zenon
by COPA-DATA

zenon driver manual

IEC850

v.8.10

Contents

1 Welcome to COPA-DATA help

ZENON VIDEO-TUTORIALS

You can find practical examples for project configuration with zenon in our YouTube channel (https://www.copadata.com/tutorial_menu). The tutorials are grouped according to topics and give an initial insight into working with different zenon modules. All tutorials are available in English.

GENERAL HELP

If you cannot find any information you require in this help chapter or can think of anything that you would like added, please send an email to documentation@copadata.com.

PROJECT SUPPORT

You can receive support for any real project you may have from our Support Team, who you can contact via email at support@copadata.com.

LICENSES AND MODULES

If you find that you need other modules or licenses, our staff will be happy to help you. Email sales@copadata.com.

2 IEC850

Communication between the driver and the PLC is based on the IEC 61850 protocol with client/server *MMS* services via TCP/IP (A1/T1 profile). The driver acts as a client (master) when communicating.

You can create and configure the driver manually or - in the **Energy Edition** - with the help of the **IEC850 Driver Configuration** wizard, using an SCL file (SCD, CID, possibly ICD etc).

Furthermore, you can create the variables manually or import them, even without the wizard:

- Offline - from an SCL file
- Online - in communication with an 850 server.

Note: For simplified import of the variables from the Datasets in RCBs, the **IEC850 Driver Configuration** wizard provides additional possibilities.

Attention

Configurations that have been amended with a driver from a later version can no longer be opened with older drivers.

3 IEC850 - data sheet

General:	
Driver file name	IEC850.exe
Driver name	IEC 61850 Treiber
PLC types	IEC 61850-compatible IEDs (680 server) edition 1 or edition 2
PLC manufacturer	ABB; GE Multilin; IEC; Kalki; NARI; NR Electric; SAT; Schweitzer Engineering Laboratories; SEL; Sprecher Automation

Driver supports:	
Protocol	IEC 61850
Addressing: Address-based	Name based
Addressing: Name-based	--
Spontaneous communication	X
Polling communication	X
Online browsing	X
Offline browsing	X
Real-time capable	X
Blockwrite	--
Modem capable	--
RDA numerical	--

Driver supports:	
RDA String	--
Hysteresis	--
extended API	X
Supports status bit **WR-SUC**	X
alternative IP address	X

Requirements:	
Hardware PC	Standard network card
Software PC	XML-Lite is needed, component of Microsoft Internet Explorer 7.0; xmllite.dll can also be downloaded from the Microsoft home page.
Hardware PLC	--
Software PLC	--
Requires v-dll	--

Platforms:	
Operating systems	Windows 10; Windows 7; Windows 8; Windows 8.1; Windows Server 2008 R2; Windows Server 2012; Windows Server 2012 R2; Windows Server 2016

4 Requirements

This chapter contains information on the requirements that are necessary for use of this driver.

4.1 PC

XML Lite, which is part of Microsoft Internet Explorer 7.0, is necessary; xmllite.dll can also be downloaded separately from the Microsoft website.

This driver supports a connection via the standard network card of the PC. Make sure that the PLC and the PC are in the same network range and that the subnet masks are set accordingly on both devices.

5 Configuration

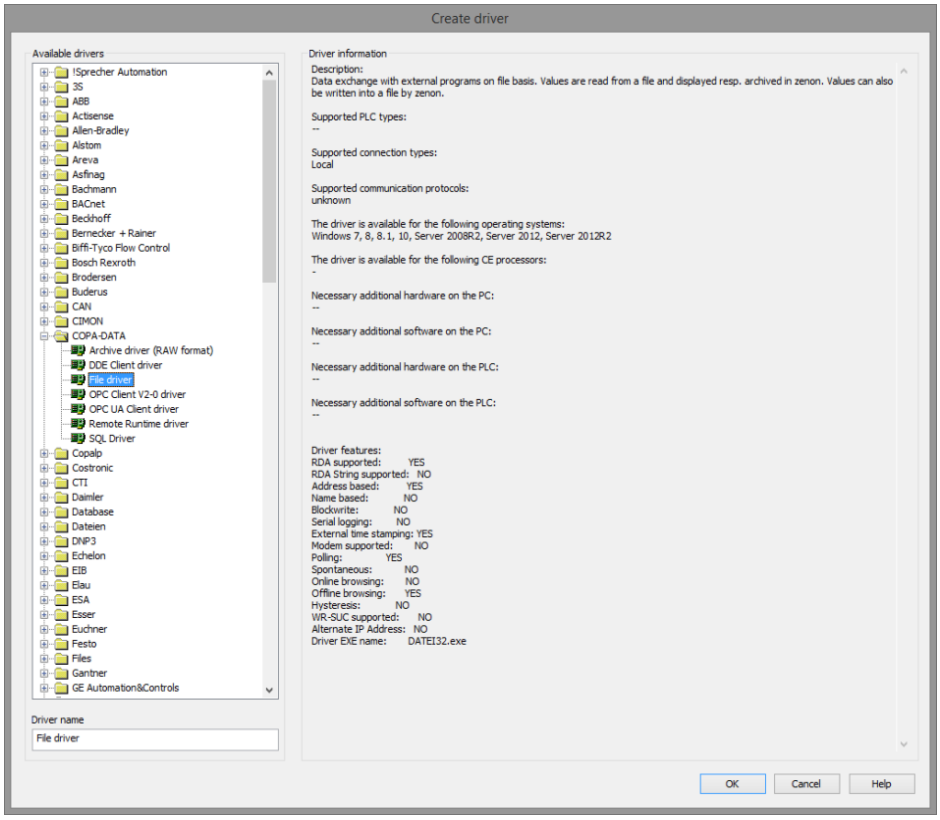
In this chapter you will learn how to use the driver in a project and which settings you can change.

Information

Find out more about further settings for zenon variables in the chapter Variables (main.chm::/15247.htm) of the online manual.

5.1 Creating a driver

In the **Create driver** dialog, you create a list of the new drivers that you want to create.



Parameter	Description
Available drivers	List of all available drivers. The display is in a tree structure: *[+]* expands the folder structure and shows the drivers contained therein. [-] reduces the folder structure Default: *no selection*
Driver name	Unique **Identification** of the driver. Default: *Empty* The input field is pre-filled with the pre-defined **Identification** after selecting a driver from the list of available drivers.
Driver information	Further information on the selected driver. Default: *Empty* The information on the selected driver is shown in this area after selecting a driver.

CLOSE DIALOG

Option	Description
OK	Accepts all settings and opens the driver configuration dialog of the selected driver.
Cancel	Discards all changes and closes the dialog.
Help	Opens online help.

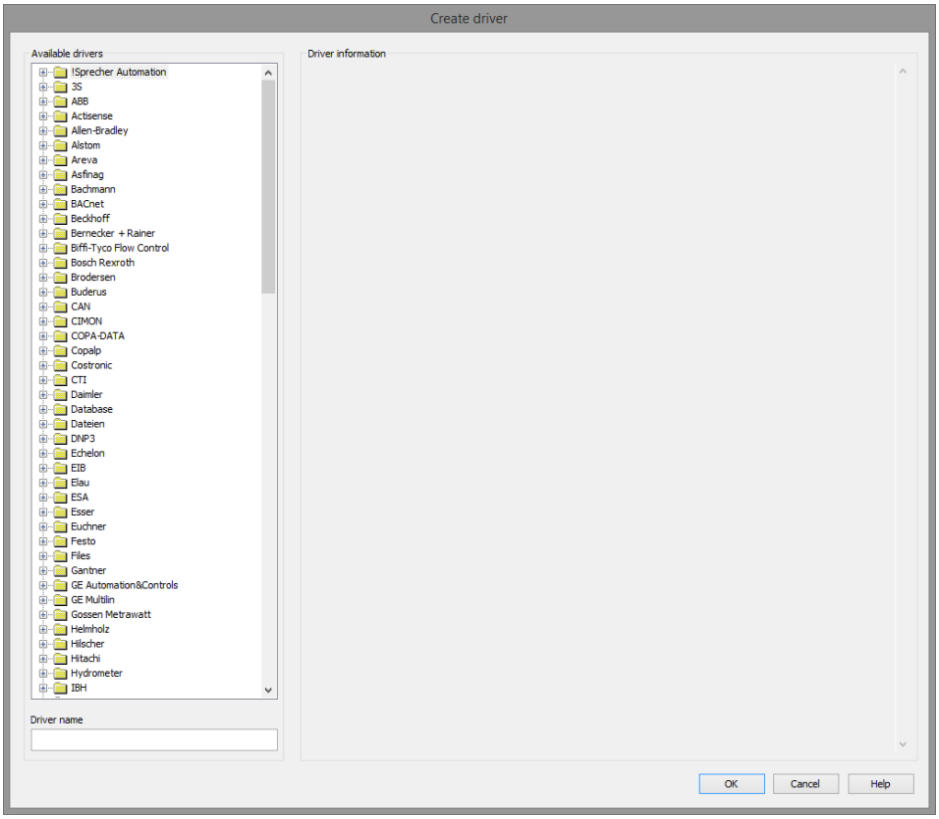
> **Information**
>
> The content of this dialog is saved in the file called Treiber_[Language].xml. You can find this file in the following folder:
> *C:\ProgramData\COPA-DATA\zenon[version number]*.

CREATE NEW DRIVER

In order to create a new driver:

1. Right-click on **Driver** in the Project Manager and select **New driver** in the context menu. Optional: Select the **New driver** button from the toolbar of the detail view of the **Variables**. The **Create driver** dialog is opened.

2. The dialog offers a list of all available drivers.



3. Select the desired driver and name it in the **Driver name** input field.
   This input field corresponds to the **Identification** property. The name of the selected driver is automatically inserted into this input field by default.
   The following is applicable for the **Driver name**:

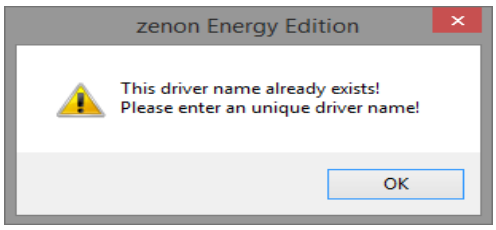
   - The **Driver name** must be unique.
     If a driver is used more than once in a project, a new name has to be given each time. This is evaluated by clicking on the **OK** button. If the driver is already present in the project, this is shown with a warning dialog.
   - The **Driver name** is part of the file name.
     Therefore it may only contain characters which are supported by the operating system. Invalid characters are replaced by an underscore (_).
   - **Attention:** This name cannot be changed later on.

4. Confirm the dialog by clicking on the **OK** button.
   The configuration dialog for the selected driver is opened.

Note: The language of driver names cannot be switched. They are always shown in the language in which they have been created, regardless of the language of the Editor. This also applies to driver object types.

DRIVER NAME DIALOG ALREADY EXISTS

If there is already a driver in the project, this is shown in a dialog. The warning dialog is closed by clicking on the **OK** button. The driver can be named correctly.



ZENON PROJECT

The following drivers are created automatically for newly-created projects:

- **Intern**
- **MathDr32**
- **SysDrv**

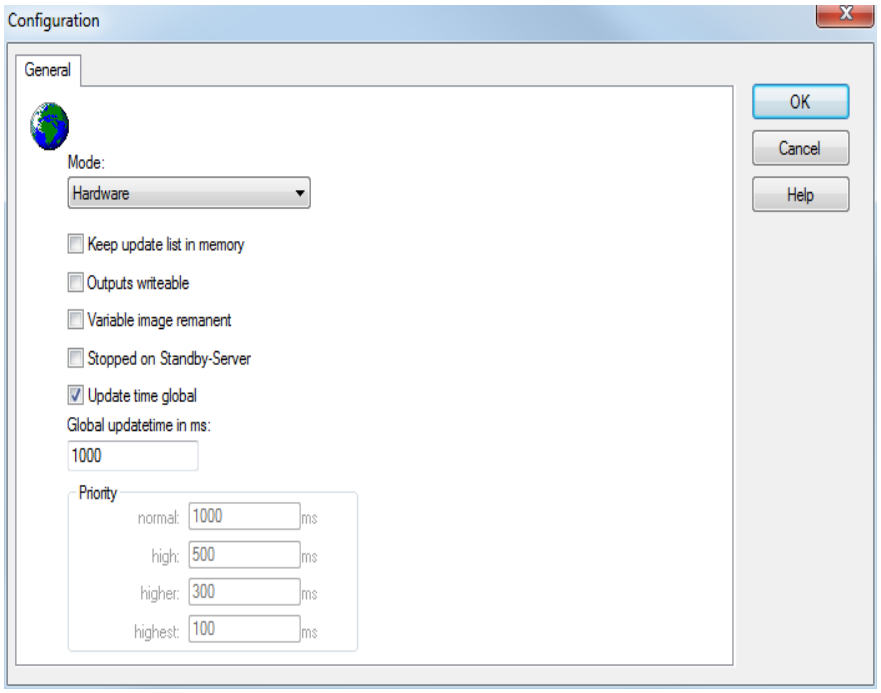
> **Information**
>
> Only the required drivers need to be present in a zenon project. Drivers can be added at a later time if required.

5.2 Settings in the driver dialog

You can change the following settings of the driver:

5.2.1 General

The configuration dialog is opened when a driver is created. In order to be able to open the dialog later for editing, double click on the driver in the list or click on the **Configuration** property.



Option	Description
Mode	Allows to switch between hardware mode and simulation mode ▸ *Hardware*: A connection to the control is established. ▸ Simulation - static: No communication between to the control is established, the values are simulated by the driver. In this modus the values remain constant or the variables keep the values which were set by zenon Logic. Each variable has its own memory area. E.g. two variables of the type marker with offset 79 can have different values in the Runtime and do not influence each other. Exception: The simulator driver. ▸ *Simulation - counting*: No communication between to the control is established, the values are simulated by the driver. In this modus the driver increments the values

Option	Description
	within a value range automatically. ▸ *Simulation - programmed*: No communication is established to the PLC. The values are calculated by a freely programmable simulation project. The simulation project is created with the help of the zenon Logic Workbench and runs in a zenon Logic Runtime which is integrated in the driver. For details see chapter Driver simulation (main.chm::/25206.htm).
Keep update list in the memory	Variables which were requested once are still requested from the control even if they are currently not needed. This has the advantage that e.g. multiple screen switches after the screen was opened for the first time are executed faster because the variables need not be requested again. The disadvantage is a higher load for the communication to the control.
Output can be written	▸ *Active*: Outputs can be written. ▸ *Inactive*: Writing of outputs is prevented. **Note**: Not available for every driver.
Variable image remanent	This option saves and restores the current value, time stamp and the states of a data point. Fundamental requirement: The variable must have a valid value and time stamp. The variable image is saved in hardware mode if one of these statuses is active: ▸ User status *M1* (*0*) to *M8* (*7*) ▸ *REVISION(9)* ▸ *AUS(20)* ▸ *ERSATZWERT(27)* The variable image is always saved if: ▸ the variable is of the object type **Driver variable** ▸ the driver runs in simulation mode. (not

Option	Description
	programmed simulation) The following states are not restored at the start of the Runtime: ▸ *SELECT(8)* ▸ *WR-ACK(40)* ▸ *WR-SUC(41)* The mode **Simulation - programmed** at the driver start is not a criterion in order to restore the remanent variable image.
Stop on Standby Server	Setting for redundancy at drivers which allow only one communication connection. For this the driver is stopped at the Standby Server and only started at the upgrade. **Attention:** If this option is active, the gapless archiving is no longer guaranteed. ▸ *Active*: Sets the driver at the not-process-leading Server automatically in a stop-like state. In contrast to stopping via driver command, the variable does not receive status **switched off** (**statusverarbeitung.chm::/24150.htm**) but an empty value. This prevents that at the upgrade to the Server irrelevant values are created in the AML, CEL and Historian. Default: *inactive* **Note:** Not available if the CE terminal serves as a data server. You can find further information in the zenon Operator manual in the CE terminal as a data server chapter.
Global Update time	Setting for the global update times in milliseconds: ▸ *Active*: The set **Global update time** is used for all variables in the project. The priority set at the variables is not used. ▸ *Inactive*: The set priorities are used for the individual variables.

Option	Description
	Exceptions: Spontaneous drivers ignore this option. They generally use the shortest possible update time. For details, see the **Spontaneous driver update time** section.
Priority	The polling times for the individual priority classes are set here. All variables with the according priority are polled in the set time. The variables are allocated separately in the settings of the variable properties. The communication of the individual variables can be graded according to importance or required topicality using the priority classes. Thus the communication load is distributed better. **Attention:** Priority classes are not supported by each driver, e.g. spontaneously communicating zenon drivers.

CLOSE DIALOG

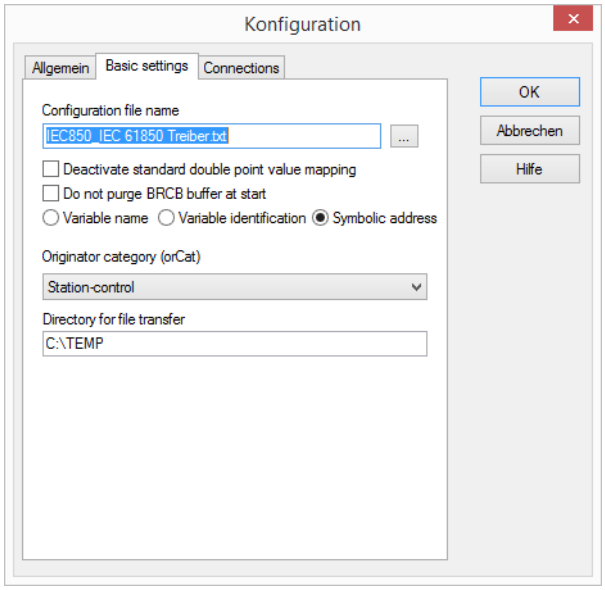
Option	Description
OK	**Applies all changes in all tabs and closes the dialog.**
Cancel	Discards all changes in all tabs and closes the dialog.
Help	Opens online help.

UPDATE TIME FOR SPONTANEOUS DRIVERS

With spontaneous drivers, for **Set value**, **advising** of variables and **Requests**, a read cycle is triggered immediately - regardless of the set update time. This ensures that the value is immediately available for visualization after writing. The update time is generally 100 ms.

Spontaneous drivers are **ArchDrv**, **BiffiDCM**, **BrTcp32**, **DNP3**, **Esser32**, **FipDrv32**, **FpcDrv32**, **IEC850**, **IEC870**, **IEC870_103**, **Otis**, **RTK9000**, **S7DCOS**, **SAIA_Slave**, **STRATON32** and **Trend32**.

5.2.2 Driver dialog basic settings



Parameter	Description
Configuration file name	Name of the file in which the driver-specific configurations are saved. Click on the **...** button to open the dialog for selecting a drop folder. **Note:** You can read about the structure of this configuration file in the Driver configuration file (on page 20) chapter.
Deactivate standard double point value mapping	▸ *Inactive*: The values of Double Point Values are adjusted to the operating elements of zenon. Use this configuration if you want to use the modules of the zenon Energy Edition. You can find details in the Double Point Value Mapping (on page 106) chapter. ▸ *Active*: The values of the Double Point Values are forwarded to zenon as they are. In this case, you cannot use the command processing function of zenon Energy or ALC for example. Default: *inactive*
Do not purge BRCB buffer at start	▸ *Active*: The buffer of the BRCBs are not deleted on the IED when the connection is first established after Runtime has started. **Requirements**: For this BRCB , the last EntryID received has been saved. If no EntryID has been

Parameter	Description
	saved yet, the property is ignored and the driver sets BRCB.PurgeBuf=TRUE. Only has an effect after the first attempt to activate a BRCB after Runtime has been restarted. Is ignored with repeated attempts to set a BRCB.RptEna=TRUE - if the **RCBs enable retries** time has expired. **Note**: If Runtime has not been stopped and only the connection to the IED has been disconnected, the setting is irrelevant. After reconnection, the driver attempts to get the buffered values again; the driver does not delete the values. More in the **Buffered reporting** (on page 126) chapter.
Addressing:	States which variable property is used in the driver for the addressing (ObjectReference). ▸ **Variable name** (**Name**) ▸ Variable identification (**Identification**) ▸ Symbolic address (**Symbolic address**) Default:**Symbolic address** **Note**: When importing the variables, the driver fills all three variable properties with valid references. You can rename the properties that the driver does not then use for addressing.
Originator category (orCat)	The driver sends the configured **orCat** value in commands - in SBOw and Oper structures - that it writes to the IED . Possible settings: ▸ *1 - Bay-control* ▸ *2 - Station-control* ▸ *3 - Remote-control* ▸ *4 - Automatic-bay* ▸ *5 - Automatic-station* ▸ *6 - Automatic-remote*

Parameter	Description
	▸ *7 - Maintenance* Default: *2 - Station-control*
Directory for file transfer	Directory for file transfer. All files loaded are saved in this folder. More in the Filetransfer (on page 113) chapter.

