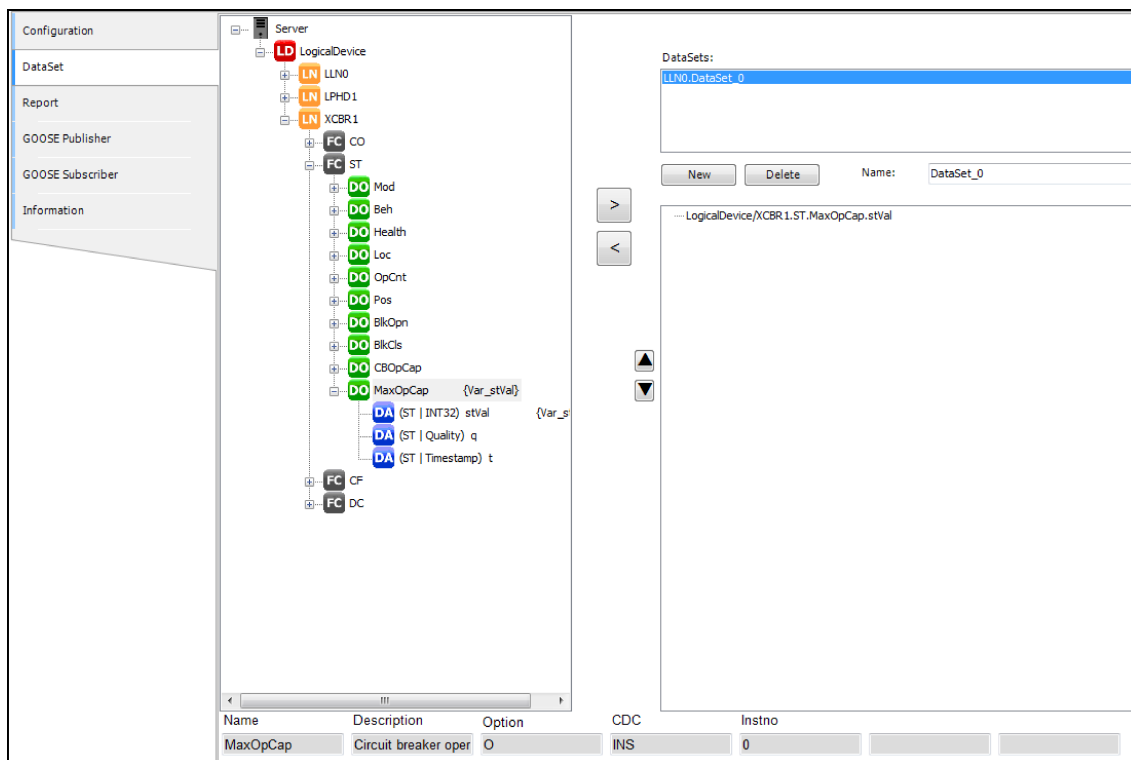


Fig. 8: 'DataSet' tab

### Step 7: Create a Report

In this step you assign a report to the defined DataSet. A report transports the data assigned via a dataset to a connected client in the event of a trigger (see [Trigger Options](#)).

1. Open the “*Report*” tab
2. Activate the “*New*” button. The “*RCB\_1*” is displayed in the “*Reports*” section. In the “*Name*.” field you can change the name of the report.
3. Select the “*LLN0.DataSet\_0*” dataset in the “*DataSet*” selection list

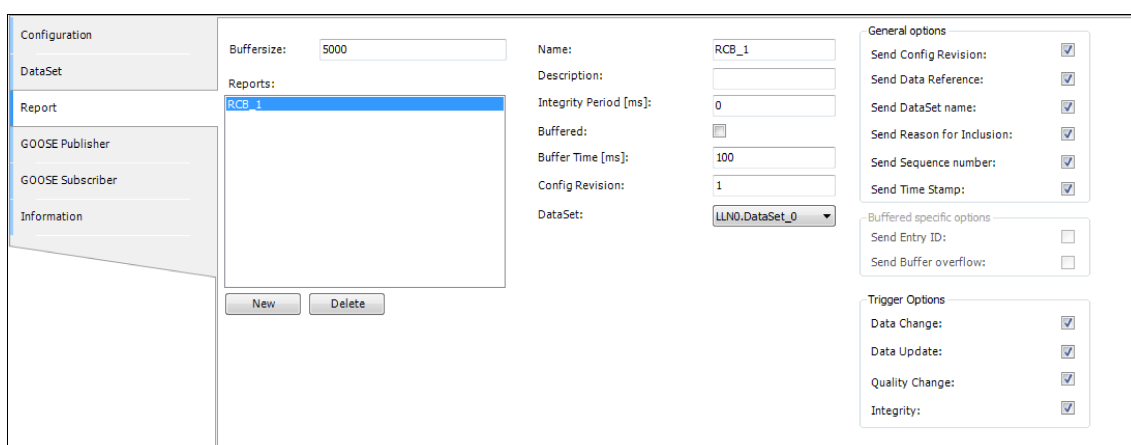


Fig. 9: 'Report' tab with created 'RCB' report

You set options about the reporting behavior in the “*General options*” section, you select the events that trigger a report in the “*Trigger Options*” section (for more information about these options see [Trigger Options](#)).

### Step 8: Generate code and load the application to the PLC

The “Generate code” command of the menu “IEC61850” generates code from the created configuration and puts it into the “IEC61850 Generated POU’s” folder of the device tree.

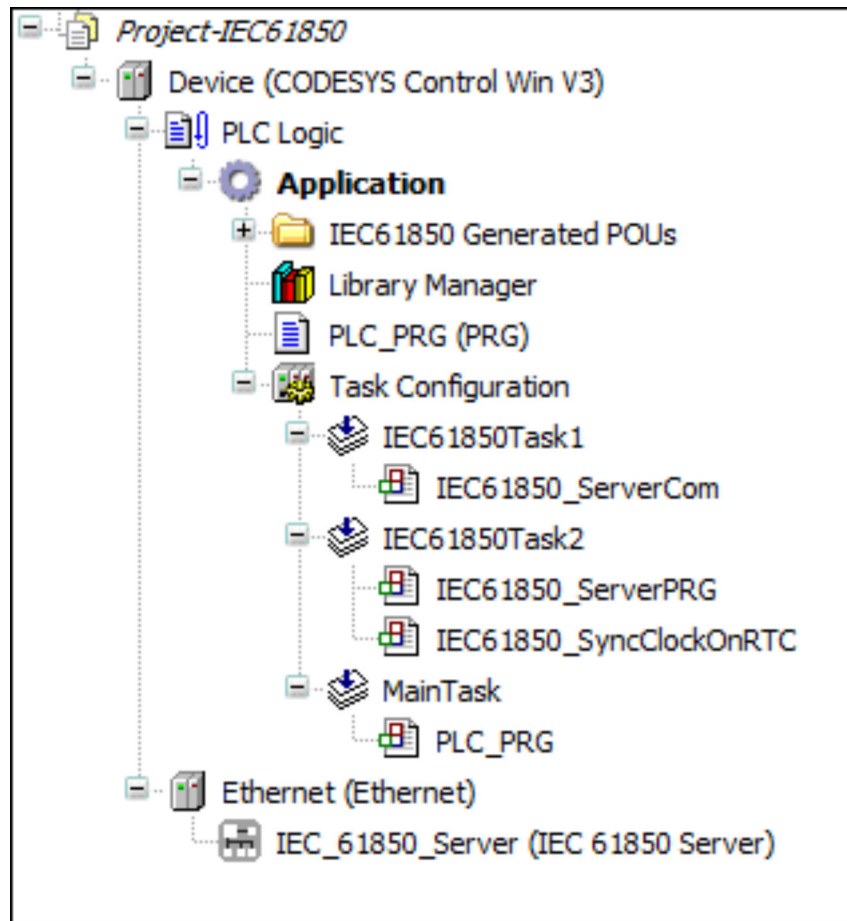


Fig. 10: device tree with 'IEC61850 Generated POU's'