5.2.2.1 Configuration of the driver

In the Editor, the driver saves its configuration in the TXT file as defined in **Configuration file name**. In Runtime, the driver gets its configuration from the copy of the file that the editor has provided.

STRUCTURE OF A CONFIGURATION FILE OF THE DRIVER

Line	Description
1	Number of configured servers
2 – (m-1)	Server configuration (see server configuration)
m – n	Possible further server configuration(s)

SERVER CONFIGURATION

Line	Description	Example
1	Start of a server configuration (= **** SERVER ****)	*** SERVER ***
2	Number of items in this server configuration, abbreviated: *CNTSRVITEMS*	44
3	Net address	1
4	Server name	RELAY1
5	Primary IP address	192.168.250.22
6	Primary IP port	102
7	**Polling rate** Read interval in milliseconds	1000
8	Calling AE qualifier	12

Line	Description	Example
9	Called AE qualifier	12
10	Calling AP title[0]	1
11	Called AP title[0]	1
12	Calling AP title[1]	1
13	Called AP title[1]	1
14	Calling AP title[2]	1
15	Called AP title[2]	999
16	Calling AP title[3]	999
17	Called AP title[3]	1
18	Calling AP title[4]	-1
19	Called AP title[4]	1
20	Calling AP title[5]	-12851
21	Called AP title[5]	-1
22	Calling AP title[6]	-12851
23	Called AP title[6]	-12851
24	Calling AP title[7]	-12851
25	Called AP title[7]	-12851
26	Calling AP title[8]	-12851
27	Called AP title[8]	-12851
28	Calling AP title[9]	-12851
29	Called AP title[9]	-12851
30	**Max. auto used URCBs** Maximum number of Unbuffered Reports (URCBs) that the driver activates with automatic assignment per Logical Device	10
31	* - in newer configurations With old configuration: names of the assigned Buffered	*

Line	Description	Example
	Reports (BRCBs), separated with commas	
32	**Use preconfigured (SCL) options** 0 = subsequently configured RCB settings (TrgOps, OptFlds, IntgPd, BufTm) are used 1 = the RCB settings that have already been preconfigured in the IEC61850 server - in its SCL file - are used	0
33	**Use Report-ID for RCB assignment** 0 = The RCB instances of the server are identified by name. 1 = Report ID that is used instead of the report name in the dialog for RCB assignment.	0
34	**Use Authentication** 0 = no ISO-Authentication used 1 = If active, the driver sends the **Authentication String** at establishing the connection.	0
35	**Authentication String**	
36	Alternative IP address	
37	Alternative IP port	0
38	TrgOp data-change: 0 = inactive ; 1 = active	1
39	TrgOp quality-change: 0 = inactive ; 1 = active	1
40	TrgOp data-update: 0 = inactive ; 1 = active	0
41	TrgOp integrity: 0 = inactive ; 1 = active	0
42	TrgOp general-interrogation: 0 = inactive ; 1 = active	1
43	**GetNameList on DO** 0 = Normal GetNameList 1 = The driver reads the object model by requesting data objects (DO) for each Logical Node available in the server and each Functional Constraint (FC) defined in the IEC61850 standard. This option has been removed from the configuration	0

Line	Description	Example
	dialog in version 8.00 and replaced with an automated method.	
44	**Integrity Period**	7000
45	**Buffer Time**	500
46	**OptFlds** Optional fields of the RCB	73
47	**RCBs enable reties** Cycle in seconds in which an attempt is made to activate RCBs that were not activated successfully again. Only present if CNTSRVITEMS >= is 45	7
48	**Automatic Watchdog**	1
49	**Data consistency scan**	300
50	**Use SCADA network orIdend**	0
51	Number of client configurations	
52 – (m-1)	Client configuration (see Client configuration)	
m – n	Possible further client configurations	

CLIENT CONFIGURATION

Line	Description	Beispiel
1	Start of a client configuration (= *** *CLIENTCFG* ***)	*** CLIENTCFG ***
2	Number of Items in this client configuration	1
3	**Hostname (RT computer name)** Name of the computer on which the driver is running that receives the reports	WKS007
4	**ClientLN.iedName**	SCADA_Server 1
5	**orIdent**	

Line	Description	Beispiel
6	Number of RCB configurations	2
7 – (i-1)	RCB configuration (see RCB configuration)	
i – (j-1)	Possible further RCB configurations	
y	Number of dynamic dataset configurations	
k – (l-1)	Dynamic dataset configuration (see dynamic dataset configuration)	
l – m	Possible further dynamic dataset configuration	

RCB CONFIGURATION

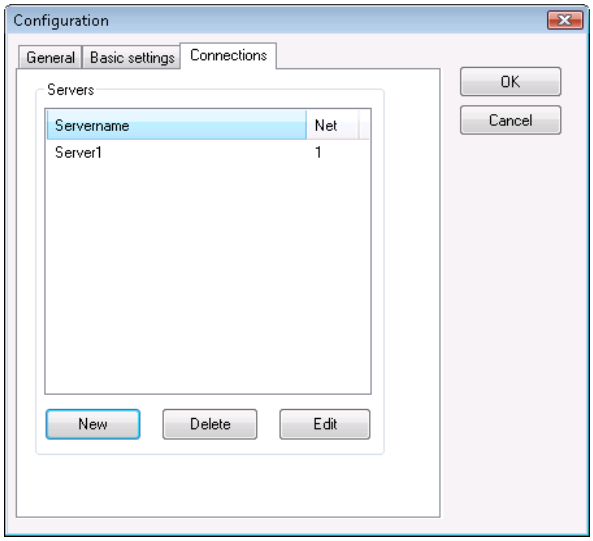
Line	Description	Example
1	Start of a RCB configuration (= *** *RCBCFG* ***)	*** RCBCFG ***
2	Number of items in this RCB configuration	2
3	RCB name or ID	UP_CTRL/LLN0/urcb_QxCSWI1_Pos02[RP]
4	Name of the dynamic data set.	NEW_DYN_DATASET

DYNAMIC DATASET CONFIGURATION

Line	Description	Example
1	Start of a dynamic dataset (= *** *DATASET* ***)	*** DATASET ***
2	Number of items in this dynamic dataset configuration	1
3	Name of the dynamic data set	NEW_DYN_DATASET
4	Number of Object References of the dynamic dataset	2
5	Object Reference	UPCTRL/Q1CSWI1CFPos
6 – n	Possible further Object Reference.	UPCTRL/Q1CSWI1STPos

5.2.3 Connections

The connections of the IEC850 driver are set in the **Connections** tab of the driver dialog.



Parameter	Description
Servers	List of the already-configured connections to the IEC 61850 server.
New	Creates a new connection to an IEC 61850 server. Opens the **Server** dialog.
Delete	Removes the selected connection from the list.
Edit	Opens the **Server** dialog to edit the selected connection

CLOSE DIALOG

Option	Description
OK	**Applies all changes in all tabs and closes the dialog.**
Cancel	Discards all changes in all tabs and closes the dialog.
Help	Opens online help.

5.2.3.1 Server

Clicking on **New** or **Edit** in the dialog **Connection** (on page 25) opens the dialog for the configuration of a connection to an IEC 61850 server:

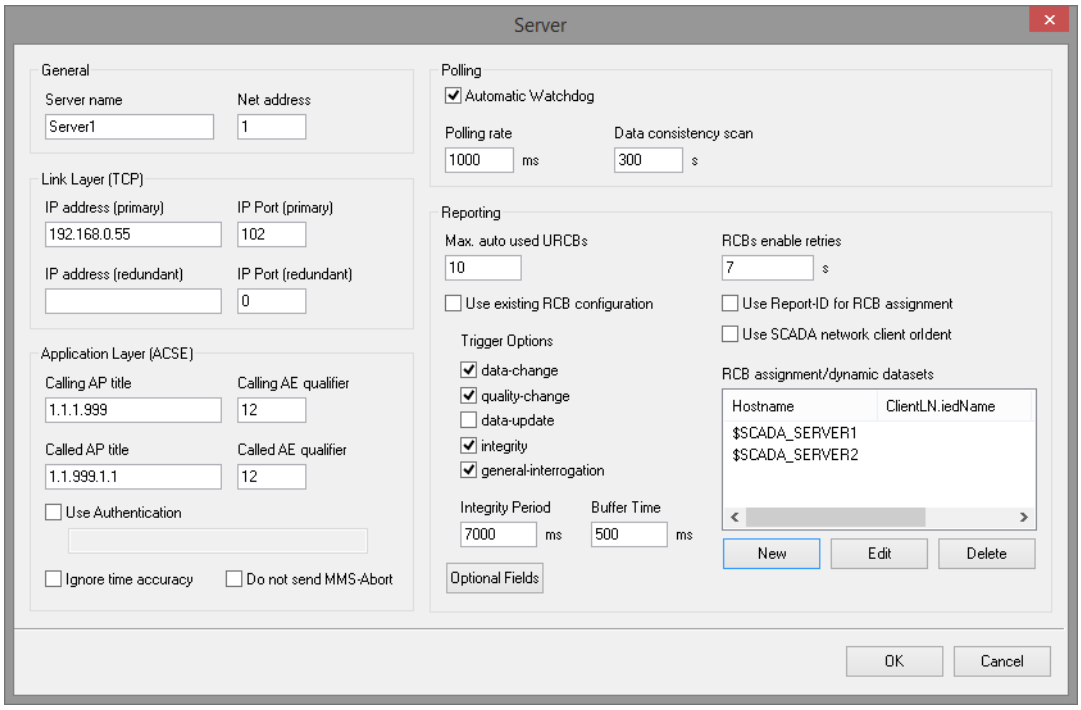
Note: This dialog is only available in English.

BASIC CONFIGURATION

In order to be able to establish an initial connection to a typical 850 server, it is generally sufficient to configure the following properties:

- **Server name**
- **Net address**
- **IP address (primary)**

You can therefore communicate with the server in Runtime or create variables by means of online import (on page 64) in the zenon Editor.



Once you have then imported the variables and tested the connection to the 850 server in Runtime, you should once again consider the driver configuration - for Reporting - carefully and carry out **RCB assignment**.

GENERAL

Parameter	Description
Server name	Freely definable name. Is used at variable import for the zenon properties **Name**, **Identification** and **Symbolic address** of the variables; syntax: <*Server name*>!<*ObjectReference*> - in order to guarantee the uniqueness of the variable name in systems where 850 Server have the same IED and LDevice names. **Note**: keep the **Server name** short (just one letter is sufficient). The name is only for the uniqueness of the variable name. The assignment of the variables to the connection (to the 850-Server) is undertaken by the driver from the **Net address** property, not from this name. Default:*Server1*
Net address	Corresponds to the **Net address** property (property group: **Addressing**) in variable configuration. Freely-selectable number. The driver assigns the zenon variables to the 850 Server using this property. Default: *1* Maximum value: *65535*

LINK LAYER (TCP)

Connection settings to the 850 server to which the connection is to be established.

Parameters	Description
IP adress (primary)	IP address of the 850 server to which a connection is to be made. Default:*192.168.0.55*
IP Port (primary)	IP port of the 850 server to which the connection is to be made. Default: *102*
IP adress (redundant)	Alternative IP address. If the connection to the first IP address fails, the alternative IP address will be used after the net error waiting time has passed *(20-30 sec., depending on the network)*. The alternative address will be kept until the driver is restarted (via driver functions or restart of the zenon Runtime) or until the connection fails. Then, the first IP address will be used again. **Attention:** In order to detect a loss of a connection, the

Parameters	Description
	Automatic watchdog watchdog property should be activated or at least one variable, such as **LLN0/Mod/stVal[ST]* should always be polled.
IP Port (redundant)	Alternative IP port.

POLLING

Parameters	Description
Automatic Watchdog	Checkbox to activate the watchdog. If active, the driver automatically sends, for each **Polling rate** configured, a read request for **LLN0STMod$stVal* in order to detect a possible loss of connection **Note**: At least one data attribute should always be polled even if all data of the project is present in the report. Otherwise the failure of the IEC61850 server cannot be detected. Only deactivate this property if it is guaranteed in the project that at least one polled variable is always signed in. Default: *active*
Polling rate	Defines the update frequency in milliseconds. The driver supports this rate to poll data that is not in active **reports**. At this a possible failure of the IEC61850 server is also considered. Maximum value: *4294967295* If a higher value is entered, it is automatically changed to 1 when saved. Default: *1000 ms* **Attention:** Exchange of data in Runtime does not depend on this setting or on the **global update time**. This is set to *100ms* and fixed.
Data consistency scan	Defines the cycle in which the driver checks the data model to see that it is consistent. Is only used if, in configured reports, the datasets contain individual data attributes instead of data objects. Default: *300 seconds* Input range: *0 - 999999*

REPORTING

Parameters	Description
Reporting	Settings for the reports (on page 115).
Max. auto used URCBs	Maximum number of Unbuffered Reports which the driver activates at automatic allocation per Logical Device, i.e. in addition to RCBs that were configured in the **RCB assignment** dialog. Default: *10* Entry is only valid for Unbuffered Reports (URCB), does not affect any BRCBs . **Note**: the setting makes the use of reporting easier in the test phase of the project already - even before the target settings for reporting have been set. Configure the use of URCB in the **RCB assignment** dialog and set the property to 0 before you approve the project. you can find more information on automatic allocation in the **Unbuffered Report** (on page 122) chapter.
Vertical group of the option group	Settings for URCBs that the driver automatically assigns and default values for properties with the same name in the **RCB assignment** dialog.
Use existing RCB configuration	You can activate/deactivate the following **Trigger Options** regardless of one another. ▸ *data-change* Default: *active* ▸ *quality-change* Default: *active* ▸ *data-update* Default: *inactive* ▸ *integrity* Default: *active* ▸ *general-interrogation* Default: *active* **Note**: Not all servers support TrgOps data-change and data-update together. TrgOp intergity can also lead to an unnecessary overload of communication if a an IntgPd (Integrity Period) that is too short was defined in the server for RCB. In

Parameters	Description
	case of doubt, set TrgOps: data-change + quality-change + general-interrogation.
Integrity Period	Time interval (IntgPd) in milliseconds in which the server sends an Integrity Report. Default:*7000* ms **Note:** not active if *TrgOp integrity* is deactivated or **Use preconfigured (SCL) options** is activated. Because an Integrity Report does not normally contain value changes, it is expressly recommended that only one single report on the server is activated with *TrgOp: integrity*. With an activated integrity report, the server can detect a connection failure more quickly. zenon does not need this report. Default: *7000 ms*
Buffer Time	Time interval (BufTime) in milliseconds in which the server collects the data for a report. Default: *500 ms* **Note:** Inactive if the **Use preconfigured (SCL) options** option has been activated.
OptFlds	Opens the dialog to configure the Optional Fields (on page 36) of the report. **Note:** If the **Use preconfigured (SCL) options** option has been activated, the dialog's options are displayed, but cannot be changed.
Vertical group of the settings	Settings relevant for **RCB assignment** dialog.
RCBs enable retries	Configuration of the periods of the renewed attempts to register the RCBs that have not been successfully registered. If the sign-in of an RCB is rejected by the 850 server, the driver will attempt it again - depending on **RCBs enable retries**. Entry of the time in seconds. Input range: *0 - 999999* Default: *7* the driver attempts to write again every 7 seconds

Parameters	Description
	RCB.RptEna=TRUE. **Note:** ▸ The variables are polled for as long as the sign-in is not successful. For this reason, the periods should be greater than the **Polling rate**, otherwise it is not guaranteed the the variables affected have the initial values. ▸ With an entry of 0, there is no attempt to register an RCB again. ▸ These settings only concern RCBs that are listed in the **RCB assignment** section.
Use Report-ID for RCB assignment	Decision of whether the driver should search and register the RCB instances using their names (normal process) or with a special process by means of *Report ID*. ▸ *Inactive*: (recommended) The RCB instances of the server are identified by name. This process is supported by all - IEC61850 standard-compliant - servers. ▸ *Active*: The *Report ID* is used instead of the report name in the static RCB assignment in the **RCB assignment** dialog. The process is only suitable for special applications. The driver will sign in all RCB instances that have the same ID. Requires corresponding configuration in the SCL file of the 850 server: ▸ A separate report ID must be defined for each client in the system, i.e. a different ID for each **Hostname**. ▸ With different RCBs, precisely one instance each is marked with the ID. Instances that need a client are thus marked. **Note**: The IEC61850 standard allows several RCBs to have the same value in RptID . In Runtime, the driver will search for **all** RCBs with the respective Report ID and register them. The driver can thus configure in such a way that it signs in several RCBs with just one entry in the list and also those that did not yet exist at the time of driver configuration. Default: *inactive*

Parameters	Description
	Attention: Do not activate if you are not sure that you want to use this special feature in the driver. If this option is amended later, all RCB assignments in the **RCB assignment** dialog must be deleted, the driver configuration has to be closed and opened, and **RCB assignment** must be set up again.
Use SCADA network orIdend	If this checkbox is activated, *orIdent* is used in commands, based on the name of the computer on which the user has triggered the command. The computer name is resolved from the list of **host names**. This configuration is carried out in the **Client configuration** dialog (on page 37). If the checkbox is not activated, the orIdent of the Primary SCADA Server is used. Default: *inactive* **Note:** The default origin.orIdent *'zenon: <computer_name>'* is used in commands if: ▸ In the client configuration for the corresponding computer (= **Hostname**), no orIdent is configured. ▸ in the client configuration for the corresponding computer, no entry with **Hostname** has been configured.
RCB assignment/dynamic datasets	Static Report Control Block allocations and settings for Dynamic Data Sets. ▸ *Hostname* ▸ *ClientLN.iedName* ▸ *orIdent* As configured in the **Client configuration** (on page 37) dialog. The width of the column display can be increased or reduced by clicking the mouse. The section can be moved with the scroll bar. **Note**: If you want to use redundancy in your zenon project (**Network active** property activated as well as **Server 1** and

Parameters	Description
	Server 2 configured), you must create at least two entries here: one for the primary server and one for the standby server in the zenon network. Two entries are already prescribed by default when a server is created (*$SCADA_SERVER1* and *$SCADA_SERVER1*). These entries each receive an empty configuration and must be configured. If in the runtime no client configuration for the computer name is found and if the project runs as standalone or at the projected **Server 1**, client configuration *$SCADA_SERVER1* is searched. If the project runs in the above mentioned case at the projected **Server 2**, an alternative client configuration *$SCADA_SERVER2* is searched. Per default the configuration for *$SCADA_Server1* and *$SCADA_SERVER2* is empty. By clicking button **Edit** you can project your correct configuration.
New	Creates a new entry in the list. Opens the **Client configuraton** (on page 37) dialog**.**
Edit	Opens the **Client configuration** (on page 37) dialog to edit the selected entry.
Delete	Removes the selected entry from the list. **Note:** the entry is deleted immediately without a further request for confirmation.

APPLICATION LAYER (ACSE)

Setting for ACSE.

Parameters	Description
Calling AP title	Settings according to ISO 8650-1(ACSE), the value for the *OSI ACSE AP Title* of the client in the Universal Identifier notation. Default: *1.1.1.999* Should not normally be amended.
Calling AE qualifier	Settings according to ISO 8650-1(ACSE). Default: *12* Should not normally be amended.

Parameters	Description
Called AP title	Settings according to ISO 8650-1(ACSE), *OSI-AP-Title* of the server in the format for Universal Identifier. Default: *1.1.999.1.1* Should not normally be amended.
Called AE qualifier	Settings according to ISO 8650-1(ACSE). Default: *12* Should not normally be amended.
Use Authentication	Activate this checkbox if you want to use authentication according to ISO 8650-1. *Active*: If active, the driver sends the Authentication String at establishing the connection.
[Input field for Authentication String]	Input field for *Authentication String*. Note the length limitation of 55 characters in accordance with ISO 8327-1 OSI session protocol. **Note:** Only active if **Use Authentication** is active. This option is deactivated by default.
Ignore time accuracy	Checkbox to ignore the precision of the received time stamp. ▸ *Active* All decimal comma points of the received time stamp are evaluated, regardless of how many decimal points the time stamp are valid according to *TimeAccuracy*. ▸ *Inactive:* The decimal points of the received time stamp are evaluated according to *TimeAccuracy*.
Do not send MMS-Abort	Defines the way of how connections to the IED are closed. ▸ *active*: The driver closes the TCP socket instead of sending a MMS (ACSE) compliant Abort. ▸ *inactive*: The driver sends the standard compliant Abort service.. Default: *inactive*

CLOSE DIALOG

Option	Description
OK	**Applies settings and closes the dialog.**
Cancel	Discards all changes and closes the dialog.

Information

OSI value (ACSE)

The driver uses the following OSI selector values:

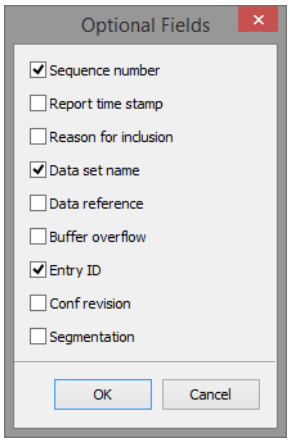
- Presentation Selector (OSI-PSEL) = "00000001"
- Session Selector (OSI-SSEL) = "0001"
- Transport Selector (OSI-TSEL) = "0001"

In a server SCL file, it corresponds to the following entries:

- <P type="OSI-AP-Title">41,999,1,1</P>
  - coded in accordance with Basic Encoding Rules (IEC 8825) for Object Identifier - corresponds to default values of the Universal Identifiers in the **Called AP title**.
- <P type="OSI-AE-Qualifier">12</P>
  - corresponds to default values in the **Called AE qualifier**.
- <P type="OSI-PSEL">00000001</P>
  - set in the driver; cannot be changed
- <P type="OSI-SSEL">0001</P>
  - set in the driver; cannot be changed
- <P type="OSI-TSEL">0001</P>
  - set in the driver; cannot be changed

5.2.3.1.1 Optional Fields

The Optional Fields are written on the server when a report is activated. These correspond to the bits in the OptFlds data attribute of the RCB.



"**Sequence number**", "**Data set name**" and "**Entry ID**" are activated by default:

- The **Data set name** option is activated by default. Deactivation of this option is not recommended.
  - The following is applicable if this option is deactivated:
    If an InformationReport is received without a DatSet Name, *RptID* is used to carry out a search to see which data set is linked in the RCB. A basic requirement for this is that the *RptIDs* is unique for the complete 850 server.
- **Entry ID** is required for Buffered Reports (BRCB) in order to request the buffered values after the connection has been reestablished. Does not exist in URCB , is thus not written even if it has been configured.
- **Sequence number** is only to check whether the reports have been transferred without omissions. Is possibly evaluated in LOG.

FURTHER OPTIONAL FIELDS:

- **Report time stamp**
  SSS
- **Reason for inclusion**
  Activate "**Reason for inclusion**" in order to read the information for the variables with the status bits **COTx**, relating to how their value has been received: via a spontaneous report or GI or Integrity report.
- **Data reference**
  Activation of the "**Data reference**" option results in the reports becoming very large. These reports then contain the ObjektReference - as a readable string - for each data attribute (variable) of the data set. This makes analysis easier, in **Wireshark** for example. These reports (with **Data reference**) are however not suitable for approved systems.

- **Buffer overflow**
  If a report is received by a driver with the *BufOvfl* flag set and this received report is not the first report that has been received (after activation of the RCB with *PurgeBuf*), this is logged by the driver in the LOG file with a corresponding warning message:

  IED reports a buffer overflow with Report-ID (Entry-ID)
- **Conf revision**
  x
- **Segmentation**
  y

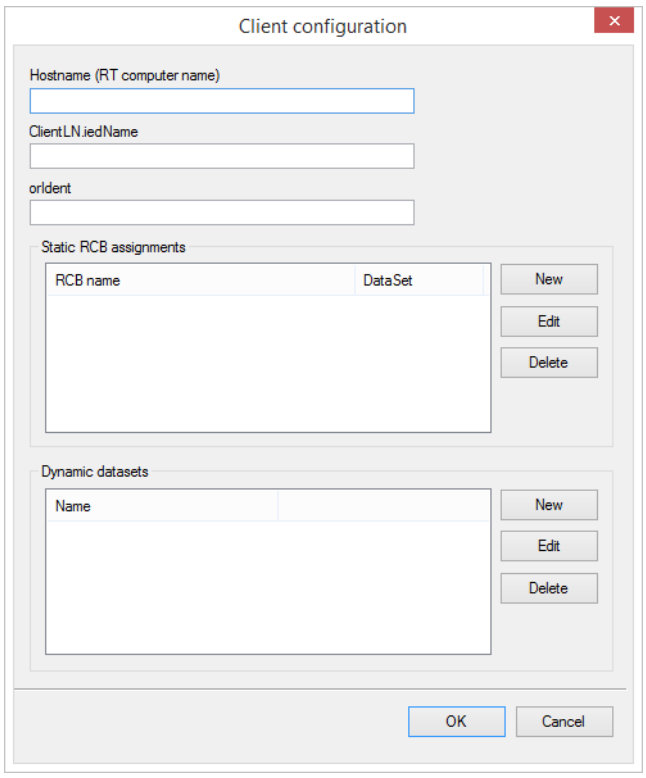
CLOSE DIALOG

Option	Description
OK	**Applies settings and closes the dialog.**
Cancel	Discards all changes and closes the dialog.

5.2.3.2 Client configuration

Clicking on **New** or **Edit** in the **RCB assignments/dynamic datasets** list of the server dialogs (on page 26) opens the dialog for the client configuration settings:

Note: This dialog is only available in English.



Parameter	Description
Hostname (RT computer name)	Name of the computer on which the driver is running that receives the reports: ▸ For standalone projects: *$SCADA_SERVER1* Or computer name of the computer on which the zenon Runtime is running ▸ In the zenon network: *$SCADA_SERVER1* Or computer name of the project server **Server 1** *$SCADA_SERVER2* or computer name of the project standby server **Server 2** Computer name of the network client for the determination of orIdent. This is only taken into account if option **Use SCADA network client orIdent** in dialog **Server** is activated. **Note**: Do not use "*localhost*"; use the computer names from the operating system instead. The **Hostname** must not be empty if at least one of the following configuration settings has been configured.

Parameter	Description
	Attention: If the driver does not find a **host name** that corresponds to the current **Runtime computer name**, it cannot activate the reports. It is logged as an error/warning.

Parameter	Description
ClientLN.iedName	IED name of the IEC61850 clients as stated in the SCD file and given there under RCB.RptEnabled.ClientLN. Permitted characters: A to Z, a to z and 0 to 9 and underscore _ maximum 64 characters. Default: *empty* **Hint:** In order to easily configure the driver with a SCD file, use the **IEC850 Driver Configuration Wizard**. You can find further details in the Wizard documentation. **Note:** The status of the *Resv* attribute is ignored when validating the availability of the *RCB* for statically-assigned *URCBss* if the **ClientLN.iedName** option is configured.
orIdent	Input field for the configuration of the orIdent. For each computer in the zenon network, a freely-definable orIdent entry can be configured. You can use up to 32 characters. Default: *empty (= 'zenon: <computer_name>')* **Note:** The Originator that is used in commands is also dependent on the configuration in the Basic **Settings** dialog (**orCat** property) and in the **Server** dialog (**Use Client orIdent** checkbox). If the **Use Client orIdent** checkbox is not active, the *orIdent* of the Primary Server is always used in commands. If the **Use Client orIdent** checkbox is active: The default origin.orIdent *'zenon: <computer_name>'* is used in commands if: ▸ In the client configuration for the corresponding computer (= **Hostname**), no orIdent is configured. ▸ in the client configuration for the corresponding computer, no entry with **Hostname** has been configured.

LIST: STATIC RCB ASSIGNMENTS

Settings for the static assignment of RCBs (the same for Unbuffered and Buffered RCBs).

Note: Buffered Reports must be configured in the driver configuration. Otherwise they are not used.

Parameter	Description
RCB name	Name of the configured RCBs. RCBs are configured in the Statically assigned RCB subdialog. This configuration is started by clicking on the corresponding **New** button.
DataSet	Displays the dynamic DataSet if the RCB was allocated one. Allocation: 1. Configure, in the **Dynamic datasets** list with the attendant **New** button, a corresponding dynamic dataset. 2. This dynamic dataset can be selected in the **Statically assigned RCB** dialog in the **Dynamic dataset** drop-down list. **Note**: the use of dynamic Data Set is optional. Not all 850 servers support the dynamic creation of additional data sets.
New	Creates a new entry in the list. Opens the **Statically assigned RCB** (on page 42) dialog, in order to create a new entry with a report name (or a report ID) - you can either enter it manually or browse in the 850 server and link to the **Dynamic Dataset** from the lower list if necessary.
Edit	Opens the '**Statically assigned RCB** (on page 42)' dialog to edit the selected entry.
Delete	Removes the selected entry from the list.

LIST: DYNAMIC DATASETS

Settings for dynamic data sets.

Note: Dynamic data sets are not a requirement for Buffered or Unbuffered Reports. They are optional settings if the IEC61850 server that is used supports this and, in selected RCBs, there is no unsuitable or replaceable configuration of the Dataset .

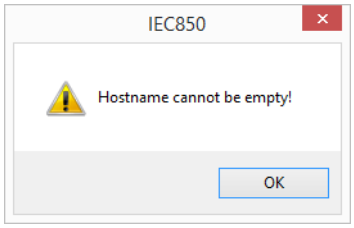
For more information, see dynamic data sets (on page 131).

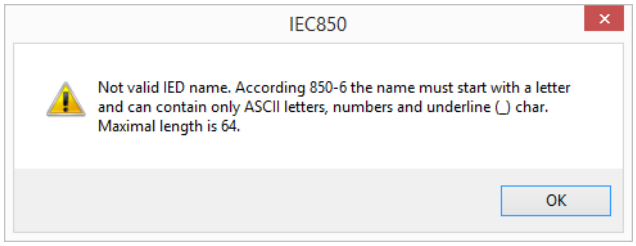
Parameter	Description
Name	Shows the previously-entered Datasets - they are then available

Parameter	Description
	in the upper list.
New	Opens the dialog to create a Dataset.
Edit	Opens the **Dynamic DataSet configuration** (on page 48) dialog to edit the selected entry.
Delete	Removes the selected entry from the list.

WARNING NOTICES

If the configuration is not correct, you are notified of this with a corresponding warning dialog. Confirm this dialog by clicking on the OK button to return to the configuration dialog. Then correct the error.

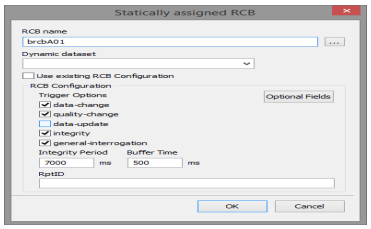




Note: The warning dialog is only available in English.

5.2.3.2.1Statically assigned RCB

Clicking on **New** or **Edit** in the **Static RCB assignment** list of the **Client configuration** (on page 37) dialog opens the dialog to create an assignment to RCB or to assign an RCB a dynamic Dataset. RCBs are defined using their name (standard case) or ID (special case):



Parameters	Description
RCB name	The name (unique) or the RptID (possibly not

Parameters	Description
	unique) of the report - buffered or unbuffered - that the driver is to use. When establishing a connection, the driver will register configured RCB instances (enable). Must correspond exactly to the name/report ID in the PLC (IEC61850 server). Clicking on **...** starts the online browsing by the configured 850 server on the first call. The result of the first call is listed when called up again. If the server is running, all instances of each Report Control Block that are present in the data model of the server are listed. You can find more details later in this chapter. **Note: RCB name** is expected here by default. The RCB name is saved with the full *ObjectReference* and is thus unique. The use of the **RCB name** can be changed to report ID using the **Use Report-ID for RCB assignment** property in the **Server** (on page 26) properties. **Report-ID**: the report ID is saved as it is received from the 850 server; the same ID can thus affect several RCBs. The standard allows several RCBs to have the same value in RptID . **Attention:** In Runtime, the driver will search for all RCBs with the respective Report ID and register them. In the event of configuration errors, it may lead to the driver registering all instances of a certain RCB even though they are all supplying the same data. There is also thus no free instance for the other clients. **Note:** If Runtime is also running at the same time on the same computer, some 850 servers can refuse the second connection from the same IP. The driver can then not browse the RCBs in the Editor. Close Runtime beforehand.
Dynamic DataSet	You can also optionally select a Data Set from the drop-down list of the data sets that have already been entered into the **Dynamic dataSet**

Parameters	Description
	configuration (on page 48) dialog. **Note:** If you do not define a Data Set here, a data set that has already been defined in the PLC (IEC61850 Server) is used for this RCB (in the SCL file).
Use existing RCB configuration	*active*: The driver activates a report without overwriting the data attributes of the RCB. The content of the SCL file of the server is defined as a result of this. The following data attributes are affected by this: ▸ IntgPd ▸ BufTime ▸ TrgOps ▸ OptFields *Inactive*: The driver writes the data attributes of the RCB during activation. The driver overwrites the data attributes of the RCB in the IED only if they do not match the settings of the driver. Default: *inactive*

RCB CONFIGURATION

Parameters	Description
Trigger Options	You can activate/deactivate the following **Trigger Options** regardless of one another. ▸ *data-change* Default: *active* ▸ *quality-change* Default: *active* ▸ *data-update* Default: *inactive* ▸ *integrity*

Parameters	Description
	Default: *active* ▸ *general-interrogation* Default: *active* **Note**: Not all servers support TrgOps data-change and data-update together. TrgOp intergity can also lead to an unnecessary overload of communication if a an IntgPd (Integrity Period) that is too short was defined in the server for RCB. In case of doubt, set TrgOps: data-change + quality-change + general-interrogation.
Integrity Period	Time interval (IntgPd) in milliseconds in which the server sends an Integrity Report. Default:*7000* ms **Note:** not active if *TrgOp integrity* is deactivated or **Use preconfigured (SCL) options** is activated. Because an Integrity Report does not normally contain value changes, it is expressly recommended that only one single report on the server is activated with *TrgOp: integrity*. With an activated integrity report, the server can detect a connection failure more quickly. zenon does not need this report. Default: *7000 ms*
Buffer Time	Time interval (BufTime) in milliseconds in which the server collects the data for a report. Default: *500 ms* **Note:** Inactive if the **Use preconfigured (SCL) options** option has been activated.
Optional Fields	Opens the dialog to configure the Optional Fields (on page 36) of the report. **Note:** If the **Use preconfigured (SCL) options** option has been activated, the dialog's options are displayed, but cannot be changed.
RptID	Input field for the Report ID which the drivers assignes at the activation of RCB (enable).

Parameters	Description
	If this input field is empty, the RCB is used with the ID already known to the IED.

CLOSE DIALOG

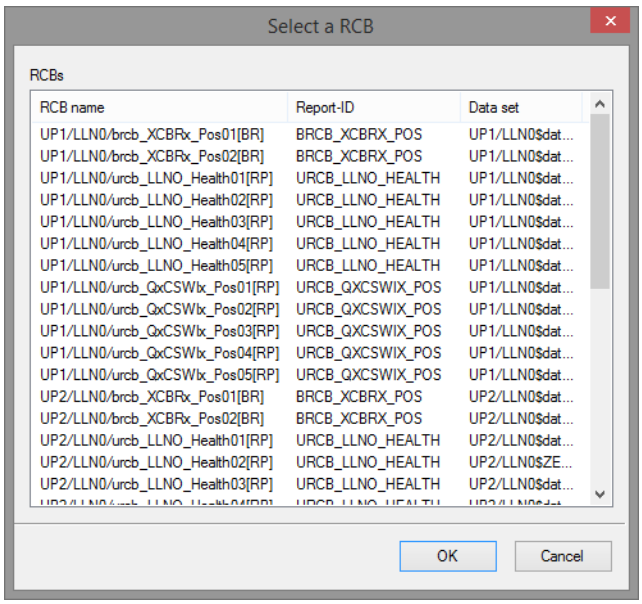
Option	Description
OK	**Applies settings and closes the dialog.**
Cancel	Discards all changes and closes the dialog.

ONLINE BROWSING OF THE RCB INSTANCES

Clicking on **...** starts online browsing of the 850 server and shows, if the server is running, all instances of each Report Control Blocks that are currently in the data model of the server.

Attention: In order to be able to establish the connection to the **IP address** of the 850 server, the driver configuration must be saved at least once beforehand.

After the driver has read the RCBs online from the IEC 61850 server, the following list is shown:



Parameter	Description
RCB name	Name of the RCBs as configured in the data model on the server.
Report ID	Identification of the RCB as configured in the data model on the server in the *RptID* attribute.

Parameter	Description
Data set	Name of the datasets in the RCB as configured in the data model on the server.
OK	Applies settings and closes the dialog. A validation is carried out before closing the dialog. In case of failure, a warning dialog pops up.
Cancel	Discards all changes and closes the dialog.

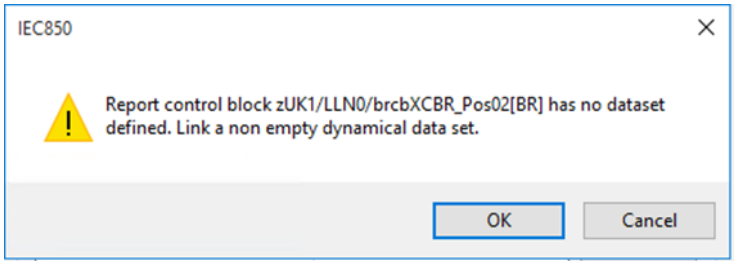
Select the desired instance of a Report Control Block from the list and click OK. You can repeat the procedure as many times as you want in order to assign further RCBs.

Note: Ensure that, for each **Hostname**, the instances with other names (and/or other number), or other report ID are selected. In accordance with the IEC61850 standard, an instance of the RCB can only be registered (enabled) by one client.

VALIDATION OF THE DATA SET

When confirming the configuration by clicking on the **OK** button, a validation is carried out for all newly-added RCBs to see whether the RCB has a dataset name from the 850 server or an existing and non-empty dynamic set has been linked. The validation reports the RCBs that cannot provide any data in the Runtime.

A warning message is shown if an error occurs.



Parameter	Description
OK	Confirms the warning message and closes the dialog.
Cancel	Cancels closing and returns to the **Statically assigned RCB** dialog.

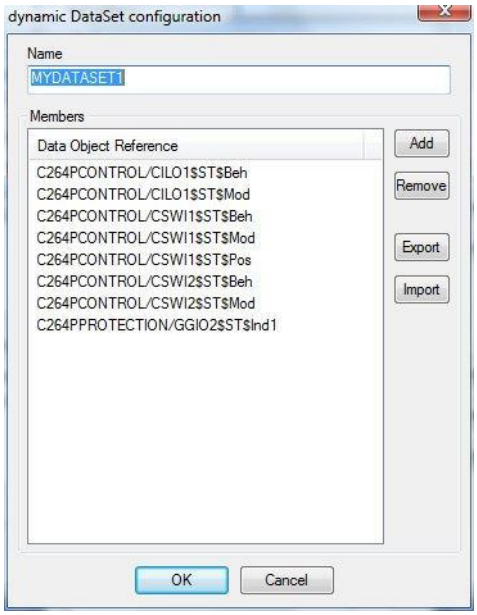
NOTES ON PROJECT CONFIGURATION

Note that not all 850 servers support dynamic data sets. In this case, configured RCBs without dataset names cannot be used in the server's data model.