The global variable “Var\_stVal” created in step 5 is listed in the “IEC61850\_Generated\_GVL” global variables list.

```

1  (* Generated on: 13.08.2013 14:53:32 *)
2  (* IEC61850 Configurator version: V2.0.0 - 2012-08-15 *)
3
4  VAR_GLOBAL
5      gfbIEC61850_LogicalDevice: IEC61850_LogicalDeviceFB;
6      Var_stVal                  : tyIEC61850_AT_INT32;
7  END_VAR
8

```

Fig. 11: IEC61850\_Generated\_GVL with 'Var\_stVal'

Subsequent compile the application via the “Build → Build” command.

### Step 9: Connecting with an IEC 61850 Client

If the application was finished successfully you create a connection to an IEC 61850 client in this step. For this, login to the PLC and start the application via the “Start” command of the “Debug” menu. Now you connect an IEC 61850 client with the IEC 61850 Server. By the client you can read out your IEC 61850 Server configuration and the configured DataSets und Reports, as well as you can receive GOOSE messages and send GOOSE messages to the server.

## 1.3 Editor of the IEC 61850 Server

### 1.3.1 IEC 61850 Editor

You open the editor of the IEC 61850 Server with the “*Edit Object*” command of the “*File*” category or with a double-click on the device in the device tree.



*If you move the mouse pointer over buttons, options or names of input fields in this editor more information about the element is displayed by the tooltip.*

The tabs of the editor::

- Chapter 1.3.2.1 “*Configuration*” on page 11
- Chapter 1.3.3 “*DataSet*” on page 21
- Chapter 1.3.4 “*Report*” on page 22
- Chapter 1.3.5 “*GOOSE Publisher*” on page 24
- Chapter 1.3.6 “*GOOSE Subscriber*” on page 26
- Chapter 1.3.7 “*Information*” on page 28

### 1.3.2 Configuration

#### 1.3.2.1 Configuration

In the “*Configuration*” tab of the IEC 61850 editor you create, configure and parametrize the IED from the pool of the existing LNC and CDC types.

The screenshot shows the 'Configuration' tab of the IEC 61850 editor. The interface is split into four main sections, numbered 1 through 4:

- Section 1:** The left sidebar contains a list of tabs: Configuration, DataSet, Report, GOOSE Publisher, GOOSE Subscriber, and Information. The 'Configuration' tab is currently selected.
- Section 2:** The top right area shows a 'LogicalDevice' selection area with a 'Server' button and navigation arrows.
- Section 3:** The 'Properties' section contains various configuration fields:
  - Server Name: Server
  - IP | Subnetmask | Gateway: 192.168.100.10 | 255.255.255.0 | 0.0.0.0
  - Max. client count: 1
  - Allowed IPs: 0.0.0.0
  - Time synchronisation: SNTP (dropdown), 0 (field), 0 (field)
  - Task Prio | Interval: 16 | 20 (field)
  - TCP KeepAlive[sec]: 5
- Section 4:** The bottom section contains a 'Name' field with the value 'Server' and several empty input fields.

Fig. 12: 'Configuration' tab

“*Configuration*” is split in 4 sections:

- Section **1** and section **2** are for creating the IEC 61850 Server. In section **1** all of the choices are displayed, which can be added to the instance currently focused or to the object of the sever currently focused in section **2**. In the default setting there is the Logical Device (**LD**) in section **1** and the server (**S**) in section **2**. For more information see [Chapter 1.3.2.2 “Creation of the IEC 61850 Server” on page 12](#)
- In the “*Properties*” section **3** the following activities can be performed, depending on the selected objects:
  - [“Parametrization of the IEC 61850 Server” on page 15](#)
  - [“Entry of a device name for the Logical Device” on page 16](#)
  - [“Connecting an attribute \(DA\) with a CODESYS variable” on page 16](#)
  - [“Entry of a node prefix for LNC instances” on page 19](#)
- **4** is the status bar. For a more information see [Chapter 1.3.2.4 “Status bar” on page 19](#).

### 1.3.2.2 Creation of the IEC 61850 Server

#### Adding instances

You add an element to the server or to the marked instance below the server by selecting the element in section **1** and activating the “>” button or by a double-click on the element

#### Removing instances

To delete instances below the server, mark the instance and activate the “<” button..

#### Configure the server

If you create a new configuration, the default settings in the [Chapter 1.3.2.1 “Configuration” on page 11](#) tab are: the Logical Device in section **1** and the server in , section **2** .

First the “*Logical Device*” (**LD**) is added to the server. The Logical Device is an instance of an IED (intelligent field device ). Together with the Logical Device the objects having the option 'mandatory' are added automatically. These objects added automatically can not be removed from the Logical Device.



Fig. 13: Server with Logical Device and objects 'LLN0' und 'LPHD'

Any number of logical nodes (**LN**) can be added to the Logical Device.