If the 850 server does not support dynamic data sets, the IED must be updated with a corrected SCL file (CID).

5.2.3.2.2 Dynamic dataset configuration

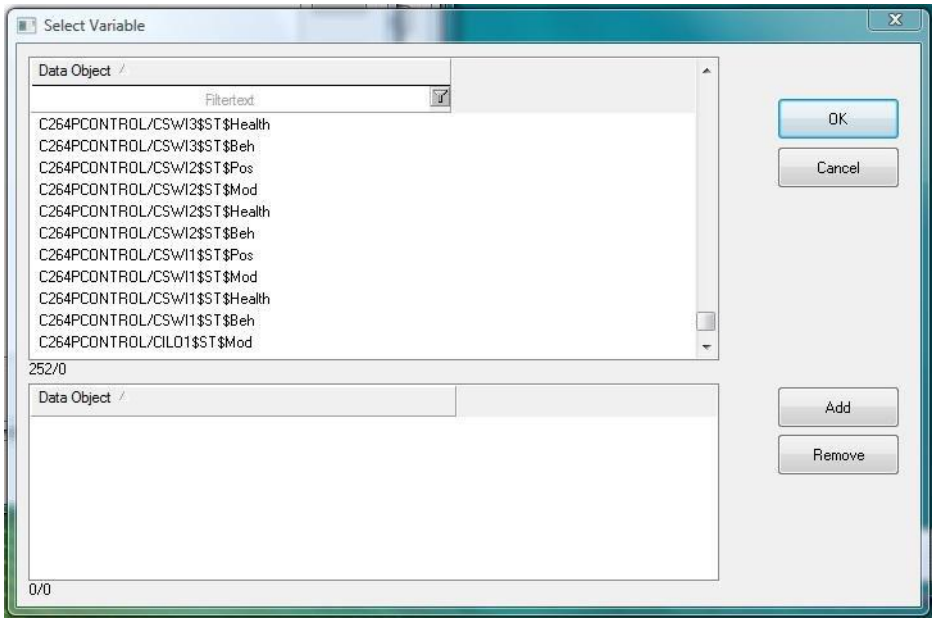
Clicking on **New** or **Edit** in the **dynamic data sets** list of the **Client configuration** (on page 37) dialog opens the dialog to define a dynamic Data Set.



Parameter	Description
Name	Name of the Data Set. **Note**: enter very short names, for example 'DS1'. The driver will automatically add the current **Runtime computer name** to the name - in order to be able to distinguish separate dynamic data sets from data sets of other clients. The RCB is thus registered with the DatSet parameter: ZENON_**hostname**_<**Name**> The RCB.DatSet parameter has, in accordance with the IEC61850 standard Ed.2, a maximum length of 32 (more precisely: 64/16$32). The other characters can be cut off.
Members	List of pre-configured data objects.
Add	Starts the browsing of ObjectReferences from the variable list of the zenon project and displays all data objects for which a variable has already been created in the project. **Note**: The driver does not read the data objects from the IEC61850 server, but from the variable list in the Editor. If the Runtime is also running at the same time on the same computer, the variables cannot be browsed.

Parameter	Description
Remove	Removes the selected entry from the list.
Export	Exports members to a TXT file.
Import	Imports members to a TXT fle. In the open dialog: ▸ Select the corresponding file. ▸ Select the desired variables. ▸ Confirm the settings by clicking on OK.

The following list is displayed once you have browsed suitable project variables:



The driver displays all data objects - that are appropriate for data reporting - from the variable list of the zenon project, except those that have already been selected for the data set. In the upper list, you can filter and select the listed variables. Multiple selection is possible (with the **Alt** or **Shift key** held down).

Clicking on the **Add** button adds your selection to the lower list. Objects that have already been selected are kept. Use the **OK** button to add the selected variables (as references to the data objects) to the **members** of the dynamic data set.

6 Creating variables

This is how you can create variables in the zenon Editor:

6.1 Creating variables in the Editor

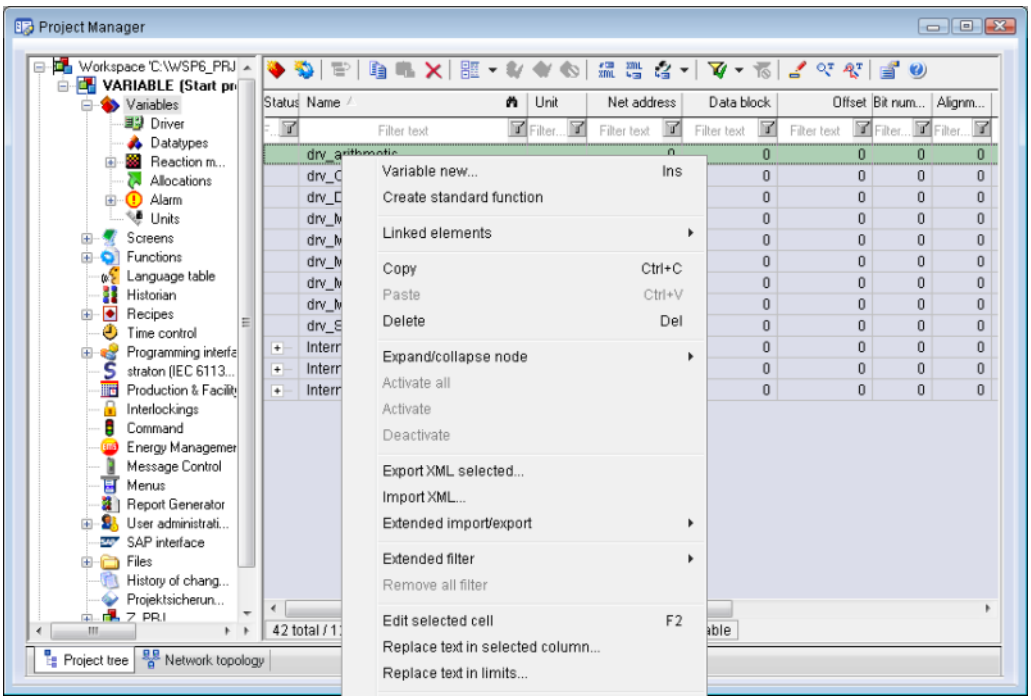
Variables can be created:

- as simple variables
- in arrays (main.chm::/15262.htm)
- as structure variables (main.chm::/15278.htm)

VARIABLE DIALOG

To create a new variable, regardless of which type:

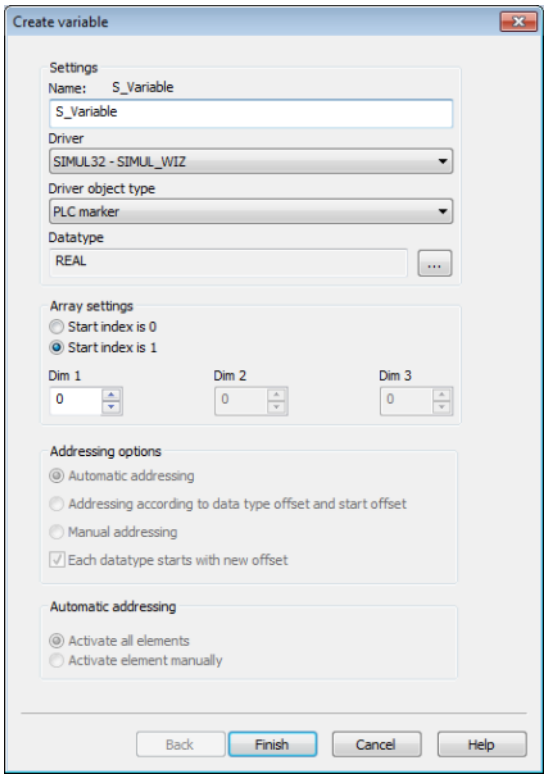
1. Select the **New variable** command in the **Variables** node in the context menu



   The dialog for configuring variables is opened

2. Configure the variable
3. The settings that are possible depends on the type of variables

CREATE VARIABLE DIALOG



Property	Description
Name	Distinct name of the variable. If a variable with the same name already exists in the project, no additional variable can be created with this name. Maximum length: 128 characters **Attention:** the characters **#** and **@** are not permitted in variable names. If non-permitted characters are used, creation of variables cannot be completed and the **Finish** button remains inactive. **Note:** For some drivers, the addressing is possible over the property **Symbolic address**, as well.
Drivers	Select the desired driver from the drop-down list. **Note:** If no driver has been opened in the project, the driver for internal variables (**Intern.exe** (**Main.chm::/Intern.chm::/Intern.htm**)) is automatically loaded.
Driver Object Type (**cti.chm::/28685.htm**)	Select the appropriate driver object type from the drop-down list.
Data Type	Select the desired data type. Click on the ... button to open the

Property	Description
	selection dialog.
Array settings	Expanded settings for array variables. You can find details in the Arrays chapter.
Addressing options	Expanded settings for arrays and structure variables. You can find details in the respective section.
Automatic addressing	Expanded settings for arrays and structure variables. You can find details in the respective section.

SYMBOLIC ADDRESS

The **Symbolic address** property can be used for addressing as an alternative to the **Name** or **Identification** of the variables. Selection is made in the driver dialog; configuration is carried out in the variable property. When importing variables of supported drivers, the property is entered automatically.

Maximum length: *1024* characters.

The following drivers support the **Symbolic address**:

- **3S_V3**
- **AzureDrv**
- **BACnetNG**
- **IEC850**
- **KabaDPServer**
- **OPCUA32**
- **Phoenix32**
- **POZYTON**
- **RemoteRT**
- **S7TIA**
- **SEL**
- **SnmpNg32**
- **PA_Drv**

INHERITANCE FROM DATA TYPE

Measuring range, **Signal range** and **Set value** are always:

- derived from the datatype
- Automatically adapted if the data type is changed

Note for signal range: If a change is made to a data type that does not support the set **signal range**, the **signal range** is amended automatically. For example, for a change from **INT** to **SINT**, the **signal range** is changed to *127*. The amendment is also carried out if the **signal range** was not inherited from the data type. In this case, the **measuring range** must be adapted manually.

6.2 Addressing

The addressing is based on the variable names.

Name	Description
Name	Freely definable name **Note:** The addressing of the variable is symbolic by means of a reference. The driver takes the reference from the **Name**, **Identification** or **Symbolic address** property of the variable, depending on the **Basic Settings** of the driver configuration (**addressing**). If the **Name** is used for the addressing of the variables, it must include a valid ObjectReference with a "*!" prefix. In doing so, * is any desired text. Just one letter is sufficient. In addition to the reference, the driver identifies the connection with the help of the **Net address** property - not using the prefix. This applies for all **driver object types**. **Attention**: The **Name** must be unique in each project. If several 850 servers provide the variables with the same references, differentiate the variable names using prefixes with different server names or use the **Symbolic address** for addressing. **Note**: With **online import** and **offline import Name**, **Identification, Symbolic address** and **Net address** are configured automatically.
Identification	Enter any desired text; for example resource name, comments, etc. Can optionally be used for addressing. Is automatically set during online import.
Net address	Network address of variable: Number of the connection in the driver configuration. This address refers to the **Net address** in the **Connections** - **Server** list of the driver configuration. It identifies the 850 server on which variables are saved.
Data block	not used for this driver

Name	Description
Offset	not used for this driver
Alignment	not used for this driver
Bit number	not used for this driver
String length	Only available for String variables. Maximum number of characters that the variable can take.
Symbolic address	The **Symbolic address** property can be used for addressing as an alternative to the **Name** or **Identification** of the variables. Selection is made in the driver dialog; configuration is carried out in the variable property. When importing variables of supported drivers, the property is entered automatically. Maximum length: *1024* characters. The **Symbolic address** of the variable is comparable to the ObjectReference in accordance with the IEC61850 standard, in a naming configuration amended to the requirements for uniqueness in addressing in a SCADA system. **Note:** The addressing of the variable is symbolic via **Symbolic address, Name** or **Identification** depending on the **Basic Settings** in the driver configuration (**addressing**). If the **Symbolic address** is used for addressing the variables, it must contain a valid ObjectReference with **!* prefix. In addition to the reference, the driver identifies the connection with the help of the **Net address** property. This applies for all **driver object types**. **Note**: With **online import** and **offline import Name**, **Identification, Symbolic address** and **Net address** are configured automatically.
Driver connection/Driver Object Type	Depending on the type of the variables, the object type is selected when the variables are created. The type can be subsequently changed here. For more information, see also the **driver objects** (on page 57) section.
Driver connection/Data Type	Data type of the variables that have been selected when setting the variables. The type can be subsequently changed here. **Attention:** If you subsequently change the data type here, you must check all variable properties, such as **value range** for example, and change them if necessary.
Driver connection/Priorit	not used for this driver The driver does not support cyclically-poling communication in priority classes.

Name	Description
y	

Note: You can create several variables with the same ObjectReference if the variable names for this are different, such as with a different prefix, for example.

SYNTAX OF THE REFERENCES FOR ADDRESSING THE VARIABLES

Addressing of the variables is symbolic via its references. The driver takes the reference from one of the properties of the variable (**Symbolic address, Name** or **Identification**), depending on the **Basic Settings** driver configuration (**addressing**). In addition to the reference, the driver identifies the connection with the help of the **Net address** property.

The following syntax is applicable for the references: *SERVER!LD/LN/DataObject/DataAttr[FC]*

In doing so, the following applies:

- The prefix (*SERVER*) is separated from the following identifiers by an exclamation mark (**!**). It is for the uniqueness of the variables in the project, not the addressing.
- Further identifiers are separated from one another by a slash (**/**).
- Only if an identifier itself is a structure are their elements are separated by a dot (**.**); for example: *SERVER!LD/LN/DataObject/DataAttr.item[FC]*.
- The Functional Constraint is defined in brackets [], at the end.

The designations are:

Identification	Description
SERVER	Freely-definable name, whereby just one letter is sufficient. This can, for example, be an abbreviated name of the 850 server. If the reference is in the **Name** property of the variable, the prefix should ensure that all variable names in the zenon project are unique. **Recommendation:** Use the same names as defined in driver dialog Dialog Server (on page 26). However, the driver does not recognize the connection to be used from the **Server name** (i.e. not from the prefix in the reference) but from the **Net address** setting**.**
LD	Name of the IED and Logical Device, such as "GE_F650" for example.
LN	Name of the logical node (Logical Node), for example "LLN0", "MMXU".
DataObject	Name of the data object, for example "*Mod*", "*PhV.phsA*". See Appendix B - data objects / data attributes

Identification	Description
DataAttr	Name of the data attribute, for example "*stVal*", "*cVal.mag.f*". See Appendix B - data objects / data attributes
FC	Functional Constraint of the data attribute, for example "*ST*", "*MX*" See Appendix A - Description of the functional constraints (FCs).

Attention

The naming convention for references of the variables does not fully correspond to the **ObjectReference** defined in the IEC61850-7-1 standard.

In the standard, a slash (**/**) is only used as separator between **LD** and **LD** and otherwise separated by dots (**.**). If **DataObject** is a structure, dots make it impossible to distinguish what is a **DataObject** and what is a **DataAttr**. Therefore an own naming conversion is used for the variable addressing.

EXAMPLE

The 'XCBR1' logical node (circuit breaker 1) has, among other things, a data object 'Pos' of CDC (Common Data Class) 'Controllable Double Point' (DPC). This 'Pos' data object in turn has the data attributes 'stVal', 'q' and 't', whose name and semantics are defined in IEC61850-7-3 - through its CDC.

LN/DO/DA[FC]	Name	IEC 61850 Standard
XCBR1/Pos	**Switching position**	In accordance with LN definition XCBR in 61850-7-4
XCBR1/Pos/stVal[ST]	**position value**	In accordance with CDC definition DPC in 61850-7-3
XCBR1/Pos/q[ST]	**Quality**	In accordance with CDC definition DPC in 61850-7-3
XCBR1/Pos/t[ST]	**Timestamp**	In accordance with CDC definition DPC in 61850-7-3
XCBR1/Pos/Oper.ctlVal[CO]	**Command values**	In accordance with Oper type definition in 61850-8-1, Table E.9

All objects in the data model of an 850 server are constructed in this way. For this reason, the driver knows, for example, that the attributes */q[ST] and */t[ST] contain the quality and the time stamp for the */stVal[ST] variable, because stVal was defined in the standard as the main data attribute in FC=*ST*. This

allows the driver to automatically assign the existing values for quality and time stamp to the actual values of the main variables.

Operate Command: If, in Runtime, the user has set a value to a */Oper.ctlVal[CO] variable, the driver can, thanks to the specific variable naming, note that an Operate command can be sent to the IED. The driver then automatically sends the required sequence of special telegrams to the 850 server.

TIME STAMP AND QUALITY

Time stamp and quality attribute are always parts of variables in zenon. */q and */t variables do not need to be created. The driver automatically uses the time stamp and the quality of the data object for its variables with FC = *ST* and *MX* (FC stands for Functional Constraint (on page 140)). Without taking into account whether a variable for the '*t*' attribute has been created, the received time stamp is used for all *ST* and *MX* variables, for example **stVal** variable for **CEL**, **AML** or **Historian**. Selected quality bits that have been received in the '*q*' attribute are also assigned the status bits of the **stVal** variable (see also **Quality, time stamp and status bits of the variable**).

6.3 Driver objects and datatypes

Driver objects are areas available in the PLC, such as markers, data blocks etc. Here you can find out which driver objects are provided by the driver and which IEC data types can be assigned to the respective driver objects.

6.3.1 Driver objects

The following object types are available in this driver:

Driver Object Type	Channel type	Read	Write	Supported data types	Comment
PLC marker	8	X	X	*REAL*, *LREAL*, *WSTRING*, *DINT*, *UDINT*, *BOOL*, *INT*, *UINT*, *STRING*, *USINT*, *SINT*	Variables that correspond to direct data attributes in the data model of the 850 server
File Transfer	9	X	X	*STRING*	Command and return variables for the file transfer. **Note**: The string length should correspond to the maximum length of the file names (including the path) in

Driver Object Type	Channel type	Read	Write	Supported data types	Comment
					the PLC; a maximum of 260 characters for *!Command* variable for example, (but more for *!Directory*). You can find more information in the chapter File transfer (on page 113)
Connection state	36	X	--	*UDINT*	Internal variables of this object type show the status of the connection to the 850 server. The variable must have *ConnectionState* as a reference and the correct **Net address**. **Example: Name** or **Symbolic address**: *!ConnectionState*. You can find more information in the chapter Establishment of a connection and detection of a connection failure (on page 90).
Command Info	11	X	--	*UINT*	Internal variables show the current status of the command; transferred from the driver to Runtime (not by the PLC). You can find more information in the chapter Additional Cause Diagnosis (on

Driver Object Type	Channel type	Read	Write	Supported data types	Comment
					page 98).
Service tracking	64	X	--	*REAL*, *LREAL*, *DINT*, *UDINT*, *BOOL*, *INT*, *UINT*, *STRING*, *USINT*, *SINT*	Additional Service tracking (*[SR]) variables. You can find more information in the chapter Service tracking (Main.chm::/IEC850.chm::/117281.htm).
Settings	65	X	X	*USINT*	In accordance with Standard 61850-8-1, 8.1.3.7: ▸ *TimeQuality* ▸ *TimeAccuracy* For the T-attribute in *SBOw*, *Oper* and *Cancel* commands. You can find more information in the chapter TimeQuality und TimeAccuracy (on page 113).
Communication details	35	X	X	*BOOL*, *SINT*, *USINT*, *INT*, *UINT*, *DINT*, *UDINT*, *REAL*, *STRING*	Variables for the static analysis of the communication; is transferred between driver and Runtime (not to the PLC). **Note**: The addressing and the behavior is the same for most zenon drivers. You can find detailed information on this in

Driver Object Type	Channel type	Read	Write	Supported data types	Comment
					the Communication details (Driver variables) (on page 78) chapter.

Key:

X: supported

--: not supported

6.3.2 Assignment of data types

All variables in zenon are derived from IEC data types. The following table compares the IEC datatypes with the datatypes of the PLC.

ASSIGNMENT OF DATA TYPES FROM THE PLC TO ZENON DATA TYPES

PLC	zenon	Data type	Remark
BOOLEAN	BOOL	8	
INT8	SINT	10	
INT8U	USINT	9	
INT16	INT	1	
INT16U	UINT	2	
INT24	DINT	3	
INT24U	UDINT	4	
INT32	DINT	3	
INT32U	UDINT	4	
INT64/INT128	LINT, LREAL	3	**Attention:** In the (U)LINT variable value, only the lowest 52-bit is applied. The other bits are cut off and not taken into account. Alternatively, the variable

PLC	zenon	Data type	Remark
			can be configured with the LREAL data type. As a result, it is possible to transfer the total value. In doing so, note that for values that are greater than 52 bit, the precision of the lowest points is lost.
FLOAT32	REAL	5	
FLOAT64	LREAL	6	
ENUMERATED	INT	1	
CODED ENUM	UDINT, STRING	4, 12	*MMS Bitstring*
OCTET STRING	STRING	12	
VISIBLE STRING	STRING	12	
UNICODE STRING	WSTRING	21	Coding is carried out in UTF-8
PACKED LIST	UDINT, STRING	4, 12	*MMS Bitstring*, inverted bit order
TIMESTAMP	LREAL	6	Only octets 0..7 (see also TimeQuality Bit mapping (on page 89))
EntryTime	LREAL	6	
TriggerConditions, Check	UDINT, STRING	4, 12	*MMS Bitstring*, inverted bit order
Tcmd	UDINT, BOOL	4, 8	*MMS Bitstring*, *FALSE* corresponds to *0x40* and *TRUE* corresponds to *0x80*
Dbpos	UDINT, STRING	4, 12	*MMS Bitstring*, **DPI mapping** (on page 106) is used by default for */stVal* variables.

DATA TYPE

The term **data type** is the internal numerical identification of the data type. It is also used for the extended DBF import/export of the variables.

MMS BITSTRING DATA TYPE

The data attribute types that were assigned to the *MMS Bitstring* in accordance with the standard (see IEC61850-8-1), for example *CODED ENUM*, *PACKED LIST*, *Check* and *TrigerConditions*, correspond to the *UDINT* data type by default in zenon. During import, the driver creates the *UDINT* variables with the **value range** of the data type - 32 bits (*0..4294967295*). The number of bits that the that the values can have depends on the size of the *Bitstrings* of the data attribute in the 850 server and cannot automatically be detected and configured by an 850 client.

If the 850 server adheres to SCL requirements, the zenon variable will have much fewer values than *4294967296* in Runtime. However, there is no need to redefine or limit the **value range** of the variables. You can however amend the **value ranges** manually for better readability of the project, once the variables have been imported. You can also replace the variables with separate *UDINT*-based data types.

The driver also allows *Bitstring* variables with the *STRING* data type instead of creating *UDINT* manually (copying). The value of the variable if it was created as a string contains only the characters "0" and "1" in the same sequence as how the bits are defined in the IEC 61850 standard and limited to the length of the *Bitstrings* .

In the case of all *Bitstrings*, except *CODED ENUM*, the bit 0 was set as the highest value in its octet in the IEC 61850 standard.

Attention: This means that the *UDINT* value will contain a reversed bit order.

Example: the value of the *TrgOps* attribute - 850 data type TriggerConditions (derived from *PACKED LIST*) - in MMS *Bitstring(6)*:

- als *String*="*011111*"
- As *UDINT=124* (*01111100b*), and not *11111b=31* (because the sequence has been reversed).

The value "*011111*" in the string means that all bits, except bit 0 which is not permitted, are set (61850-8-1):

- Bit 0 - Reserved
- Bit 1 - data-change
- Bit 2 - quality-change
- Bit 3 - data-update
- Bit 4 - integrity
- Bit 5 - general-interrogation

A further example - the value "*010001*" (in *UDINT*=68, because 0100 0100) has *data-change* and *general-interrogation* bits.

MMS BIT STRING IN COMMAND DIRECTION

Command variables (**/Oper.ctlVal[CO]*) that match an MMS Bitstring - such as Tcmd or other CODED ENUM based bTypes are created as variables with the data type *UDINT* on import. You can later change the data type manually to data type *BOOL*, e.g. for variables **/TapChg/Oper.ctlVal[CO]*. If the command variable is data type *BOOL*, on **write set value**, the driver will map the value *FALSE* to *0x40 (lower)* and the value *TRUE* to *0x80 (higher)*. Thus this *BOOL* variable can be directly linked to switching actions in **zenon Command Processing**.

DATA TYPE ENUMERATED

The data attribute types that were assigned to *ENUMERATED* in accordance with the standard (see IEC61850-8-1), correspond to the *INT* data type in zenon.

Example: the data attribute *Beh/stVal[ST]* from Common Data Class *ENS* (see 850-7-3 and 850-7-4) is *ENUMERATED* and the standard defines only 5 possible values. An SCL file of the 850 server:

```
<EnumType id="Beh">
    <EnumVal ord="1">on</EnumVal>
    <EnumVal ord="2">blocked</EnumVal>
    <EnumVal ord="3">test</EnumVal>
    <EnumVal ord="4">test/blocked</EnumVal>
    <EnumVal ord="5">off</EnumVal>
</EnumType>
```

However, there is no need to redefine or limit the **value range** of the *INT* variables. You can however amend the **value ranges** manually for better readability or evaluation in the project, once the variables have been imported. You can also replace the variables with separate *INT*-based data types.

Note: you can already link a **reaction matrix** to a data type - it is then applicable for all variables of the data type.

DATA TYPE BTYPE INT64(U) AND INT128

INT64 and INT128 data types are supported at MMS communication level in full.

In zenon, they are mirrored by default to the *LINT* data type. The driver also allows them to be imaged on *LREAL* data type variables.

The following limitations are applicable for this data type:

- In the *LINT* variable value, only the lowest 52-bits of the value is applied.
  The other bits are cut off and not taken into account.

- In *LREAL* variables, the value of the 64 bits is taken, however with a loss of precision if the value is greater than 52 bit.

"ARRAY OF" TYPE DATA ATTRIBUTES

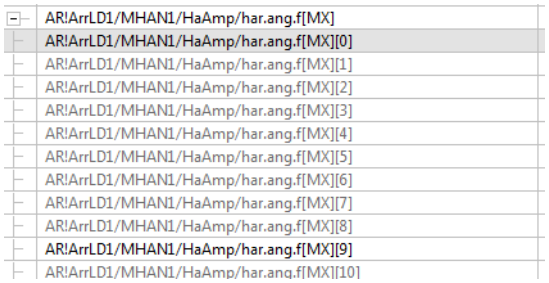
If there is an array level in one of the data attributes in an IEC 61850 Common Data Classs (CDC), this level is placed at the end of the variable structure for display in zenon.

If the data attribute with *count > 1* is a structure itself (a Vector for example) then - from an **ARRAY OF** - there are several arrays of scalar values in the zenon variable model. This remapping is carried out at the start of the configuration time during **offline/online import** and in the Runtime environment during the allocation between the zenon variable list and the IEC61850 object model.

As a result of this, there is the restriction that only one array level is supported. Support for arrays on the data attributes is thus also limited; the arrays from data objects (from the complete CDC) are ignored.

Example

The *HaAmp* data object (the Common Data Class *HMV*) in Logical Node *MHAN* contains the *har* data attribute - defined in the IEC 61850-7-3 standard: *ARRAY[0..numHar] of Vector*. This becomes the following array in zenon:



In addition, there are of course also the arrays for **ang.i**, **mag.f** and **mag.i**.

Note: with **offline/online import** of the variables in the **Type** column, the arrays are also marked with square brackets (*[n]*), for example : *BOOL[99]*, *FLOAT32[20]*, etc.

6.4 Creating variables by importing

Variables can also be imported by importing them. The XML and DBF import is available for every driver.

Information

You can find details on the import and export of variables in the Import-Export (main.chm::/13028.htm) manual in the Variables (main.chm::/13045.htm) section.

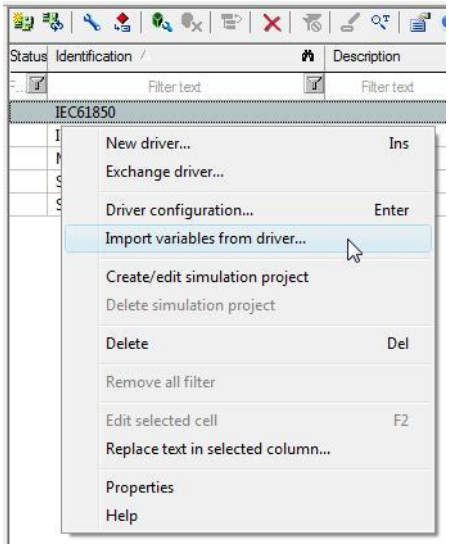
6.4.1 Online import of an IEC 61850 server

Variables in a zenon project can be created in <CD_PRODUKTNAME> Editor with the import of the driver. The driver can read the data model of the IEC 61850 server (browsing) and display it as a variable list.

Attention

If Runtime is running on the same computer at the same time, the variables in the editor cannot be imported by the PLC, because the driver in Runtime uses the given settings for communication.

You call up the import using the context menu of the driver in the driver list.



A dialog is opened.

SELECT A SERVER

Parameter	Description
Server	List of the connections to IEC61850 servers created in the driver. You can read further information about the configuration of server connections in the Connections (on page 25) chapter.
Source	Source of the data model: ▸ PLC Browsing Variables are imported from an IEC61850 server that is available online. ▸ File Browsing Variables are imported from an SCL file.

Parameter	Description
	You can read further information about the SCL file in the IEC61850-6 standard.
OK	Applies settings and closes the dialog.
Cancel	Discards all changes and closes the dialog.

PROCEDURE FOR PLC BROWSING

- In the dialog that opens, select the PLC Browsing option and select a server from which the variables can be imported.
- The connection to the server is established and the list of existing data points (LDs, LNs, data objects, data attributes) is read.
- If the reading in has ended, an important dialog opens in which you can filter the browsed variables (capitalization, for example *XCBR1*stVal*), select them (including multiple selection) and add them from the upper to lower list.
- You create the selected variables in the project using the OK button.

Attention

The driver creates variables with default value ranges, for example a UDINT with <0... 4294967295> and a LREAL with <-1000..1000>, which may not correspond to the value ranges of the attributes, for example stVal-attribute UDINT <0..3> or t-attribute LREAL<0.. 2147483647> with three decimal places for milliseconds. Therefore ensure after import after that all variables have the correct value range properties and the string is the right length.

IMPORT OF ADDRESSES WITH MORE THAN 128 CHARACTERS

When reading (browsing) the data model, the driver generates the addresses of the variables. This is displayed in the '*Symbolic address*' column. The generated address is Server!ObjectReference[FC].

If this address is longer than the 128 characters permitted for the variable name, it is shortened to 124 characters and supplemented with _###. ### stands for a serial number. This number counts up from *001* to *999*.

If new variables are created, whose generated name was longer than 128 characters, this shortened number supplemented with figures is used as variable **Name** and **Identification**. The unshortened address is used as **Symbolic address**.

Attention

In Runtime, more than 128 characters is only supported if, in the driver configuration, in the Basic settings (on page 18) dialog, **Symbolic address** is selected for the addressing.

RECOMMENDATION

Rename the variables after the import. Otherwise naming conflicts could occur after another import.

"ARRAY OF" IMPORT

As a result of the limitation of only one array level being supported (on page 60), the support of arrays is also limited to the data attributes.

These **ARRAY OF** variables are created as zenon arrays when imported.

Example

The data attribute *HaAmp.har* of the Common Data Class **MHAN** - as defined in the IEC61850 standard: *ARRAY[0..numHar] of Vector* - becomes up to four arrays in zenon, with the same respective number of elements:

- ***/HaAmp.har.ang.f[MX][0..count-1]**
- ***/HaAmp.har.ang.i[MX][0..count-1]**
- ***/HaAmp.har.mag.f[MX][0..count-1]**
- ***/HaAmp.har.mag.i[MX][0..count-1]**

SERVICE TRACKING IMPORT

Service tracking (**Main.chm::/IEC850.chm::/117281.htm**) is only offered if one or more elements with FC = SR are present on the Logical Device. For example, one or more Logical Nodes LTRK. For import, only Service tracking is automatically offered for Control Services. Control Services means: only Service tracking command execution information.

If there is Service tracking on the server, a proposal for the creation of additional service tracking variables is created for each data object that contains the data attributes with FC = CO.

Example

Data object with command execution:
S1!Device/Node/Pos/Oper.ctlVal[CO]

These additional variables no longer exist on the server but are additionally created in the respective data object with a possible command execution.

The variables that are actually created as additional service tracking variables are selected from this list of proposals.
The mane of this proposal comprises the following:
Datenobjektreferenz_Servicetracking-Datenattributname[SR]. As a service tracking data attribute name, the data attributes that are present in the Logical Node LRTK for Control Services are proposed.

Example

Name: S1!Device/Node/Pos_errorCode[SR].

The data type of the additional service tracking variable corresponds to the data type of the SR data attribute that is present in the Logical Node LRTK.
The driver object type is Service tracking.

In addition, a string variable *_allCTS[SR] is also offered. This string variable contains the complete Service tracking (Main.chm::/IEC850.chm::/117281.htm) Information and can be evaluated with the help of zenon Logic or VBA/VSTA.

GETNAMELIST ON DO

The *GetNameList on DO* option from versions before 8.00 is ignored in the IEC850 driver. From zenon version 8.00, the driver always sends *getVariableAccessAttributes* to the server for each node. If the driver receives a negative response from the server, another query at a lower level is sent to the server for the corresponding Node. If this renewed query also fails, there is refinement at DataObject level.

A corresponding LOG entry is generated in the event of an error. *Failed to retrieve variable information for <Failed Request Name>*

The following is applicable for the online import of variables:

- The online reading of the variables only takes into account the highest level from a *DataObject*. If this depth is not sufficient, import the variables from an SCL file.
- Refinement takes place down to *DataAttribute* level in Runtime.
- If the *DataAttribute* cannot be read, the Runtime without values and receives the status *Invalid*.

The following is applicable for the online import of variables in zenon Editor:

- The node must be read in full in order for the variables contained in the node to be offered in the selection dialog.

Note: If the zenon project is compiled for a version before version 8.00, a corresponding entry in the configuration file continues to be taken into account.

6.4.2 Offline-Import from a SCL file

Variables for a project can be created with the import of the driver in a zenon project. The driver can read the data model from an SCL file and display it as a variable list.

Note: For simplified import of the variables from the Datasets in RCBs, the **IEC850 Driver Configuration** wizard provides additional possibilities. The wizard is only available in the **Energy Edition**.

The following file endings are accepted for offline import:

- **.scl*
- **.scd*
- **.cid*
- **.icd*
- **.xml*, if the content of the file has been defined in accordance with the rules of the IED61850-6 standard.

The driver only imports DOI elements offline. The Control Blocks, for example *ReportControl* (Report Control Block) and *SettingControl* (Setting Control Block) are not supported for offline import. You can create the variables for these attributes by means of online import or manually.

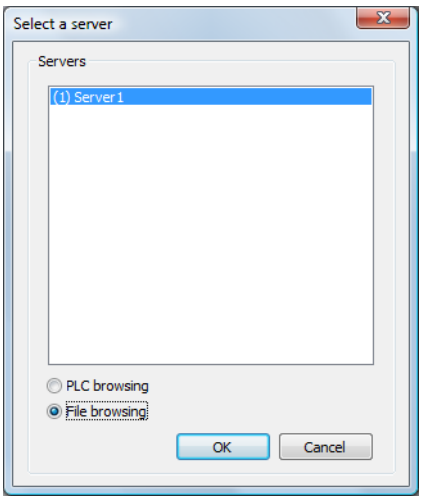
Attention

The driver can then only import from the data model of the IED if the data model is compliant with the IEC61850 standard. All non-compliant elements are then ignored and cannot be selected in the import dialog. For example, the driver ignores the Logical Nodes that are linked directly to the IED nodes, instead of to the Logical Device nodes.

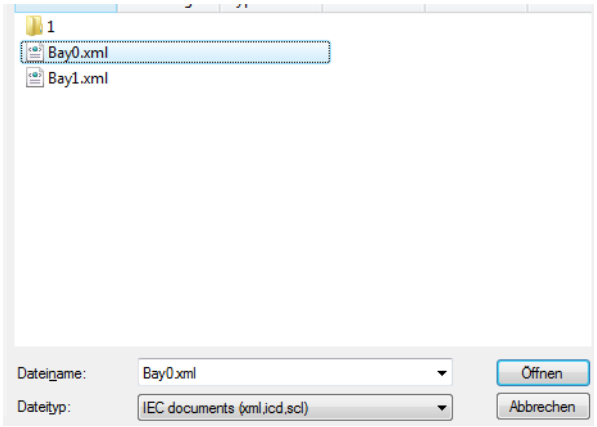
To import variables from a file:

1. You call up the import using the context menu of the driver in the driver list.

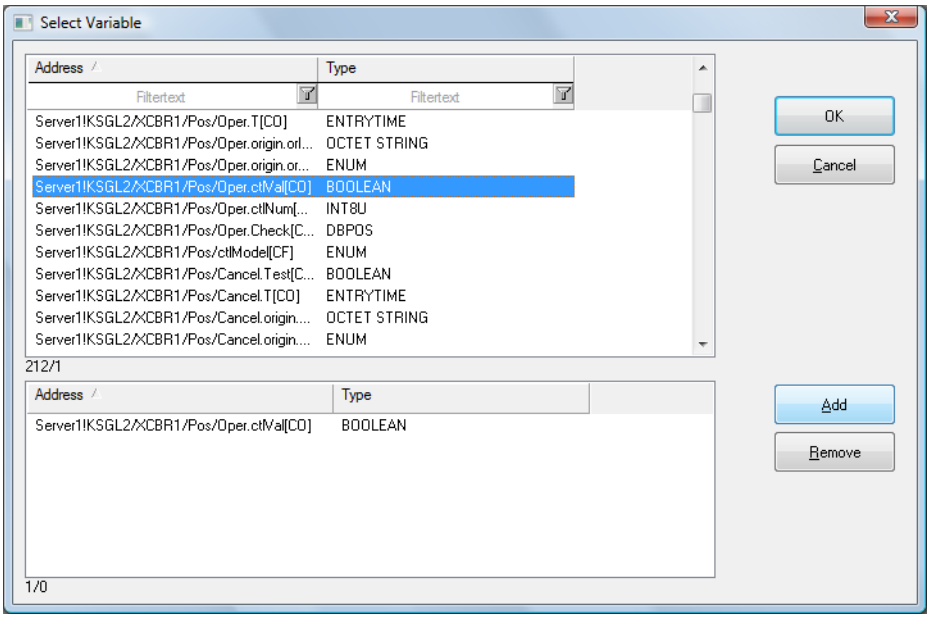
2. In the server selection select the option **File browsing**



3. Select the import file.



4. The following steps for the selection of variables are similar to online import.



IMPORT OF ADDRESSES WITH MORE THAN 128 CHARACTERS

When reading (browsing) the data model, the driver generates the addresses of the variables. This is displayed in the '*Symbolic address*' column. The generated address is Server!ObjectReference[FC].

If this address is longer than the 128 characters permitted for the variable name, it is shortened to 124 characters and supplemented with _###. ### stands for a serial number. This number counts up from *001* to *999*.

If new variables are created, whose generated name was longer than 128 characters, this shortened number supplemented with figures is used as variable **Name** and **Identification**. The unshortened address is used as **Symbolic address**.

Attention

In Runtime, more than 128 characters is only supported if, in the driver configuration, in the Basic settings (on page 18) dialog, **Symbolic address** is selected for the addressing.

RECOMMENDATION

Rename the variables after the import. Otherwise naming conflicts could occur after another import.

SERVICE TRACKING IMPORT

Service tracking is only offered if one or more elements with FC = SR are present on the Logical Device. For example, one or more Logical Nodes LTRK. For import, only Service tracking is automatically offered for Control Services. Control Services means: only Service tracking command execution information.

If there is Service tracking in the SCL file, a proposal for the creation of additional service tracking variables is created for each data object that contains the data attributes with FC = CO.