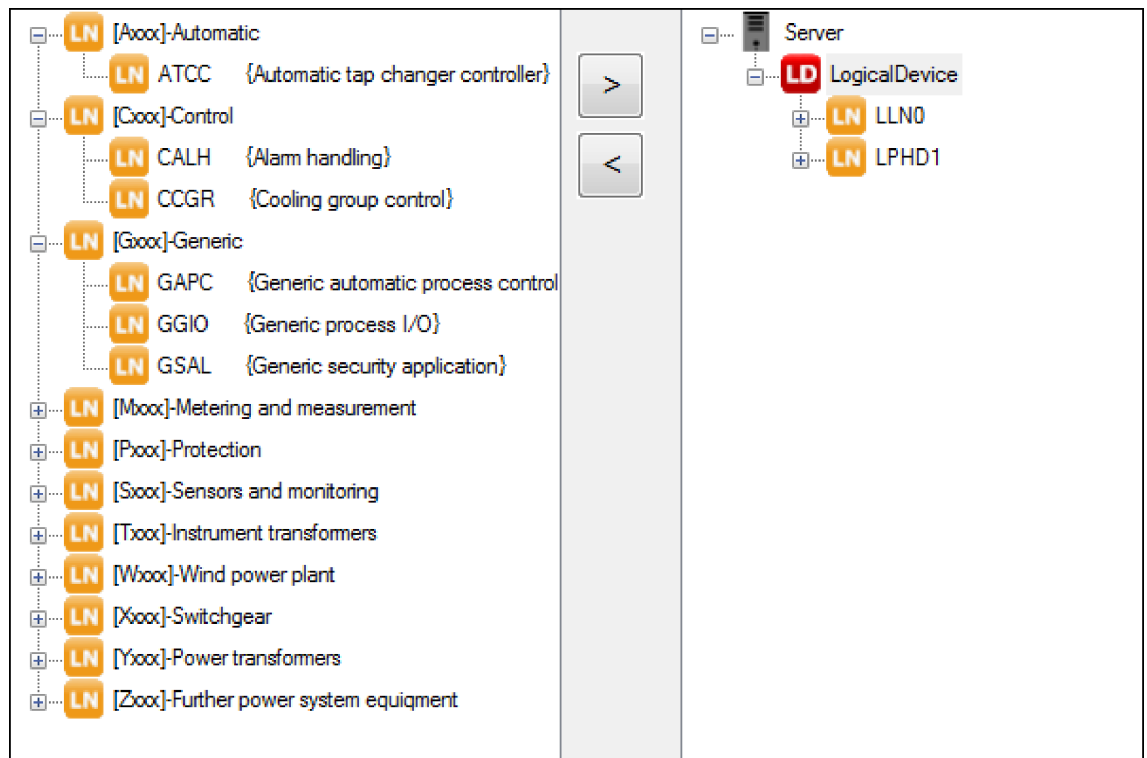


Fig. 14: 'Configuration': List of the available LACS

If you mark a LNC instance in section 2 all mandatory and all optional CDC types (data object **DO**) will be listed in section 1. The mandatory CDC types (Mod, Beh, Health, NamPlt, in the example) are already contained in the LNC instance (LN GGIO1) and can not be removed.

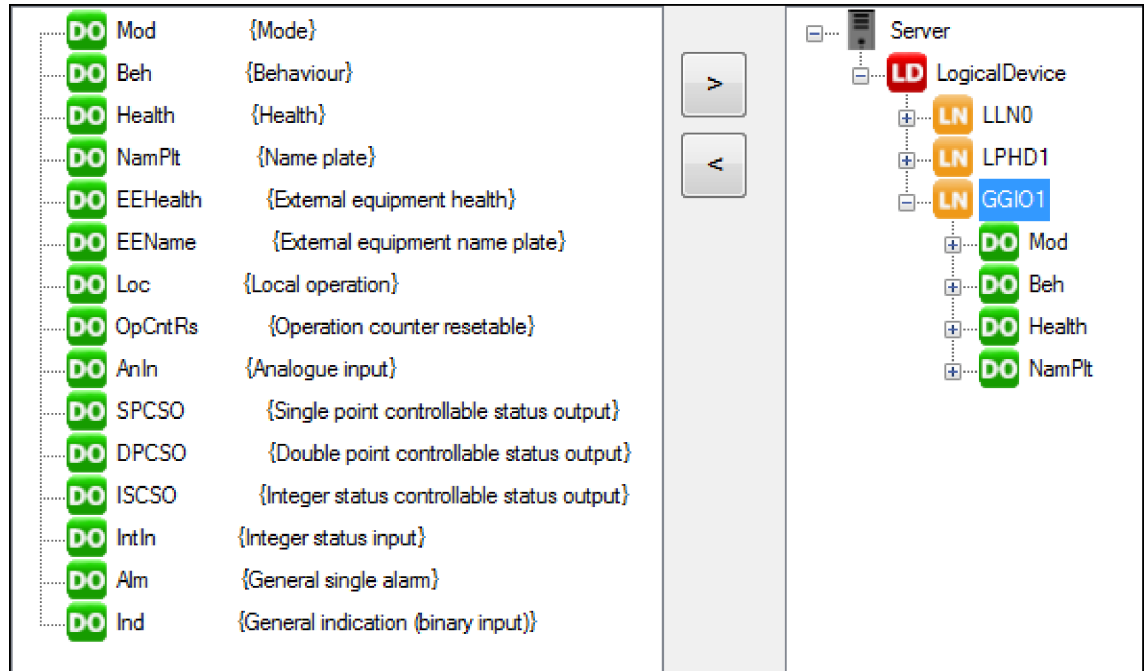


Fig. 15: 'Configuration' list of the CDCs (DO) available for the GGIO1

The DOs include the attributes (DAs)

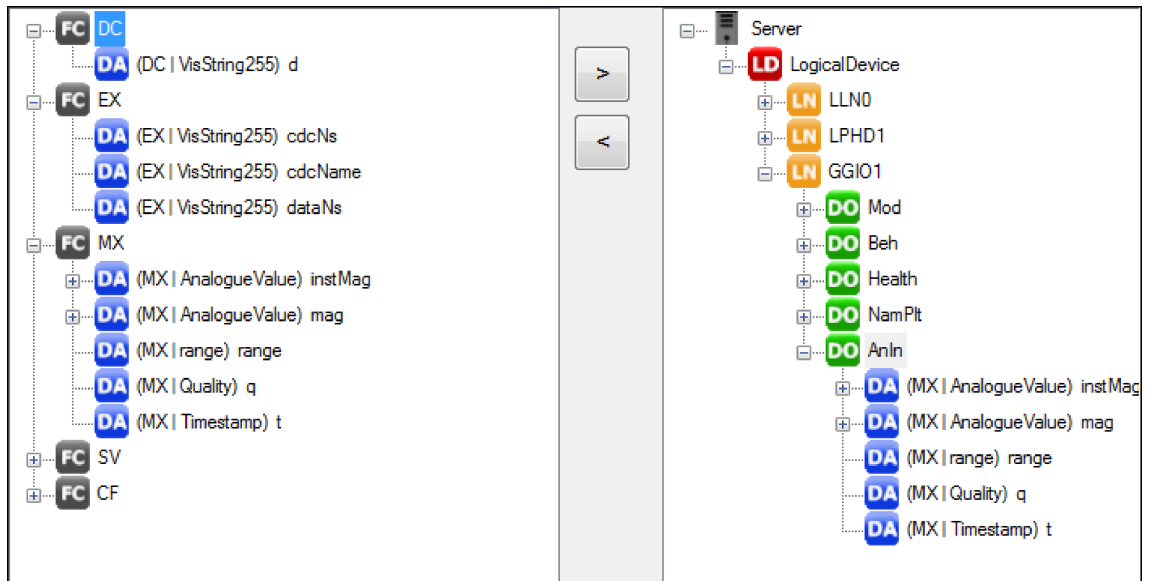


Fig. 16: 'Configuration': list of attributes (DA) of the added to the CDC 'DO AnIn'

The attributes of the server can be connected with CODESYS variables (see [“Connecting an attribute \(DA\) with a CODESYS variable” on page 16](#)).