Example

Data object with command execution:
S1!Device/Node/Pos/Oper.ctlVal[CO]

These additional variables no longer exist on the server but are additionally created in the respective data object with a possible command execution.

The variables that are actually created as additional service tracking variables are selected from this list of proposals.
The mane of this proposal comprises the following:
Datenobjektreferenz_Servicetracking-Datenattributname[SR]. As a service tracking data attribute name, the data attributes that are present in the Logical Node LRTK for Control Services are proposed.

Example

Name: S1!Device/Node/Pos_errorCode[SR]

The data type of an additional service tracking variable corresponds to the data type of the SR data attribute, that is in the Logical Node LRTK.
The driver object type is Service tracking.

In addition, a string variable **_allCTS[SR]* is also offered. This string variable contains the complete service tracking Information and can be evaluated with the help of zenon Logic or VBA/VSTA.

6.4.3 XML import

During XML import of variables or data types, these are first assigned to a driver and then analyzed. Before import, the user decides whether and how the respective element (variable or data type) is to be imported:

- *Import*:
  The element is imported as a new element.
- *Overwrite*:
  The element is imported and overwrites a pre-existing element.
- *Do not import*:
  The element is not imported.

Note: The actions and their durations are shown in a progress bar during import. The import of variables is described in the following documentation. Data types are imported along the same lines.

REQUIREMENTS

The following conditions are applicable during import:

- **Backward compatibility**

  At the XML import/export there is no backward compatibility. Data from older zenon versions can be taken over. The handover of data from newer to older versions is not supported.

- **Consistency**

  The XML file to be imported has to be consistent. There is no plausibility check on importing the file. If there are errors in the import file, this can lead to undesirable effects in the project.

  Particular attention must be paid to this, primarily if not all properties exist in the XML file and these are then filled with default values. E.g.: A binary variable has a limit value of *300*.

- **Structure data types**

  Structure data types must have the same number of structure elements.
  Example: A structure data type in the project has 3 structure elements. A data type with the

same name in the XML file has 4 structure elements. Then none of the variables based on this data type in the file are imported into the project.

Hint

You can find further information on XML import in the **Import - Export** manual, in the **XML import** (**main.chm::/13046.htm**) chapter.

6.4.4 DBF Import/Export

Data can be exported to and imported from dBase.

Information

Import and Export via CSV or dBase supported; no driver specific variable settings, such as formulas. Use export/import via XML for this.

IMPORT DBF FILE

To start the import:

1. right-click on the variable list
2. in the drop-down list of **Extended export/import...** select the **Import dBase** command
3. follow the import assistant

The format of the file is described in the chapter File structure.

Information

Note:

- Driver object type and data type must be amended to the target driver in the DBF file in order for variables to be imported.
- dBase does not support structures or arrays (complex variables) at import.

EXPORT DBF FILE

To start the export:

1. right-click on the variable list
2. in the drop-down list of **Extended export/import...** select the **Export dBase...** command

3. follow the export assistant

> **Attention**
>
> DBF files:
>
> - must correspond to the 8.3 DOS format for filenames (8 alphanumeric characters for name, 3 character suffix, no spaces)
> - must not have dots (.) in the path name.
> e.g. the path *C:\users\John.Smith\test.dbf* is invalid.
> Valid: *C:\users\JohnSmith\test.dbf*
> - must be stored close to the root directory in order to fulfill the limit for file name length including path: maximum 255 characters

The format of the file is described in the chapter File structure.

> **Information**
>
> dBase does not support structures or arrays (complex variables) at export.

FILE STRUCTURE OF THE DBASE EXPORT FILE

The dBaseIV file must have the following structure and contents for variable import and export:

> **Attention**
>
> dBase does not support structures or arrays (complex variables) at export.
>
> DBF files must:
>
> - conform with their name to the 8.3 DOS format (8 alphanumeric characters for name, 3 characters for extension, no space)
> - Be stored close to the root directory (Root)

STRUCTURE

Identification	Type	Field size	Comment
KANALNAME	Char	128	Variable name. The length can be limited using the **MAX_LAENGE** entry in the **project.ini** file.
KANAL_R	C	128	The original name of a variable that is to be replaced by the new name entered under "VARIABLENNAME"

Identification	Type	Field size	Comment
			(variable name) (field/column must be entered manually). The length can be limited using the **MAX_LAENGE** entry in the **project.ini** file.
KANAL_D	Log	1	The variable is deleted with the *1* entry (field/column has to be created by hand).
TAGNR	C	128	Identification. The length can be limited using the **MAX_LAENGE** entry in the **project.ini** file.
EINHEIT	C	11	Technical unit
DATENART	C	3	Data type (e.g. bit, byte, word, ...) corresponds to the data type.
KANALTYP	C	3	Memory area in the PLC (e.g. marker area, data area, ...) corresponds to the driver object type.
HWKANAL	Num	3	Net address
BAUSTEIN	N	3	Datablock address (only for variables from the data area of the PLC)
ADRESSE	N	5	Offset
BITADR	N	2	For bit variables: bit address For byte variables: 0=lower, 8=higher byte For string variables: Length of string (max. 63 characters)
ARRAYSIZE	N	16	Number of variables in the array for index variables ATTENTION: Only the first variable is fully available. All others are only available for VBA or the Recipegroup Manager
LES_SCHR	L	1	Write-Read-Authorization 0: Not allowed to set value. 1: Allowed to set value.
MIT_ZEIT	R	1	time stamp in zenon (only if supported by the driver)
OBJEKT	N	2	Driver-specific ID number of the primitive object comprises TREIBER-OBJEKTTYP and DATENTYP

Identification	Type	Field size	Comment
SIGMIN	Float	16	Non-linearized signal - minimum (signal resolution)
SIGMAX	F	16	Non-linearized signal - maximum (signal resolution)
ANZMIN	F	16	Technical value - minimum (measuring range)
ANZMAX	F	16	Technical value - maximum (measuring range)
ANZKOMMA	N	1	Number of decimal places for the display of the values (measuring range)
UPDATERATE	F	19	Update rate for mathematics variables (in sec, one decimal possible) not used for all other variables
MEMTIEFE	N	7	Only for compatibility reasons
HDRATE	F	19	HD update rate for historical values (in sec, one decimal possible)
HDTIEFE	N	7	HD entry depth for historical values (number)
NACHSORT	R	1	HD data as postsorted values
DRRATE	F	19	Updating to the output (for zenon DDE server, in [s], one decimal possible)
HYST_PLUS	F	16	Positive hysteresis, from measuring range
HYST_MINUS	F	16	Negative hysteresis, from measuring range
PRIOR	N	16	Priority of the variable
REAMATRIZE	C	32	Allocated reaction matrix
ERSATZWERT	F	16	Substitute value, from measuring range
SOLLMIN	F	16	Minimum for set value actions, from measuring range
SOLLMAX	F	16	Maximum for set value actions, from measuring range
VOMSTANDBY	R	1	Get value from standby server; the value of the variable is not requested from the server but from the Standby Server in redundant networks
RESOURCE	C	128	Resources label. Free string for export and display in lists.

Identification	Type	Field size	Comment
			The length can be limited using the MAX_LAENGE entry in **project.ini**.
ADJWVBA	R	1	Non-linear value adaption: *0*: Non-linear value adaption is used *1*: Non-linear value adaption is not used
ADJZENON	C	128	Linked VBA macro for reading the variable value for non-linear value adjustment.
ADJWVBA	C	128	ed VBA macro for writing the variable value for non-linear value adjustment.
ZWREMA	N	16	Linked counter REMA.
MAXGRAD	N	16	Gradient overflow for counter REMA.

Attention

When importing, the driver object type and data type must be amended to the target driver in the DBF file in order for variables to be imported.

LIMIT VALUE DEFINITION

Limit definition for limit values *1* to *4*, or status *1* to *4*:

Identification	Type	Field size	Comment
AKTIV1	R	1	Limit value active (per limit value available)
GRENZWERT1	F	20	technical value or ID number of a linked variable for a dynamic limit value (see VARIABLEx) (if VARIABLEx is *1* and here it is *-1*, the existing variable linkage is not overwritten)
SCHWWERT1	F	16	Threshold value for limit value
HYSTERESE1	F	14	Is not used
BLINKEN1	R	1	Set blink attribute
BTB1	R	1	Logging in CEL
ALARM1	R	1	Alarm

Identification	Type	Field size	Comment
DRUCKEN1	R	1	Printer output (for CEL or Alarm)
QUITTIER1	R	1	Must be acknowledged
LOESCHE1	R	1	Must be deleted
VARIABLE1	R	1	Dyn. limit value linking the limit is defined by an absolute value (see field GRENZWERTx).
FUNC1	R	1	Functions linking
ASK_FUNC1	R	1	Execution via Alarm Message List
FUNC_NR1	N	10	ID number of the linked function (if "-1" is entered here, the existing function is not overwritten during import)
A_GRUPPE1	N	10	Alarm/Event Group
A_KLASSE1	N	10	Alarm/Event Class
MIN_MAX1	C	3	Minimum, Maximum
FARBE1	N	10	Color as Windows coding
GRENZTXT1	C	66	Limit value text
A_DELAY1	N	10	Time delay
INVISIBLE1	R	1	Invisible

Expressions in the column "Comment" refer to the expressions used in the dialog boxes for the definition of variables. For more information, see chapter Variable definition.

6.5 Communication details (Driver variables)

The driver kit implements a number of driver variables. This variables are part of the driver object type *Communication details*. These are divided into:

- Information
- Configuration
- Statistics and
- Error message

The definitions of the variables implemented in the driver kit are available in the import file **DRVVAR.DBF** and can be imported from there.
Path to file: *%ProgramData%\COPA-DATA\zenon<Versionsnummer>\PredefinedVariables*

Note: Variable names must be unique in zenon. If driver variables of the driver object type *Communication details* are to be imported from **DRVVAR.DBF** again, the variables that were imported beforehand must be renamed.

Information

Not every driver supports all driver variables of the driver object type *Communication details*.

For example:

- Variables for modem information are only supported by modem-compatible drivers.
- Driver variables for the polling cycle are only available for pure polling drivers.
- Connection-related information such as **ErrorMSG** is only supported for drivers that only edit one connection at a a time.

INFORMATION

Name from import	Type	Offset	Description
MainVersion	*UINT*	0	Main version number of the driver.
SubVersion	*UINT*	1	Sub version number of the driver.
BuildVersion	*UINT*	29	Build version number of the driver.
RTMajor	*UINT*	49	zenon main version number
RTMinor	*UINT*	50	zenon sub version number
RTSp	*UINT*	51	zenon Service Pack number
RTBuild	*UINT*	52	zenon build number
LineStateIdle	*BOOL*	24.0	TRUE, if the modem connection is idle
LineStateOffering	*BOOL*	24.1	TRUE, if a call is received
LineStateAccepted	*BOOL*	24.2	The call is accepted
LineStateDialtone	*BOOL*	24.3	Dialtone recognized
LineStateDialing	*BOOL*	24.4	Dialing active

Name from import	Type	Offset	Description
LineStateRingBack	*BOOL*	24.5	While establishing the connection
LineStateBusy	*BOOL*	24.6	Target station is busy
LineStateSpecialInfo	*BOOL*	24.7	Special status information received
LineStateConnected	*BOOL*	24.8	Connection established
LineStateProceeding	*BOOL*	24.9	Dialing completed
LineStateOnHold	*BOOL*	24.10	Connection in hold
LineStateConferenced	*BOOL*	24.11	Connection in conference mode.
LineStateOnHoldPendConf	*BOOL*	24.12	Connection in hold for conference
LineStateOnHoldPendTransfer	*BOOL*	24.13	Connection in hold for transfer
LineStateDisconnected	*BOOL*	24.14	Connection terminated.
LineStateUnknow	*BOOL*	24.15	Connection status unknown
ModemStatus	*UDINT*	24	Current modem status
TreiberStop	*BOOL*	28	Driver stopped For *driver stop*, the variable has the value *TRUE* and an **OFF** bit. After the driver has started, the variable has the value *FALSE* and no **OFF** bit.
SimulRTState	*UDINT*	60	Informs the status of Runtime for driver simulation.
ConnectionStates	*STRING*	61	Internal connection status of the driver to the PLC. Connection statuses: *0:* Connection OK *1:* Connection failure *2:* Connection simulated Formating: *<Netzadresse>:<Verbindungszustand>;...;...;*

Name from import	Type	Offset	Description
			A connection is only known after a variable has first signed in. In order for a connection to be contained in a string, a variable of this connection must be signed in once. The status of a connection is only updated if a variable of the connection is signed in. Otherwise there is no communication with the corresponding controller.

CONFIGURATION

Name from import	Type	Offset	Description
ReconnectInRead	*BOOL*	27	If TRUE, the modem is automatically reconnected for reading
ApplyCom	*BOOL*	36	Apply changes in the settings of the serial interface. Writing to this variable immediately results in the method SrvDrvVarApplyCom being called (which currently has no further function).
ApplyModem	*BOOL*	37	Apply changes in the settings of the modem. Writing this variable immediately calls the method SrvDrvVarApplyModem. This closes the current connection and opens a new one according to the settings **PhoneNumberSet** and **ModemHwAdrSet**.
PhoneNumberSet	*STRING*	38	Telephone number, that should be used
ModemHwAdrSet	*DINT*	39	Hardware address for the telephone number
GlobalUpdate	*UDINT*	3	Update time in milliseconds (ms).
BGlobalUpdaten	*BOOL*	4	TRUE, if update time is global
TreiberSimul	*BOOL*	5	TRUE, if driver in sin simulation mode
TreiberProzab	*BOOL*	6	TRUE, if the variables update list should be kept in the memory
ModemActive	*BOOL*	7	TRUE, if the modem is active for the driver

Name from import	Type	Offset	Description
Device	*STRING*	8	Name of the serial interface or name of the modem
ComPort	*UINT*	9	Number of the serial interface.
Baudrate	*UDINT*	10	Baud rate of the serial interface.
Parity	*SINT*	11	Parity of the serial interface
ByteSize	*USINT*	14	Number of bits per character of the serial interface Value = *0* if the driver cannot establish any serial connection.
StopBit	*USINT*	13	Number of stop bits of the serial interface.
Autoconnect	*BOOL*	16	TRUE, if the modem connection should be established automatically for reading/writing
PhoneNumber	*STRING*	17	Current telephone number
ModemHwAdr	*DINT*	21	Hardware address of current telephone number
RxIdleTime	*UINT*	18	Modem is disconnected, if no data transfer occurs for this time in seconds (s)
WriteTimeout	*UDINT*	19	Maximum write duration for a modem connection in milliseconds (ms).
RingCountSet	*UDINT*	20	Number of ringing tones before a call is accepted
ReCallIdleTime	*UINT*	53	Waiting time between calls in seconds (s).
ConnectTimeout	*UINT*	54	Time in seconds (s) to establish a connection.

STATISTICS

Name from import	Type	Offset	Description
MaxWriteTime	*UDINT*	31	The longest time in milliseconds (ms) that is required for writing.

Name from import	Type	Offset	Description
MinWriteTime	*UDINT*	32	The shortest time in milliseconds (ms) that is required for writing.
MaxBlkReadTime	*UDINT*	40	Longest time in milliseconds (ms) that is required to read a data block.
MinBlkReadTime	*UDINT*	41	Shortest time in milliseconds (ms) that is required to read a data block.
WriteErrorCount	*UDINT*	33	Number of writing errors
ReadSucceedCount	*UDINT*	35	Number of successful reading attempts
MaxCycleTime	*UDINT*	22	Longest time in milliseconds (ms) required to read all requested data.
MinCycleTime	*UDINT*	23	Shortest time in milliseconds (ms) required to read all requested data.
WriteCount	*UDINT*	26	Number of writing attempts
ReadErrorCount	*UDINT*	34	Number of reading errors
MaxUpdateTimeNormal	*UDINT*	56	Time since the last update of the priority group **Normal** in milliseconds (ms).
MaxUpdateTimeHigher	*UDINT*	57	Time since the last update of the priority group **Higher** in milliseconds (ms).
MaxUpdateTimeHigh	*UDINT*	58	Time since the last update of the priority group **High** in milliseconds (ms).
MaxUpdateTimeHighest	*UDINT*	59	Time since the last update of the priority group **Highest** in milliseconds (ms).
PokeFinish	*BOOL*	55	Goes to *1* for a query, if all current pokes were executed

ERROR MESSAGE

Name from import	Type	Offset	Description
ErrorTimeDW	*UDINT*	2	Time (in seconds since 1.1.1970), when the last error occurred.

Name from import	Type	Offset	Description
ErrorTimeS	*STRING*	2	Time (in seconds since 1.1.1970), when the last error occurred.
RdErrPrimObj	*UDINT*	42	Number of the PrimObject, when the last reading error occurred.
RdErrStationsName	*STRING*	43	Name of the station, when the last reading error occurred.
RdErrBlockCount	*UINT*	44	Number of blocks to read when the last reading error occurred.
RdErrHwAdresse	*DINT*	45	Hardware address when the last reading error occurred.
RdErrDatablockNo	*UDINT*	46	Block number when the last reading error occurred.
RdErrMarkerNo	*UDINT*	47	Marker number when the last reading error occurred.
RdErrSize	*UDINT*	48	Block size when the last reading error occurred.
DrvError	*USINT*	25	Error message as number
DrvErrorMsg	*STRING*	30	Error message as text
ErrorFile	*STRING*	15	Name of error log file

7 Driver command function

The zenon **Driver commands** function is to influence drivers using zenon.
You can do the following with a driver command:

- Start
- Stop
- Shift a certain driver mode
- Instigate certain actions

Note: This chapter describes standard functions that are valid for most zenon drivers.
Not all functions described here are available for every driver. For example, a driver that does not, according to the data sheet, support a modem connection also does not have any modem functions.

Attention

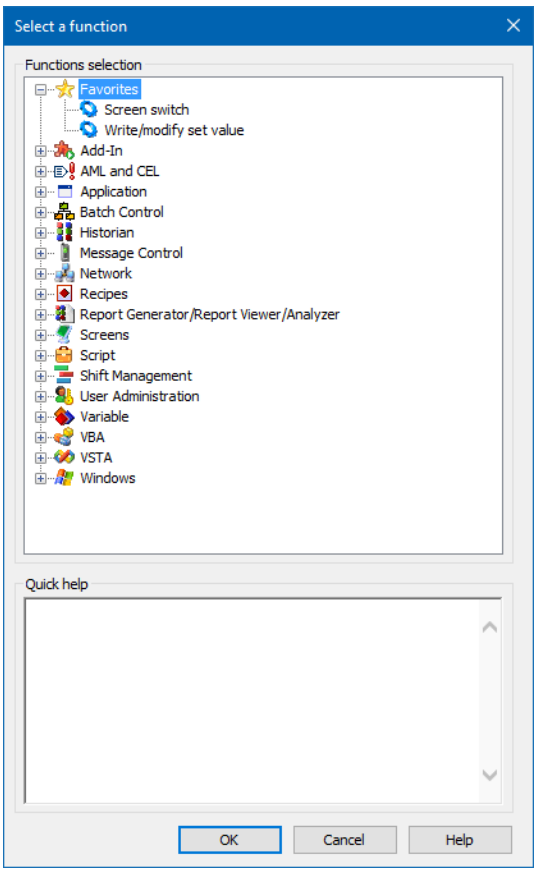
The zenon **Driver commands** function is not identical to driver commands that can be executed in the Runtime with Energy drivers!

CONFIGURATION OF THE FUNCTION

Configuration is carried out using the **Driver commands** function.
To configure the function:

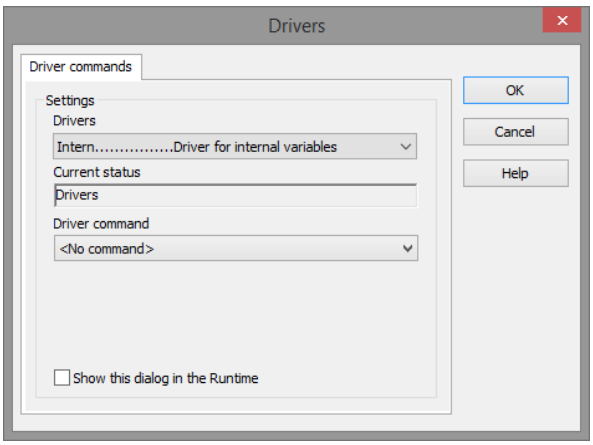
1. Create a new function in the zenon Editor.