### 1.3.2.3 Properties

**3**: In the “Properties” section of the [Chapter 1.3.2.1 “Configuration” on page 11](#) tab the following functions can be performed dependent on the marked object or the marked instance:

- [“Parametrization of the IEC 61850 Server” on page 15](#)
- [“Entry of a device name for the Logical Device” on page 16](#)
- [“Connecting an attribute \(DA\) with a CODESYS variable” on page 16](#)
- [“Entry of a node prefix for LNC instances” on page 19](#)



*If you move the mouse pointer over an input field or the name of an input field, you get a tooltip with a description in the window below the “Properties” (see the following figure).*

## Parametrization of the IEC 61850 Server

**Properties:**

Server Name:	<input type="text" value="Server"/>		
IP   Subnetmask   Gateway:	<input type="text" value="192.168.100.10"/>	<input type="text" value="255.255.255.0"/>	<input type="text" value="0.0.0.0"/>
Max. client count:	<input type="text" value="1"/>		
Allowed IPs:	<input type="text" value="0.0.0.0"/>		
Allowed IPs:			
Time synchronisation:	<input type="text" value="SNTP"/>	<input type="text" value="0"/>	<input type="text" value="0"/>
Task Prio   Interval:	<input type="text" value="16"/>	<input type="text" value="20"/>	<input type="text" value="[ms]"/>
TCP KeepAlive[sec]	<input type="text" value="5"/>		

**Server Name:**  
Name of Server

Fig. 17: 'Properties' with tooltip of 'Max. client count'

Property	Description
Server Name	Name of the server,
IP   Subnetmask   Gateway	Own IED IP address,   Subnetmask   own gateway address
Max.client count	The maximum number of clients that can connect to the IED, possible values: 1, 2, 3, 4, 5
Allowed IPs	Allowed IPs for clients 1...5  default is 0.0.0.0, whereby an IP address that equals 0.0.0.0 means that no IP address validity test will take place. If more than one client connection was selected above, additional IPs must be configured for each one. As soon as an IP address is parameterized with 0.0.0.0, testing for all connected clients is deactivated.

Property	Description
Time synchronisation	<p>Selection: SNTP</p> <p>SNTP (default): SNTP time synchronization. In addition to activation, functionality must be parameterized in the device's web-based management. Currently, the SNTP time telegram does not use milliseconds, which means accuracy is measured in 1 second increments.</p> <p>1. Input field <b>Time zone</b>: Offset between Greenwich (GMT)- and the local time (for Germany 1 h, for example). The value is limited between -12 and + 14</p> <p>2. Input field: <b>DLS Mode</b>: Ratio for the mode summer/winter time change-over. Possible values:</p> <ul style="list-style-type: none"> <li>0 = No automatic summertime/wintertime changeover</li> <li>1 = Timeover from wintertime to summertime on last the Sunday in March, changeover from summertime to wintertime on the last Sunday in October</li> </ul>
Task Prio I Interval	<p>Task</p> <p>1.input field: entry of the priority,</p> <p>2.input field: entry of the interval in ms</p>
TCP KeepAlive[sec]	The KeepAlive is to check the connection to the client.

#### Entry of a device name for the Logical Device

If the Logical Device **LD** is focused in the configured server you can entry a device name for the Logical Device in the 'Properties' section.

#### Connecting an attribute (DA) with a CODESYS variable

1. Select the attribute of a CDC instance below the server.
2. Enter the desired CODESYS variable name into the input field *"Monitoring Var"* in the properties section.

Entry optionally an initial value into the input field right-side hand of the variable name.

In case of an attribute with RW-access, a *"Control Variable"* (writing access) can be entered in addition to the *"Monitoring Var"* variable (reading access) . For a more detailed description about reading and writing of variables at the IEC 61850 Server see [Chapter 1.4 "Reading and Writing from CODESYS Variables"](#) on page 28. The monitoring and control variables declared in the *"Properties"* section are displayed next to the respective attribute and at the superordinated node *"DO"* of the server tree.

By activating the *"Autom. declare"* checkbox the variable is declared by the IEC 61850 configurator and stored in the *"IEC61850\_Generated\_GVL"* (of the *"IEC61850 Generated POU's"* folder) after [Chapter 1.5.1.1 "Generate code"](#) on page 29 of the IEC 61850 Server.



*If you do not activate the "Autom. declare" checkbox you select the variable via the input assistance ([F2])) or you declare the variable yourself.*

**"Trigger option:"** With the trigger options you set the attributes to select the events which might trigger a report. The selected trigger option is displayed in the status bar. For a description of the options see [status bar](#).





*The trigger option determines whether the ↗ Chapter 1.3.4 “Report” on page 22, assigned to the ↗ Chapter 1.3.3 “DataSet” on page 21, is sent when the value of this attribute changes.*

The screenshot displays the configuration tree of an IEC 61850 server. The tree structure is as follows:

- Server
  - LogicalDevice (LD)
    - LN0
      - LPHD1
        - PhyNam (DO)
        - PhyHealth (DO)
        - Proxy (DO)
      - GGIO1 (LN)
        - Mod (DO) {Var\_ctlNum}
          - (ST | Originator) origin (DA)
          - (ST | INT8U) ctlNum {Var\_ctlNum} (DA) - **Selected**
          - (ST | INT8) stVal (DA)
          - (ST | Quality) q (DA)
          - (ST | Timestamp) t (DA)
          - (ST | BOOLEAN) stSeld (DA)
          - (CF | CtlModels) ctlModel (DA)
          - (CF | INT32U) sboTimeout (DA)
          - (CF | SboClasses) sboClass (DA)
          - (CF | INT8) minVal (DA)
          - (CF | INT8) maxVal (DA)
          - (CF | INT32U) stepSize (DA)
        - Beh (DO)
        - Health (DO)
        - NamPlt (DO)

The 'Properties' dialog for the selected attribute (DA) 'ctlNum' is shown below the tree:

**Properties:**

Monitoring Var   Initvalue:	Var_ctlNum	
Autom. declare:	<input checked="" type="checkbox"/>	
Trigger option: <input checked="" type="radio"/> None <input type="radio"/> Dchg <input type="radio"/> Qchg <input type="radio"/> Dupd		

Fig. 18: 'Properties' for the attribute(DA) 'ctlNum', input fields: 'Monitoring Var' with 'Initvalue'

Properties:	
Monitoring Var   Initvalue:	<input type="text"/> <input type="text"/>
Autom. declare:	<input checked="" type="checkbox"/>
Control Variable:	<input type="text"/>
Autom. declare:	<input checked="" type="checkbox"/>
Trigger option:	<input checked="" type="radio"/> None <input type="radio"/> Dchg <input type="radio"/> Qchg <input type="radio"/> Dupd

Fig. 19: 'Properties' of an attribute with RW-access: in addition input : 'Control Variable'

Entry of a node  
prefix for LNC  
instances

Server

- LD LogicalDevice
  - LN LLN0
  - LN LPHD1
  - LN GGIO1

Properties:

Node prefix:

Fig. 20: 'Properties' of the LNC instance 'GGIO1' with 'Node prefix' input field

Here you enter a prefix for the selected LNC instance. The prefix is put in front of the LN name in the server tree. The prefix is displayed in the [Chapter 1.3.2.4 "Status bar" on page 19](#), too.

#### 1.3.2.4 Status bar

In the status bar (4 of the [Further information on page 11](#)) of the IEC 61850 editor you find object-specific detail information about the selected object.

Object informa-  
tion: Server and  
Logical Device

Name
Server

Fig. 21: Status bar for the Server

Only the information "Name" is displayed for the server and the Logical Device.

Object informa-  
tion: LN

Name	Description	Group	Prefix
LPHD	Physical device info	[Lxxx]-System	

Fig. 22: Status bar for the LN instance 'LPHD'

Status	Description
"Name"	Name of the selected LN instance
"Description"	Description of the selected LN instance
"Group"	Associated group of the LN instance Examples: [Axxx]-Automatic [Cxxx]-Control [Gxxxx]-Generic ...
"Prefix"	Prefix of the LNC instance, entered by the user

**Object information: Common Data Class Object (CDC Object)**

Name	Description	Option	CDC	Instno
Beh	Behaviour	M	INS	0

Fig. 23: Status bar of the CDC instance 'Beh'

Status	Description
"Name"	Name of the attribute
"Description"	Description of the selected CDC instance
"Option"	Option of the selected CDC- instance M = mandatory O = optional
"CDC"	Type of the selected CDC instance
"Instno"	Instance number of the CDC instance. Only optional CDCs can have instance numbers. If there is only one optional CDC, it has no instance number. Otherwise 1 to n.



Objects with the 'mandatory' options are inserted automatically when adding the Logical Device.

**Object information: Attribute (DA)**

Name	FC	Option	Type	Trigger option	Value	Writeable
q	ST	M	Quality	qchg		R

Fig. 24: Status bar of the attribute 'q'

Status	Description
"Name"	Name of the attribute
"FC"	Functional Constraint of the selected attribute
"Option"	Option of the selected attribute: M = mandatory O = optional

Status	Description
"Type"	Data type of the attribute
"Trigger Option"	Trigger option of the attribute dchg = data change dupd = data update qchg = quality change <empty> = no trigger option
"Value"	Associated variable
"Writeable"	Access for the attribute R = Read W = Write RW = Read and Write

### 1.3.3 DataSet

In this tab of the IEC 61850 editor you create and delete datasets, you assign attributes (DA) and data objects (DO) to a dataset and you delete existing assignments.

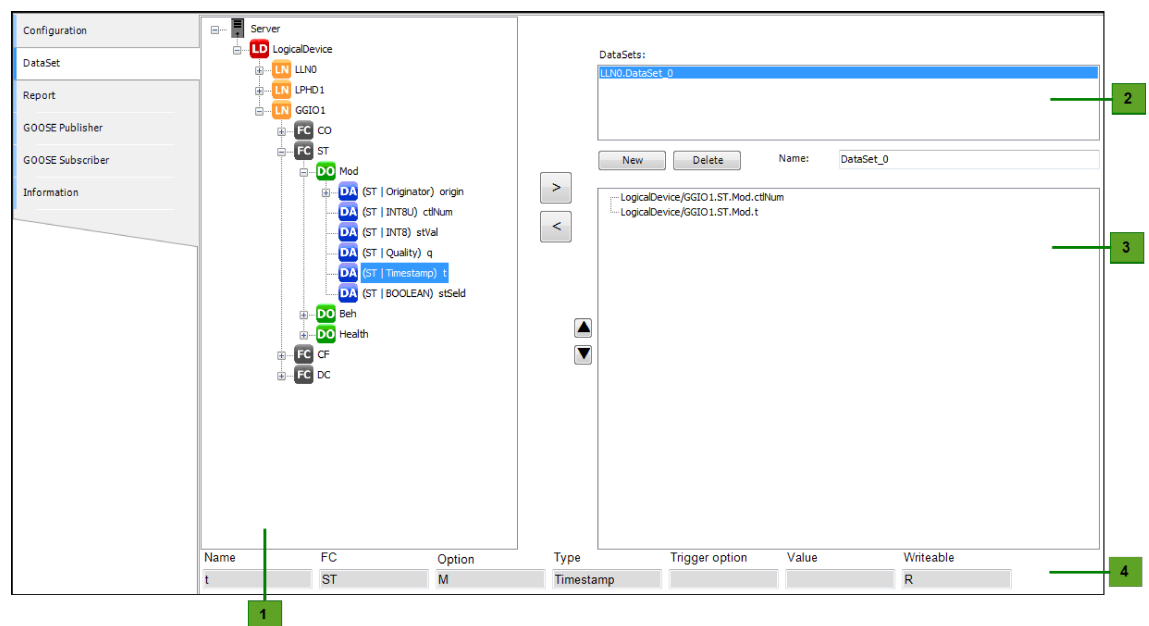


Fig. 25: 'DataSet' tab with 'LLN0.DataSet\_0' dataset and DAs 't' and 'ctlNum'

#### Structure of the tab

Section 1 displays the IEC 61850 Server created in the Chapter 1.3.2.1 "Configuration" on page 11 tab.

The sections 2 and 3 are for creating, editing and deleting of DataSets. In section 2 the datasets are listed. In section 3 the attributes and data objects of the dataset are listed, which is marked in section 2.

For more information about section 4 see Chapter 1.3.2.4 "Status bar" on page 19.



### NOTICE!

The order of the attributes of a DataSet is important for the receiving and the sending of GOOSE messages. Type and order of the entries from sender and recipient must be identical for GOOSE communication. For more information about GOOSE communication see [Chapter 1.3.5 "GOOSE Publisher" on page 24](#) and [Chapter 1.3.6 "GOOSE Subscriber" on page 26](#).

#### Buttons:

- **"New"**: Create a new dataset. This is displayed in the **"DataSets"** section and is named **"LLN0.DataSet\_Suffix"**. The suffix is incremented beginning with 0 (1. DataSet: LLN0.DataSet\_0 ...)
- **"Delete"**: Delete a dataset: Select the desired dataset in the **"DataSets"** section and activate the **"Delete"** button.
- **">"**: Assign an attribute or a data object to the selected dataset. First select the dataset in section 2 then select the attribute or the data object in section 1 and activate the **">"** button.
- **"<"**: Deletes an element from a dataset. First select the dataset in section 2 then select the attribute or the data object in section 1 and activate the **"<"** button.
- : Moves the selected entry one row up
- : Moves the selected entry one row down.

#### Input fields

- **"Name:"** Name of the dataset can be edited. The name gets the prefix **"LLN0."**.

## 1.3.4 Report

In this tab of the IEC 61850 editor you create and parametrize buffered und unbuffered reports. A report transports the data, that are assigned to it, to the connected client in the event of a trigger. Each report a dataset must be assigned to.

Fig. 26: 'Report' tab

In section **1** the created report control blocks (RCB) are listed. The following buttons are available:

- **"New"**: Create a new report control block.
- **"Delete"**: Delete the selected report control block

In section **2** you make general settings for the reporting configuration.