   The dialog for selecting a function is opened



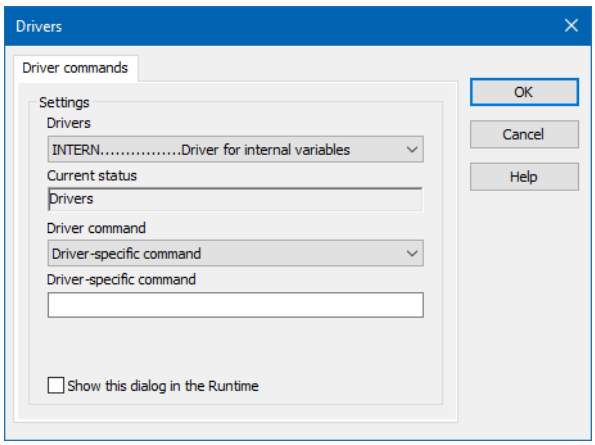
2. Navigate to the node **Variable.**
3. Select the **Driver commands** entry.

The dialog for configuration is opened



4. Select the desired driver and the required command.
5. Close the dialog by clicking on **OK** and ensure that the function is executed in the Runtime. Heed the notices in the **Driver command function in the network** section.

DRIVER COMMAND DIALOG



Option	Description
Driver	Selection of the driver from the drop-down list. It contains all drivers loaded in the project.
Current condition	Fixed entry that is set by the system. Has no function in the current version.
Driver command	Selection of the desired driver command from a drop-down list. For details on the configurable driver commands, see the **available driver commands** section.
Driver-specific command	Entry of a command specific to the selected driver.

Option	Description
	Note: Only available if, for the **driver command** option, the *driver-specific command* has been selected.
Show this dialog in the Runtime	Configuration of whether the configuration can be changed in the Runtime: ▸ *Active*: This dialog is opened in the Runtime before executing the function. The configuration can thus still be changed in the Runtime before execution. ▸ *Inactive*: The Editor configuration is applied in the Runtime when executing the function. Default: *inactive*

CLOSE DIALOG

Options	Description
OK	**Applies settings and closes the dialog.**
Cancel	Discards all changes and closes the dialog.
Help	Opens online help.

AVAILABLE DRIVER COMMANDS

These driver commands are available - depending on the selected driver:

Driver command	Description
<No command>	No command is sent. A command that already exists can thus be removed from a configured function.
Start driver (online mode)	Driver is reinitialized and started. **Note:** If the driver has already been started, it must be stopped. Only then can the driver be re-initialized and started.
Stop driver (offline mode)	Driver is stopped. No new data is accepted. **Note:** If the driver is in offline mode, all variables that were created for this driver receive the status *switched off* (*OFF*; Bit *20*).

Driver command	Description
Driver in simulation mode	Driver is set into simulation mode. The values of all variables of the driver are simulated by the driver. No values from the connected hardware (e.g. PLC, bus system, ...) are displayed.
Driver in hardware mode	Driver is set into hardware mode. For the variables of the driver the values from the connected hardware (e.g. PLC, bus system, ...) are displayed.
Driver-specific command	Entry of a driver-specific command. Opens input field in order to enter a command.
Activate driver write set value	Write set value to a driver is possible.
Deactivate driver write set value	Write set value to a driver is prohibited.
Establish connection with modem	Establish connection (for modem drivers) Opens the input fields for the hardware address and for the telephone number.
Disconnect from modem	Terminate connection (for modem drivers)
Driver in counting simulation mode	Driver is set into counting simulation mode. All values are initialized with *0* and incremented in the set update time by *1* each time up to the maximum value and then start at *0* again.
Driver in static simulation mode	No communication to the controller is established. All values are initialized with *0*.
Driver in programmed simulation mode	The values are calculated by a freely-programmable simulation project. The simulation project is created with the help of the zenon Logic Workbench and runs in the zenon Logic Runtime.

DRIVER COMMAND FUNCTION IN THE NETWORK

If the computer on which the **Driver commands** function is executed is part of the zenon network, further actions are also carried out:

- A special network command is sent from the computer to the project server.
  It then executes the desired action on its driver.
- In addition, the Server sends the same driver command to the project standby.
  The standby also carries out the action on its driver.

This makes sure that Server and Standby are synchronized. This only works if the Server and the Standby both have a working and independent connection to the hardware.

7.1 SwitchConnection

The driver-specific command *SwitchConnection* switches between a primary and secondary IP address.

Procedure:

1. The active IP address is closed for the **Net address** entered with the command.
2. In doing so, the **INVALID** bit is not set for the variables.
3. The connection is then established via the other IP address.
4. If the connection is not successfully established, the **INVALID** bit is set and a switch back to the active connection is made.

Note: The driver command is taken into account if the connection to an IP address has been established successfully. The command is ignored if there is no connection or a connection is currently being established.

Syntax:

- *SwitchConnection <NetAddr>*
  <NetAddr> Stands for the number of the **Net address**.

Example:

- **SwitchConnection 1**
  Switches between primary and secondary address for the connection to net address *1*.

8 IEC850 client functions

Special specifications of the IEC 61850 standard were implemented as specific functions in the IEC 850 client driver.

You can find detailed information in the respective chapters:

- Verbindungaufbau und Verbindungsausfallerkennung (on page 90)
- Commands (Control Model) (on page 94)

  Commands - overview
  - Select und Cancel (on page 96)
  - Additional Cause Diagnosis (on page 98)
  - Service parameters of the command (on page 100)
- Service Tracking (Main.chm::/IEC850.chm::/117281.htm)

- Mapping of double point values (on page 106)
- Quality bits, time stamp and status bits of the variable (on page 109)
  - TimeQuality and TimeAccuracy (on page 113)
- Filetransfer (on page 113)

  There are three functions implemented for the file transfer:
  - Request folder information
  - Get file from server
  - Delete file

LIMITATIONS

- The driver also supports controllers based on **IEC 61400-25-4 Annex C** (from 2008-08), provided they are compatible with at least Edition 1 of the **IEC 61850** standard, taking into account the **TISSUE**s (Technical Issues) that have been corrected by Edition 1 by 2008-08.
- Data type: **ARRAY OF**
  Only one array level is supported. The support for arrays is limited to the data attributes. It is not possible to write array elements. When reading by means of polling or reporting, as with other data attributes too, the complete Data Object (FCD reference), which contains the array attribute, is always read.

Data type**INT64(U)**:
In the (U)LINT variable value, only the lowest 52-bit is applied.
The other bits are cut off and not taken into account.

  - Alternatively, the variable can be configured with the LREAL data type. As a result, it is possible to transfer the total value.
    In doing so, note that for values that are greater than 52 bit, the precision of the lowest points is lost.
- For reports with Service Tracking, only DataSets with references are supported.
- **Conformance statement** (PICS, MICS):
  You can find the information on supported or required services and data types in Appendix C (on page 155).

8.1 Establishment of a connection and detection of a connection failure

When starting the zenon Runtime, the driver also starts and starts establishing the connections to IEDs. The driver only opens a connection to a Logical Device if at least one variable from the LD is created in

the project. For performance reasons, the driver also ignores the Logical Nodes for which no variables have been created in the project. **Exception:** LLN0 - the content of LLN0 (its RCBs) is always read.

On Windows operating systems, the information can only be provided via the operating system's TCP timeout (20-30s) when sending (not when receiving). The driver therefore cannot detect an interruption in the connection if all variables are received by means of Reports . After a communication breakdown (due to a network failure, for example), the connection to the Logical Device is then only reestablished automatically if at least one variable of the LD is being polled.

Recommendation: To detect a connection failure, activate the **Automatic Watchdog** property in the driver configuration.

If **Automatic Watchdog**has been activated: the driver automatically starts to poll the **/LLN0/Mod/stVal[ST]* data attribute as soon as all other data of the Logical Device only comes via reports, i.e. whilst all polled variables are not signed in. The drivers polls the data attribute regardless of whether it would be present in one of the RCBs. The MMS.Read queries that are sent cyclically, in the cycle of the **Polling rate** driver setting force the operating system to check the TCP connection again and to report to the driver if the connection has been disconnected.

TCP KEEP_ALIVE

The driver opens the TCP socket in Windows with the following keep-alive parameters:

- The timeout for *keep_alive* is 20 seconds.
- The interval for *keep_alive* is 1 second.
- *Retries* are defined and fixed by the operating system at 10 retries.
- This means:
  If the driver does not send a TCP telegram within 20 seconds (no *MMS request*), the Windows operating system sends a TCP *keep_alive* message every second. If no response is received for 10 such *keep_alive* messages, the connection to the 850 server is closed.

CANCEL WITH PENDING MMS REQUESTS

If the IEC850 driver does not receive any responses from the 850 sever for the *MMS requests* sent, these remain pending until the number of *negociatedMaxServOutstandingCalled* (from *MMS Initiate*) has been reached. If, as a result, the driver is blocked for longer than 50 seconds, the connection to the server is automatically disconnected.
This prevents an incorrect IED blocking the driver's communication process.
This disconnection creates the following error message in the LOG file:
Outstanding requests are not answered for more than 50s

CONNECTION STATE VARIABLE

A *Connection State* variable, if created, provides information on whether the driver has a TCP and then MMS connection to the server and whether the connection consists of primary or secondary IP addresses. Furthermore, you receive information on whether all configured static RCB assignments have been successfully registered.

This variable must be created with the *Connection state* **Driver object type** (on page 57). It must contain the correct **net address** of the connection, the reference with a configured syntax **!ConnectionState* and the data type has to be **UDINT**.

The bits of the variable value mean the following:

For the primary TCP/IP connection to the 850 server:

Bit	Meaning	Value (hex)
1	*TCP_CONNECTED*	0x02
2	*TCP_CONNECTING*	0x04
3	*TCP_CONNECT_FAILED*	0x08
16	*MMS_ASSOCIATED*	0x10000
17	*MMS_RCB_ENABLE_FAILED*	0x20000

For the secondary TCP/IP connection:

Bit	Meaning	Value (hex)
5	*TCP_CONNECTED*	0x20
6	*TCP_CONNECTING*	0x40
7	*TCP_CONNECT_FAILED*	0x80
24	*MMS_ASSOCIATED*	0x1000000
25	*MMS_RCB_ENABLE_FAILED*	0x2000000

The bit *MMS_RCB_ENABLE_FAILED* is only set if one (or more) RCBs that have been configured in the driver configuration in **RCB assignment** (on page 42) could not be activated. This happens for example if the IEC850 server does not write to RCB data attributes because another client is already using this report.

The *Connection State* variable does not provide an evaluation of whether it was possible to activate the URCBs via '**max. auto used URCBs** (on page 26)'.

Example

The standard process for the value change of the variable is:

The Runtime starts (o. TCP_CONNECT_FAILED) => TCP_CONNECTING => TCP_CONNECTED => TCP_CONNECTED + MMS_ASSOCIATED

Or, in the event of a permanent TCP error:

TCP_CONNECT_FAILED => TCP_CONNECTING => TCP_CONNECT_FAILED

Or, if the connection was established correctly but activation of an RCB failed:

=> TCP_CONNECTED + MMS_ ASSOCIATED + MMS_RCB_ENABLE_FAILED

When starting zenon Runtime, it is possible that the TCP connections to some IEDs get to the drive before Runtime is ready for the evaluation of the *Connection State* variables; whilst the variables have not yet been registered in Runtime. In this case, only *TCP_CONNECTED*, or *MMS_ASSOCIATED* bits are evaluated (and visible in the **CEL** for example).

REDUNDANT ZENON NETWORK

In a redundant zenon network, both the **Primary Server** and the **Standby Server** start their own IEC850 driver. Both drivers must register different RCB instances (otherwise they are in conflict because an 850 server can only issue a client the RCB instance).

Attention: If you use redundancy in your zenon project (**Network active** property and **Server 1** and **Server 2** have been configured), you must create at least two entries in the driver configuration **RCB assigngment**: a **Hostname** for**Server 1** and second **Hostname** for **Server 2** (Standby). You must then select different instances of the RCB for these entries.
Note: Per default the IEC850 driver creates two host names: *$SCADA_SERVER1* and *$SCADA_SERVER2*.

The *Connection State* variable cannot result in a different evaluation for drivers on the **Server 1** network than that on **Server 2**. For the user, also on the Standby, only the current value of the current **Primary Server** is visible. If you also want to make the current evaluation for **Standby Server** visible - in order, for example, to trigger an alarm if the Standby could not register its RCBs, you can create a copy of the *Connection State* variable - with the same reference (in **Symbolic address**), a different prefix in the **Name** and with the **Read from Standby Server only** property activated.

Note: For **Evaluated network**, you do not need any of the variables requested by the Standby in the **Valuations** property. The evaluation takes place separately on both servers, using the local values of the variables. Therefore in the standby, it is always the value of the *Connection State* variable that is evaluated by its internal image, even if no copy has been created in the project.

ESTABLISHMENT OF A CONNECTION TO IED WITH SMALL PDU SIZE

The driver automatically reads the data model in zenon Runtime from an IED during the *Association* (establishment of the connection). If the IED uses a different frame size to that necessary for the reading of the data model, this is automatically detected and the procedure is amended dynamically. The basis is the variables created in the zenon project.
The following is applicable for the creation of the variables in zenon Editor: If the the data model cannot be fully imported online by IED, use the offline import from an SCL file.

8.2 Commands (Control Model)

The driver supports the commands 'Direct Operate' and 'Select Before Operate' (SBO) with normal and enhanced security (normal security and enhanced security) - i.e. all Control Models *1...4* envisaged by the IEC 61850 Standard.

To trigger a command, in any desired Control Model, set a value to the variable with the reference **/Oper.ctlVal** , i.e.:

- **/Oper.cltVal[CO]* for commands where the ctlVal item is a simple bType in the Oper structure.
- **/Oper.ctlVal.f[CO]* Or **/Oper.ctlVal.i[CO]* for commands where the cltVal item itself is a structure, for example an AnalogueValue.

The driver then automatically checks the actual Control Model of the data object on the 850 server and executes a complete command sequence accordingly. For the pending command, the required command sequences are automatically executed by the driver in the correct sequence accordingly.

Example: If the user amends the value of the variable with a reference **/CSWI1/Pos/Oper.ctlVal[CO]*, the driver first carries out a Select and then an Operate or just an Operate. The decision as to whether a Select is required is made by the driver itself. No additional configuration steps are necessary for this.

Attention

Do not create any variables that correspond to the data attributes */SBO, */SBOw* or */Cancel*.

To send a command to the server, only set the value of the */Oper.ctlVal*[CO] variable. The driver will automatically recognize that the command sequence must also contain a Select. A Select is then executed automatically.

DATA ATTRIBUTES WITH FUNCTIONAL CONSTRAINT CO

With Functional Constraint *CO*, variables are only supported with the following references:

- **/Oper.ctlVal[CO]*, **/Oper.ctlVal.i[CO]* and **/Oper.ctlVal.f[CO]* - the triggers of a command

- **/Oper.Test[CO]* and **/Oper.Check[CO]* - optional service parameters of the command that has been triggered by writing the set value to *ctlVal*.

In Runtime, only the values of the *CO* variables *Oper.ctlVal**, *Oper.Check* and *Oper.Test* are displayed, other zenon variables with Functional Constraint *CO*, even if configured, are ignored by the driver. The driver only supports remaining *CO* data attributes in the *Oper*, *SBOw* and *Cancel* structures for communication with an 850 server, not for the exchange of data with Runtime.

In Runtime, the variables with Functional Constraint *CO* are only 'write-only'. That means:

- These only have a value once it has been set in Runtime - by the user.
- These variables still do not have a value after starting in Runtime.
- They are reset to the value 0 after a connection has been lost and is established again.

PROCESS AFTER WRITING SET VALUE TO OPER.CTLVAL

If a value is set to a project variable that corresponds to the *ctlVal* item in a structure data attribute with the name '*Oper*' and it has the Functional Constraint *CO* or *SP* (**/Oper.ctlVal[CO|SP]*, **/Oper.ctlVal.i[CO]* or **/Oper.ctlVal.f[CO]*), the driver automatically checks which Control Model is required for a command in thisData Object (p.e.: *Pos* if the reference is **/Pos/Oper.ctlVal[CO]*).
To do this, the data attribute **/ctlModel[CF]* of the data object is read by the 850 server (**/Pos/ctlModel[CF]*). Depending on the value of this data attribute, the respective Control Model is used and the command is executed in the corresponding procedure. Control Model:

- *Value 0* - status only*:*
  No action is carried out. It is forbidden to send a command to the 850 server, in accordance with the IEC 61850 standard.
- *Value 1* - direct control with normal security*:*
  An 'Operate' service is executed - the value is written to the **/Oper[CO]* structure (and the structure sent to the 850 server).
- *Value 2* - select before operate with normal security*:*
  The 'Select' and 'Operate' services are executed - read of **/SBO[CO]*, write to **/Oper[CO]*.
- *Value 3* - direct control with enhanced security*:*
  An 'Operate' service is executed - the value is written to **/Oper[CO]*.
- *Value 4* - select before operate with enhanced security*:*
  The 'SelectWithValue' and 'Operate' services are executed - write to **/SBOw[CO]*, write to **/Oper[CO]*.

The **/Oper[CO]* and **/SBOw[CO]* written to the 850 server are structures with several data attributes. The driver fills them automatically; you can find further information in the Service parameters of the command (on page 100) chapter.

Info

The driver always reads the *ctlModel* data attribute again - from the 850 server - in order to execute the command correctly. However the driver does not transfer the **ctlModel** to the Runtime automatically. This includes situations where a variable was created for the **ctlModel**. If a variable was created, it is updated in accordance with the **Polling Rate** that is defined in the driver configuration.

COMMANDS FOR ANALOG VALUES

If it is a command to an analog value **/Oper.ctlVal.i[CO]* or **/Oper.ctlVal.f[CO]*, the driver checks to see whether the respective counterpart *f* or *i* exists for the set value in the data model of the server.

If both values are present in the object (despite the **TISSUE 925**), the other respective other value is calculated automatically using the previously-read configuration of the data object with the formula *f = ((i * scaleFactor) + offset) / 10^unitsMultiplier* (**Note:** *10* high *unitsMultiplier*) automatically calculated. Then both values (*i* and *f*) are sent as a structure in a command. No configuration steps are necessary for this.

Note: the **TISSUE 925** for IEC 61850 standard edition 2 has the restriction that an *Oper* with *AnalogueValue* can contain either item *f* or *i* , not both. Older devices can thus possibly have a data model that no longer complies with the standard - with *Oper.ctlVal.i* and *f* .

COMMANDS FOR MMS BIT STRINGS

Command variables (**/Oper.ctlVal[CO]*) that match an MMS Bitstring - such as Tcmd or other CODED ENUM based bTypes are created as variables with the data type *UDINT* on import. You can later change the data type manually to data type *BOOL*, e.g. for variables **/TapChg/Oper.ctlVal[CO]*. If the command variable is data type *BOOL*, on **write set value**, the driver will map the value *FALSE* to *0x40 (lower)* and the value *TRUE* to *0x80 (higher)*. Thus this *BOOL* variable can be directly linked to switching actions in **zenon Command Processing**.

COMMANDS - OVERVIEW

- Select and Cancel (on page 96)
- Additional Cause Diagnosis (on page 98)
- Service parameters of the command (on page 100)

8.2.1 Select and cancel

The IEC850 driver works together with the zenon module **Command Processing**. The driver provides the **Command Processing** with special features for commands Select and Cancel.

Thus in **Command Processing** e.g. a Select can be separated from an Operate. After the Select, instead of an Operate it is possible for a Cancel to follow.

Prerequisite for this is that at the action in the Command Processing property **two-stage** is enabled. At the action variable property **Select Before Operate** must be enabled.

The driver supports a Cancel during a command only with zenon **Command Processing**.

PROCEDURE

The driver always sends a Select automatically to the IED if this is required according to the Control Model.