Table 1: General settings

Setting possibility	Description
"Buffersize"	Buffer size of buffered reports (in bytes).
"Name"	Unique Report Block name within the logical node.
"Description"	Description of the report block
"Integrity Period [ms]"	Stealthy general interrogation. After this time the referenced dataset will be actuated.  Time (ms) between two messages  The messages are transferred cyclic, independent from other events.
"Buffered"	Enable / disable the report buffering.  A buffered report stores the data, even if there's no connection to the client. In the case of an unbuffered report, the messages will get lost, if there is no connection to the client.
"Buffer Time [ms]"	Buffer time is the amount of time that the server waits to transfer a report after a given event occurs. Events that occur during this time period are collected and then transferred as a batch.  If the buffer time is 0, the telegram will be sent immediately. For example, if the buffer time 10s the telegram will be sent after this time period or when the value changes the second time.
"Config Revision"	Versioning is used to identify whether or not a member was deleted from a dataset or whether member order has changed. Such changes cause values to not be transferred, or cause values to be in a different location within the report. Such an event is communicated to the client with a new version number.  Since all datasets are firmly defined, this identifier does not apply to the solution described here.
"DataSet"	Data set reference

Section 3 is for the setting of the following options:

- "General options": Control of the reporting behavior. An activated checkbox means, that the information is transferred by the message
- "Buffered specific options": can be activated, if the option "Buffered:" (in section 2) is activated.
- "Trigger options": Determining of attributes to select the events which may trigger a message.

If the checkbox is activated the information will be transferred by the message.

Table 2: General options

Setting Possibility	Description
"Send Config Revision"	'Config Revision' information
"Send Data Reference"	Enable/disable to transfer the complete reference information, for example: LogicalDevice/GGIO1.ST.Mod.ctlNum
"Send DataSet name"	Enable/disable to transfer the dataset name
"Send Reason for Inclusion"	Enable/disable to transfer the reason of transmission for each attribute
"Send Sequence Number"	Enable/disable to transfer a unique sequence number for each message
"Send Time Stamp"	Enable/disable to transfer the timestamp of transmission for each message

Table 3: Buffered specific options

Setting Possibility	Description
"Send Entry ID"	Enable/disable to transfer the 'Entry ID'
"Send Buffer overflow"	Enable/disable to transfer the message if a buffer overflow occurs.

Table 4: Trigger options

Setting Possibility	Description
"Data Change "	Enable/disable to trigger the report if a 'data change' event occurred
"Data Update"	Enable/disable to trigger the report if a 'data update' event of an attribute occurred.
"Quality Chance"	Enable/disable to trigger the report if a 'quality change' event of an attribute occurred
"Integrity"	Enable/disable the cyclic transmission of the report independent of any datachanges (Stealthy general interrogation) . The time period has to be defined in the "Integrity Period" general setting.
"General Interrogation"	

- Create a report control block and assign it to a dataset**
1. Activate the "New" button
  2. Select the desired dataset from the "DataSet" selection list

### 1.3.5 GOOSE Publisher

In the "GOOSE Publisher" tab of the IEC 61850 editor you create, edit and delete GOOSE messages. If a value changes in the selected dataset, a GOOSE message is sent.

Fig. 27: 'GOOSE Publisher' tab



#### NOTICE!

The order of the attributes of a DataSet is important for the receiving and the sending of GOOSE messages. Type and order of the entries from sender and recipient must be identical for GOOSE communication.



**NOTICE!**

To receive a GOOSE message from an IED, sender and recipient must have the identical settings in the following input fields:

- “APPID”
- “GOOSE-ID”
- “Dataset structure (with regard to order and data type of the attributes)”

After the dataset is sent, it is sent again after time interval of 500 ms. The repeat time then doubles and the dataset is sent again. The dataset is sent repeatedly until the value set in the “Repeat Time” input field is reached. The dataset is then sent again at the Repeat Time interval.

Sections of the tab:

**1**: List of the GOOSE control blocks (GCB).

A GOOSE control block is a GOOSE message.

Buttons

- “New”: Create a new GOOSE control block
- “Delete”: Delete the selected GOOSE control block.

**2**: General settings:

Table 5: General

Setting	Description
“Name”	Name of the GOOSE control block., editable
“Description”	Description of the GOOSE control block
“GOOSE-ID”	Unique character string of the GOOSE control block, editable
“DataSet”	Dataset sent as a GOOSE message.
“MAC”	Multicast addressing Multicast addressing is used to send GOOSE messages. Addressing allows a entire group of devices to exchange data with each other. Requirement: unique address allocation of the different device groups. Valid range of values: 01-0C-CD-01-00-00....01-0C-CD-01-01-FF
“APPID”	Application-ID Number for the system-wide unique identification of a GOOSE control block. To exchange GOOSE telegrams, this number must be identical for sender and recipient. Valid range of values: 0 ... 4095
“Source Address (MAC)”	“Browse...” button: looks for an Ethernet Port in the network. Requirement: an existing network path to the PLC (see ).

**3**: GOOSE Publisher settings

Table 6: Publisher

Setting	Description
“Needs Commissioning”	Indicates whether the control block must be checked Value is provided from the configurator. Usage of the flag is customer-specific.
“DataSet Config Revision”	Integer value with the version of the GOOSE control block.
“Repeat Time (T0)[ms]”	Time interval during which the GOOSE telegram is valid.

Setting	Description
"Max. Time [ms]"	Source supervision time (heartbeat cycle)
"Min. Time [ms]"	Maximum permissible send delay time of a data change
"VLAN"	<p>'Virtual Local Area Network'</p> <p>Logical subnet within a physical network. Multicast messages can be passed through and filtered. The configuration is done in managed ETHERNET switches.</p> <p>If the "VLAN" checkbox is activated, values can be entered into the "VLAN-ID" and "VLAN-Priority" input fields, concerning the passed through of messages via switches.</p>
"VLAN-ID"	<p>A value of 0 is a non-configured VLAN in which the switch performs no filtering. This value is recommended when no logical network should be set up.</p> <p>Valid range of values: 0 ... 4095.</p>
"VLAN-Priority"	<p>Messages within a managed ETHERNET switch can be forwarded depending on the priority</p> <p>Valid range of values: : 0 ... 7.</p> <p>Default value for GOOSE: 4.</p>

**4**: Content of the Dataset assigned to the GOOSE control block.

#### Create an GOOSE control block and assign it to a dataset

1. Activate the "New" button
2. Select the desired dataset from the "DataSet" selection list.

### 1.3.6 GOOSE Subscriber

In this tab of the IEC 61850 editor you make settings for the receiving of GOOSE messages.

Fig. 28: 'GOOSE Subscriber' tab



#### NOTICE!

The order of the attributes of a dataset is important for the receiving and the sending of GOOSE messages. Type and order of the entries from sender and recipient must be identical for GOOSE communication.

**NOTICE!**

To receive a GOOSE message from an IED, sender and recipient must have the identical settings in the following input fields:

- “APPID”
- “GOOSE-ID”
- “DataSet” structure (with regard to order and data type of the attributes)

Sections of this tab:

**1**: List of the GOOSE control blocks (GCB)

Buttons

- “New”: Create a new GOOSE control block
- “Delete”: Delete the selected GOOSE control block.
- “Import”: Import a GOOSE control block in the SCL format

**2**: General settings:

Table 7: General

Setting	Description
“Name”	Name of the GOOSE control block., editable
“Description”	Description of the GOOSE control block
“GOOSE-ID”	Unique character string of the GOOSE control block, editable
“DataSet”	Dataset received as a GOOSE message.
“MAC”	Multicast addressing  Multicast addressing is used to send GOOSE messages. Addressing allows a entire group of devices to exchange data with each other.  Requirement: unique address allocation of the different device groups  Valid range of values: 01-0C-CD-01-00-00....01-0C-CD-01-01-FF
“APPID”	Application-ID  Number for the system-wide unique identification of a GOOSE control block. To exchange GOOSE telegrams, this number must be identical for sender and recipient.  Valid range of values: 0 ... 4095
“Source Address (MAC)”	“Browse...” button: looks for an Ethernet Port in the network. Requirement: an existing network path to the PLC (see ).

**3**: List to assign GOOSE messages to global variables.

All attributes within the selected dataset are listed in this list. You can assign incoming GOOSE messages to global CODESYS variables. For this, select the desired attribute in the list and edit the name of a global variable in the “Varname” column. If you edit a new variable name a global variable will be created, if you activate the “Use default name” checkbox, a variable name is generated automatically. This variable will be written by incoming GOOSE messages.

The variables will be stored “IEC61850\_Generated\_GVL” (of the “IEC61850 Generated POU’s” folder) after generating the code of the IEC 61850 Server.

No.	Reference	Type	Varname	Use default name
1	LogicalDevice/GGIO1.ST.Mod.ctdNum	INT8U	Var_ctdNum	<input type="checkbox"/>
2	LogicalDevice/GGIO1.ST.Mod.t	Timestamp	Subs_0_Entry1	<input checked="" type="checkbox"/>

Fig. 29: Example for the variable list

- Create a GOOSE control block and assign it to a dataset**
1. Activate the “New” button
  2. Select the desired dataset from the “DataSet” selection list

### 1.3.7 Information

This tab of the IEC 61850 editor shows information on the IEC 61850 Server

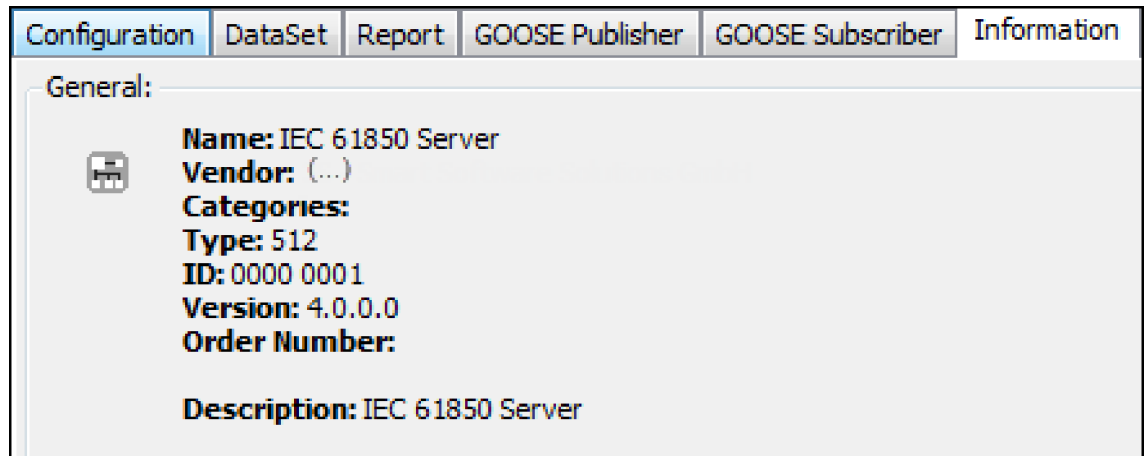


Fig. 30: 'Information' tab'

## 1.4 Reading and Writing from CODESYS Variables

### Monitoring direction, reading

For reading in monitoring direction you connect an attribute (DA) with R-access (read) a CODESYS monitoring variable (see ↗ “*Parametrization of the IEC 61850 Server*” on page 15).

The following dataflow variants are possible:

- from the IEC 61850 Server to the connected IEC 61850 Client to read a CODESYS monitoring variable
- from an I/O module to the IEC 61850 Server to the connected IEC 61850 client to read an I/O module pin.

### Control direction, writing

For writing in control direction you connect an attribute (DA) with W-access (write) to a CODESYS control variable (see ↗ “*Parametrization of the IEC 61850 Server*” on page 15).

The following dataflow variants are possible:

- from a connected IEC 61850 client to the IEC 61850 Server to write a CODESYS-variable
- from the connected IEC 61850 client to the IEC 61850 Server to an I/O module to write the I/O module pins.

### Monitoring direction + control direction, reading and writing

It may be the case that the IEC 61850 client will read the monitoring variable of an attribute and will write the control variable of the same attribute. Monitoring variable and control variable must not be the same CODESYS variable.

In monitoring direction the data flow takes place from the IEC 61850 Server to the connected IEC 61850 client to read the CODESYS monitoring variable.

In control direction the data flow takes place from the connected IEC 61850 client to the IEC 61850 Server to write the CODESYS control variable.

## 1.5 Menu Command sorted by Categories

### 1.5.1 IEC61850

#### 1.5.1.1 Generate code

Symbol: 

On activating the “*Generate code*” command of the “*IEC61850*” category the code generation is started and the generated IEC 61850 code is stored in the folder “*IEC61850 Generated POU's*” in the device tree.

#### 1.5.1.2 Export Server

This command of the “*IEC61850*” category exports the current configuration. In the “*Save as*” dialog select the format filter:

- XML Files: for IEC 61850 format with all specific data, variable mapping, for example
- SCL-Files: for IEC 61850 format to export data to other IEC 61850 tools

If you have changed the configuration since the latest code generation, you will be asked whether new code should be generated before export.

#### 1.5.1.3 Import Server

This command of the “*IEC61850*” category discards the current configuration and imports a new configuration. In the “*Save as*” dialog select the format filter:

- XML Files: for IEC 61850 format with all specific data, variable mapping, for example
- SCL Files: for IEC 61850 format to import data from other IEC 61850 tools

#### 1.5.1.4 Options

The “*Options*” command of the “*IEC61850*” category opens a dialog for the setting of different display options for the IEC 61850 configurator.

Option	Description
“ <i>Show FC besides data attribute</i> ”	Display option, shows functional constraint of attribute as a comment.
“ <i>Show type besides data attribute</i> ”	Display option, shows type of attribute as a comment
“ <i>Show trigger option besides data attribute</i> ”	Display option, shows trigger option of attribute as a comment
“ <i>Show description besides data objects</i> ”	Display option, shows description of attribute as a comment
“ <i>Enable SCL Private block</i> ”	
“ <i>Select all Data Objects</i> ”	Debug-Option: Selection of all data objects (DO)
“ <i>Select all Data Attributes</i> ”	Debug-Option: Selection of all data attributes (DA)

#### 1.5.1.5 Reset

This command of the “*IEC61850*” category deletes the whole current configuration and all objects of the current application created via the “*Generate code*” command.

## 1.6 Logical Name Classes (LNC)

The following LNCs are available for the configuration of the IEC 61850 Server

Name	Description
	<b>Automatic Control Functions</b>
ATCC	Automatic tap changer controller
	<b>Control</b>
CALH	Alarm handling
CCGR	Cooling group control
	<b>Generic Functions</b>
GAPC	Generic automatic process control
GGIO	Generic process I/O
GSAL	Generic security application
	<b>System</b>
LLN0	Logical Node Zero
LPHD	Physical device information
	<b>Metering and measurement</b>
MMTR	Metering
MMXN	Non phase related Measurement
MMXU	Measurement
MSQI	Sequence and imbalance
MSTA	Metering Statistics
	<b>Protection</b>
PDIF	Differential
PFRC	Rate of change of frequency
PHAR	Harmonic restraint
PHIZ	Ground detector
PIOC	Instantaneous overcurrent
PMRI	Motor restart inhibition
PMSS	Motor starting time supervision
PTOV	Overvoltage
	<b>Sensors and monitoring</b>
SARC	Monitoring and diagnostics for arcs
SIMG	Insulation medium supervision (gas)
SIML	Insulation medium supervision (liquid)
	<b>Instrument transformers</b>
TCTR	Current transformer
TVTR	Voltage transformer
	<b>Wind power plant (IEC61400-25)</b>
WALM	Wind power plant alarm information
WAPC	Wind power plant active power control

Name	Description
WCNV	Wind turbine converter information
WGEN	Wind turbine generator information
WMET	Wind power plant meteorological information
WNAC	Wind turbine nacelle information
WROT	Wind turbine rotor information
WAPC	Wind power plant reactive power control information
WOW	Wind turbine tower information
WTRF	Wind turbine transformer information
WTRM	Wind turbine transmission information
WTUR	Wind turbine general information
WYAY	Wind turbine yawing information
	<b>X-Switchgear Functions</b>
XCBR	Circuit Breaker
XSWI	Circuit Switch
	<b>Y-Power Transformers</b>
YEFN	Earth fault neutralizer (Petersen Coil)
YLTC	Tap Changer
YPSH	Power Shunt
YPTR	Power Transformer
	<b>Further power system equipment</b>
ZAXN	Auxiliary network
ZBAT	Battery
ZCAP	Capacitor Bank
ZCON	Converter
ZGEN	Generator
ZGIL	Gas Insulated Line
ZLIN	Power Overhead Line
ZMOT	Motor
ZREA	Reactor
ZRRC	Rotating reactive component
ZSAR	Surge arrestor
ZTCF	Thyristor controlled frequency converter
ZTCR	Thyristor controlled reactive converter

## 1.7 IEC 61850 Functionalities

### Models Con- formance

Functionality	Support	Comment
Logical device	yes	
Logical node	yes	
Data	yes	
DataSet	yes	
Substitution	yes	
Setting group control	no	
<b>Reporting</b>		
<b>Buffered report control</b>	yes	
Sequence number	yes	
Report time stamp	yes	
Reason for inclusion	yes	
DataSet name	yes	
Data reference	yes	
Buffer overflow	yes	
Entry-ID	yes	
Buffer Time	yes	
Integrity Period	yes	
General Interrogation	yes	
Config Revision	yes	
<b>Unbuffered report control</b>	yes	
Sequence number	yes	
Report time stamp	yes	
Reason for inclusion	yes	
DataSet name	yes	
Date reference	yes	
Buffer Time	yes	
Integrity Period	yes	
General Interrogation	yes	
Config Revision	yes	
Logging	no	
Log Control	no	
Log	no	
Control	yes	Only Operate
GOOSE	yes	
GSSE	no	
Multicast SVC	no	
Unicast SVC	no	
Time	yes	
File Transfer	no	
Maximum number of simultaneously client connections	5	Parameter in the configurator. 1...5



Functionality	Support	Comment
Maximum MMS PDU size	45 000	
Time synchronisation	yes	SNTP
SCL File support	yes	Ex-/Import in CODESYS IEC 61850 Server TOOL

## Service Conformance

Table 8: Server

Services	Support	Comment
ServerDirectory	yes	

Table 9: Application association

Services	Support	Comment
Associate	yes	
Abort	yes	
Release	yes	

Table 10: Logical Device

Services	Support	Comment
LogicalDeviceDirectory	yes	

Table 11: Logical Node

Services	Support	Comment
LogicalNodeDirectory	yes	
GetAllDataValues	yes	

Table 12: Data

Services	Support	Comment
GetDataValues	yes	
SetDataValues	yes	
GetDataDirectory	yes	
GetDataDefinition	yes	

Table 13: DataSet

Services	Support	Comment
GetDataSetValues	yes	
SetDataSetValues	yes	
CreateDataSet	no	
DeleteDataSet	no	
GetDataSetDirectory	yes	

Table 14: Substitution

Sevices	Support	Comment
SetDataValues	yes	

Table 15: Reporting

Sevices	Support	Comment
<b>Buffered report control block (BRCB)</b>		
Report	yes	
data-change (dchg)	yes	
qchg-change (qchg)	yes	
data-update (dupd)	yes	
GetBRCBValues	yes	
SetBRCBValues	yes	
<b>Unbuffered report control block (URCB)</b>		
Report	yes	
data-change (dchg)	yes	
qchg-change (qchg)	yes	
data-update (dupd)	yes	
GetURCBValues	yes	
SetURCBValues	yes	

Table 16: Generic substation event model (GSE)

Sevices	Support	Comment
<b>GOOSE-CONTROL-BLOCK</b>		
SendGOOSEMessage	yes	
GetReference	no	
GetGOOSEElementNumber	no	
GetGoCBValues	yes	
SetGoCBValues	yes	
<b>GSSE-Control-Block</b>		
SendGSSEMessage	no	
GetReference	no	
GetGSSEElementNumber	no	
GetGsCBValues	no	
SetGsCBValues	no	

Table 17: Control

Sevices	Support	Comment
Select	no	
SelectWithValue	no	
Cancel	no	

Sevices	Support	Comment
Operate	yes	
Command-Termination	no	
TimeActivated-Operate	no	

Table 18: Time

Sevices	Support	Comment		
Time resolution of internal clock	7	nearest power of 10 ms		
Time accuracy of internal clock		TL (ms)	(low accuracy)	T3 < 7 (only Ed2)
		T0 (ms)	(<= 10 ms)	7 <= T3 < 10
		T1 (μs)	(<= 1ms)	10 <= T3 < 13
		T2 (μs)	(<= 100 μs)	13 <= T3 < 15
		T3 (μs)	(<= 25 μs)	15 <= T3 < 18
		T4 (μs)	(<= 25 μs)	15 <= T3 < 18
		T5 (μs)	(<= 1 μs)	T3 >= 20
Supported TimeStamp resolution	7	nearest power of 10 ms		

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