- If the **command processing** sends a two-stage command and the **Select Before Operate** property of the action variable is active, the driver then - in accordance with the *ctlModel* of the data object - sends a Select during the first stage of the command action.
  - For *ctlModel=2* or *4* , a Select is sent to the IED (850 server).
  - A Select for values *ctlModel=1* or *3* (direct control) is immediately responded positively for the **Command Processing**. Thus the driver confirms a positive execution of the Select to the action of the Command Processing without the IED being involved in the communication.
  - A Select for value *ctlModel=0* (status only) is responded negatively as an IED will not carry out a command.

Note: Select Before Operate means the property for the *Oper.ctlVal[CO]* variable in zenon and must not be confused with the data attribute *SBO* in the data model of the 850 server.

If the IEC 61850 server responds to the Select positively, the driver saves the information using the selected data object. In the following command (from the second stage of the command processing) the driver only executes the Operate .

The **Select Before Operate** property of the *ctlVal* variables has no influence on the execution of commands if the value of the *ctlVal* has been set directly and not by an action of the **Command Processing**.

CANCEL OF SELECT

If, in the **command processing**, the command action is canceled at the second step, the driver sends a Cancel (*ctlModel=2* or *4*) or immediately confirms the Cancel for the action of the command processing (*ctlModel=1* or *3*).

CANCEL OF OPERATE

The driver supports Cancel operate only for the **Command Processing** module in zenon.
If the **Cancel Operate** property is activated for the command variable, an Operate that has not yet

been completed can be canceled for a Control Model with increased safety (*3* and *4*). If an ongoing Operate is canceled in the command processing, the driver sends a Cancel to the server.

The **Cancel Operate** property of the *ctlVal* variable has no influence on the execution of commands if the value of the *ctlVal* has been set directly and not by an action of the **Command Processing**.

Note: not all IEC 61850 servers support a Cancel after an Operate has been started.

8.2.2 Additional Cause Diagnosis

In accordance with the IEC 61850 standard, an IEC61850 server should also send an additional service with *AdditionalCauseDiagnosis* to the driver (*AddCause* in *LastApplError* structure) for negative responses to a command. The possible values of the *AddCause* service parameter are listed in the IEC 61850-7-2. The driver can forward the *AddCause* received to zenon. To do this, the **drive object type** *Command Info* variables are used.

The driver also uses further *Command Info* driver object variables to inform Runtime of the current status of the ongoing command (for example Select/Operate/Cancel) and provides information on whether the command was successful.

'COMMAND INFO' VARIABLES

Whilst already running, the driver provides the additional information in variables of the *Command Info* driver object type (see driver objects (on page 57)) as soon as these have been created in the project. Variables that relay the stage of the current command can be created for each **/Oper* structure. They then provide information not just about Operate , but also about Select and Cancel commands. The driver supports *Command Info* variables with the following references:

- **/Oper.AddCause*:
  After a command has failed, the value shows the error information - AddCause. This information is only available if it has been sent by the 850 server. Not every server supports this service. In this case, the value of the variable remains *0*.
- **/Oper.ControlRun*:
  The variable shows the condition or the result of the current command:
  - *1* = command is running
  - *0* = command successful
  - *-1* = command failed
- **/Oper.ControlState*:
  The variable shows the condition of the command that is currently running (processed sequentially):
  - *-1* = command ended
  - *0* = read ctlModel

- *1* = 'Select' sent
- *2* = 'Operate' sent
- *3* = 'Cancel of Selectsent
- 4 = 'Operate response' received (only in ctlModel=3 or 4)
- 5 = 'Cancel of Operate' received (only in ctlModel=3 or 4)

The references of the *Command Info* variables do not need a Functional Constraint, but they must address the data object of the corresponding **/Oper.ctlVal*[CO]* variable.

Example:

For the variable *PLC marker*, *BOOL*, with the reference (for example **symbolic address**) *GE650!GEDeviceF650/CSWI1/Pos/Oper.ctlVal[CO]*, you can create the *Command Info* variables with the following references:

- *Command Info*, *SINT*: *X!GEDeviceF650/CSWI1/Pos/Oper.AddCause*
- *Command Info*, *SINT*: *X!GEDeviceF650/CSWI1/Pos/Oper.ControlRun*
- *Command Info*, *SINT*: *X!GEDeviceF650/CSWI1/Pos/Oper.ControlState*

Case 1:

If you set the value to **/Oper.ctlVal* directly or the variable does not have the **Select Before Operate** property, the sequence of states is as follows:

1. */Oper.ControlRun = *1* and */Oper.ControlState = *0* - command is running, the driver checks Control Model.
2. */Oper.ControlState = *1* and dann */Oper.ControlState = *2* - command is running, the driver sends Operate.
3. */Oper.ControlRun = *0* and */Oper.ControlState = *-1* - command successfully completed.

Case 2:

If you use the two-stage command processing for **/Oper.ctlVal* with the **Select before Operate** property, the sequence of states for each command service (for Select, Operate or Cancel) is as follows:

1. */Oper.ControlRun = 1 and */Oper.ControlState = 0
2. */Oper.ControlState = x
3. */Oper.ControlRun = 0 and */Oper.ControlState = -1

For this, the following applies: x=1 or 2 or 3, depending on the command service.

Case 3:

If a command has been sent and the value */Oper.ControlRun remains 1 ("running") for a while, i.e. it does not change to either 0 or -1, this means that the driver must still wait for the attendant response from the 850 server. The 850 server has not yet initiated the command - neither positively nor

negatively. This can happen regardless of whether the other data exchange with the server continues to work. It can happen whilst the 850 server checks the time-intensive Interlocking for example, or there would be a notification of an overload of the 850 server (or incorrect behavior with regard to command processing).

Attention

The **Command Info** variables do not have any value if no command was given. To evaluate these variables, you must first set a value to the **/Oper.ctlVal[CO]* variable.

8.2.3 Service parameters of the command

The command services (for example Operate) that the driver sends to the 850 server consist of defined structures with additional parameters. The structure is defined in the IEC 61850 standard.

These parameters are handled as follows.

CHECK PARAMETERS

The driver sends all commands with *Check = 0* by default. There are two methods for setting the *Check* value for the following Operate or SelectWithValue service:

1. The *Check* parameter can be pre-defined by setting a value for the **/Oper.Check[CO]* variable. The current value of the variable is used for the command service parameter.

   Attention: The *Check* data attribute is a PACKED LIST (MMS bit string) with 2 bits. In accordance with IEC61850-8-1 8.1.3.5, the first member of the PACKED LIST is mapped to bit(0) and this bit should be the highest value (most significant) bit of the octet. This means that the valid set values for the *Check* data attribute 128 (0x80 synchrocheck), 64 (0x40 interlock-check), are 192 (0xC0 both check bits) and 0x00.

2. In zenon by setting in the command processing: Action - **Qualifier of Command** property. The valid set values are 2 - synchrocheck (inverted 01b), 1 - interlock-check (inverted 10b), 3 (both check bits) and 0. With this method, the **/Oper.Check[CO]* variable, which may have been created, is ignored.

TEST PARAMETER

The driver sends all commands with *Test = 0* by default. The *Test* flag for the following Operate, SelectWithValue and Cancel services can be predefined by setting a value for the **/Oper.Test[CO]* variable. The current value of the variable is used for the command service parameter.

Attention

If you set the new values to the *[CO] variables in Runtime, these are forwarded to the driver. The values are then set to the next Operate or SelectWithValue in the driver.

The new values are initially written to the server in the subsequent command.

A loss of the connection sets the values, including the values of all CO variables, to the status *INVALID*. The reestablishment of the connection then resets the values to 0.

ORIGINATOR

The Originator data attributes *orCat* (Category) and *orIdent* (Identification) show which *Originator* (for example a client that is at bay level) has caused the last change of data (issued a command for example).

The driver compiles the Originator when sending a command, consisting of:

- **orCat**
  Dialog **Basic Settings**
- **orIdent**
  Dialog **Client configuration**

The orIdent can be used, based on the computer name of the computer on which the user has triggered the command. To do this, activate the **Use Client orIdent** property in the **Server** dialog. Then also create, in the **Client configuration** driver dialog, a **Hostname** for each computer in the zenon network.

The default origin.orIdent *'zenon: <computer_name>'* is used in commands if:

- In the client configuration for the corresponding computer (= **Hostname**), no orIdent is configured.
- in the client configuration for the corresponding computer, no entry with **Hostname** has been configured.

If the **Use Client orIdent** property is not active, the *orIdent* of the Primary Server is used.

Example

When a command is executed, the driver sets the originator for the *Originator* data attributes SBOw, Oper and Cancel as follows:

Example 1 - default settings:

- **orCat =** *2* (station control)
- **orIdent =** empty

Result: *2,'zenon: <computer_name>'* (string between quotation marks - CHAR(27)) , e.g. 'zenon: MyPC'

Example 2 - "Use Client orIdent" checkbox deactivated:

- **orCat =** *2* (station control)
- **orIdent =** "SCADA_850_Client"
  Configured in the **Hostname** for **Server 1** and **Server 2** in the dialog **Client configuration**

Result: *2,'SCADA_850_Client'*

Example 3 - "Use Client orIdent" checkbox activated:

- **orCat =** *2* (station control)
- **orIdent =** "PC_Room01"
  Configured in the **Hostname** for all computers in the zenon network that are physically in the same room.

Result: *2,'PC_Room01'*

The *Origin* attributes are an obligatory part of the Oper, SBOw and Cancel services and optional for the upper node of a data object, e.g. 'Pos'. In order to be able to analyze the *Originator* of the **/Pos/stVal[ST]* value changes in Runtime, you can create attendant project variables in zenon if **/Pos/origin.orCat[ST]* and **/Pos/origin.orIdent[ST]* exist in the data model of the 850 server. If the 850 server does not support **Service Tracking**, then it is evident in these attributes which client was the last to give a successful command. The attributes with Functional Constraintt *CO* are not suitable for this because, according to the standard, it is not permitted to read them from an 850 server.

Attention: In order to analyze the Originator of a data object, the 850 server must be programmed accordingly. The server must accept the *Origin* of the received command from **/Oper.origin.*[CO]* in these *ST* attributes.

If a Report is received, the driver forwards the *Originator* to Runtime with priority before it forwards the other data attributes of the received data object.

Note: You can use *orCat* or *orIdent* variables to compile a *dynamic limit value text* for value changes to the *stVal* variables.

CTLNUM (CONTROL SEQUENCE NUMBER) PARAMETER

The driver automatically creates the values of the *ctlNum* parameter and sends it in commands. Each time a value is set to the **/Oper.ctlVal[CO]* variable, the driver automatically increases the value of the **/Oper.ctlNum[CO]*. The driver restarts at *0* if the value *127* has been reached. A zenon variable *ctlNum[CO]*, even if configured, is not however updated in Runtime. The *ctlNum* value is only for correct execution of commands, not for the information of users.
The driver also counts **write set value** to *ctlVal* if *ctlModel=0* (no action).

T (TIME) PARAMETER

The driver automatically sends the time of command execution, *TimeQuality* and *TimeAccuracy* information in commands. You can find further details in the **TimeQuality and TimeAccuracy of a command** chapter.

8.3 Service Tracking

Service tracking was introduced with edition 2 of the IEC61850 standard. As a basic requirement, the IEC61850 server must contain at least one logical node LTRKin the data model.

In order to use this functionality, corresponding additional service tracking variables must be created.

You can find detailed information on creating these variables in the Online import of an IEC 61850 server (on page 65) and Offline import (on page 69) chapters.

Attention

The additional service tracking variables - "Service tracking" driver object type - only get the values in Runtime if at least one *[SR] "PLC marker" driver object type variable of Logical Node LTRK in this Logical Device has been created in the project.

A PLC marker of LTRK need only exist and does not need to be requested nor shown in a screen.

A Service Tracking object with FC = *SR* can be received from polling or by means of a report. **Note:** the data from LTRK should be provided by the controllers (850 server) in reports in accordance with the standard.

The driver also supports data models with more than one instance of the LTRK node per Logical Device.

Info: If a screen contains *Service Tracking* variables that have not previously been registered, the variables remain empty until service tracking information is received by the server.

SERVICE TRACKING OF THE SERVICES RELEVANT TO COMMANDS

If a PLC marker of LTRK is created, the driver automatically requests all relevant data attributes of the following data objects with Service tracking from the controller:

- *SpcTrk*
- *DpcTrk*
- *IncTrk*
- *EncTrk*
- *ApcFTrk*
- *ApcIntTrk*
- *BscTrk*
- *IscTrk*
- *BacTrk*

These data objects in LTRK belong to all of the CTS Common Data Class and are for Service tracking of the services relevant to commands such as: Select, SelectWithValue, Operate, etc.

Example:

Create the following variables in order to receive Service tracking via the data objects **CSWI1/Pos* and **CSWI2/Pos*:

- A PLC marker variable *LTRK*[SR], for any desired data attribute. This ensures that the driver, during the Association with the 850 server, does not skip the data model in this LTRK node.
- the *Service tracking* variables *CSWI1/Pos_serviceType[SR] and *CSWI2/Pos_serviceType[SR] (and more, e.g. *_respAddCause[SR])

If one of the 850 clients executes a command, via which the 850 server then provides the information in service tracking - this information is distributed to the correct variables according to ObjRef (Object Reference).

SERVICE TRACKING OF THE SERVICES RELEVANT TO CONTROL BLOCKS

The IEC 61850 standard also envisages Service tracking of the services relevant to the Control Block , such as: SetBRCBValues, SetURCBValues, SetGoCGValues, SelectActiveSG, etc. The tracking of these services is portrayed in 850 servers in further data objects in LTRK that belong to another Common Data Class (as CTS), e.g. BTS, UTS etc.

The Service Tracking variables for Control Blocks are not offered during **online import**, but they can be created manually:

- Create the LTRK*[SR] PLC marker type variables, at least the LTRK*/objRef[SR], for example all *LTRK1/UrcbTrk/*[SR] for tracking via Unbuffered Report Control Blocks.
  By means of online or offline import.
- Create additional Service Tracking driver object type variables, for example all *LLN0/urcbST01_*[SR] for tracking via URCB with the name "urcbST01".
  This must be carried out manually.

Example:

To receive Service tracking by means of value changes of the RptEna[BR] attribute in report control blocks 'brcbA01' and 'brcbB02', create the following variables:

- The PLC marker variables *LTRK*BrcbTrk/objRef[SR] and *LTRK*BrcbTrk/rptEna[SR]
- the *Service tracking* variables *brcbA01_objRef[SR],*brcbB02_objRef[SR], *brcbA01_rptEna[SR] and *brcbB02_rptEna[SR]

ERRORCODE[SR] VARIABLES - ACTION FOR STATUS BIT M1

If additional service tracking variables are created for a data object, there is no pre-defined sequence in which the values are transferred from the driver to Runtime.

The consistency of data, for example for the creation of dynamic limit texts for the CEL, is however ensured by the following process:

- Each time service tracking is received, the driver sets the status bit **M1** with the service tracking variable **_errorCode[SR]*.
- After all service tracking values have been transferred to Runtime, the driver resets the status bit M1 of the **_errorCode[SR]* variable (*M1 = 0*).
- This resetting of the M1 status bit is a suitable trigger for the creation of a CEL/AML entry.

> **Attention**
>
> If you evaluate the status bit M1 with a reaction matrix and the service tracking values are received from polling and not from a report, the initial value also triggers a CEL/AML entry.

ALLCTS[SR] VARIABLE

A **_allCTS[SR]* variable contains the received service tracking information, consisting of the data attributes of the Common Data Class CTS.

- This variable is a string variable.

- The value of the variable is a text, consisting of data attributes of the Common Data Class CTS in the following sequence: *objRef*, *serviceType*, *errorCode*, *originatorID*, *t*, *ctlVal*, *origin.orCat*, *origin.orIdent*, *ctlNum*, *T*, *Test*, *Check*, *respAddCause*.
- The individual data attributes are each separated by a ;.
- The status bits of the variable result from the sum of all status bits of the data attributes.
- The time stamp results from the time stamp of the last attribute of the service tracking object. If there is no time stamp, the current time is used.

If the service tracking object received does not contain a Control Service (CTS), but instead Common (CST) or Control Blocks (UTS, BTS etc.), then the *_allCTS variable only consists of data attributes of the Common Data Classe CST: *objRef*, *serviceType*, *errorCode*, *originatorID*, *t*.

LOG ENTRIES

LOG entry	Debug Level	Description
Variable %s has wrong format for a service tracking variable.	ERRORS	The variable addressing used does not correspond to the expected format. The following is expected: *„Server!Device/Node/Object_Attribute"*
Variable %s cannot be advised since no Service Tracking Variable from Driver Object Typ SPS-Merker was found.	ERRORS	The driver cannot request the variable from the PLC because no "PLC marker" [SR] variables were created in the Editor. Create at least one corresponding variable.
Delete dataset xxx failed	ERRORS	The server has refused the deletion of the xxx data set.
Dataset xxx deleted sucessfully	MSG	The xxx data set has been successfully deleted by the server.

8.4 Mapping of double point values

Double Point Value Mapping Is a standard function of the zenon Energy driver. It only influences zenon Runtime and has no effect on the driver communication with a device. Configuration is carried out in the driver settings in the **Basic Settings** tab.

Note: It is recommended that you leave the **Deactivate standard double point value mapping** option in the driver configuration as the default, inactive.

The driver uses Double Point Value Mapping to convert values so that they are displayed in a user-friendly manner. However this only applies to the HMI.

The driver always communicates with one device with values for Double Points with 2-bit information. This corresponds to the definitions of the energy standard. That means:

Parameter	Double Point	Value	Meaning
Intermediate	*00b*	*0*	Switches are neither open nor closed, for example the End-Position has not yet been reached
Off	*01b*	*1*	Switch open
On	*10b*	*2*	Close switch/switch closed
Fault	*11b*	*3*	Error

Double Points are coded with 2-bits in the energy sector for historical reasons: The transmission of a telegram to a serial connection (RS232) with a series of values that only contain *0* was not safeguarded against transmission errors. In order to increase the certainty, it was decided in the first standards that the value for *OFF* is not to be sent as *0* but as *01b*, which corresponds to decimal *1*. These Double Point Values also precisely reflect the type of how two sensors record the physical position of a switch.

However, the values sent this way may be confusing for people:

- *OFF = 1*
- *ON = 2*

Humans are used to all other devices and systems:

- *OFF = 0*
- *ON = 1*

  At the same time in the same standard, the Single Point Values are defined with *OFF = 0* and *ON = 1*.

In order to avoid dangerous incorrect actions by the user, the zenon Energy driver offers its own Double Point Value Mapping. Without DPI Mapping, the user must always be aware of the technical level on which they are acting and receiving or sending information. In stress situations, this can very easily lead to serious errors, for example if *ON* is sent instead of *OFF*.

MAPPING BEFORE HMI

With the Double Point Value Mapping, all Double Points in zenon have the following values:

- *Intermediate = 2*
- *Off = 0*
- *On = 1*

- *Fault = 3*

> **Information**
>
> This function can be deactivated in the driver settings. However some features such as Command Processing or ALC can no longer be used then.
>
> **Recommendation:** Do not use numerical elements and numerical values to display *OFF/ON* or *OPEN/CLOSE*. Use combined elements with graphic symbols or text elements instead.

DPI MAPPING IN IEC850 CLIENT DRIVER

In accordance with the IEC 61850-7-3 standard, in Common Data Classes, Double Point Status (DPS) and Controllable Double Point (DPC), the *stVal* attribute has the data type *CODED ENUM* with the value range: intermediate-state (00) | off (01) | on (10) | bad-state (11). The driver therefore waits until a Double Point attribute of the data type *CODED ENUM* is mapped to the communication protocol as an MMS of the *bit string* data type. The *stVal* data attribute can thus have the following values: *0x00*, *0x40*, *0x80* and *0xC0*. This basic data type is permitted in the SCL language with the name *Dbpos* (IEC 61850-6). In zenon, this corresponds to a variable with data type *UDINT* (default) or *STRING* (if changed manually) - see assignment of datatypes (on page 60).

In the driver configuration, the **Deactivate standard double point value mapping** option should remain inactive by default in order to use the modules from the zenon Energy Edition, for example the functions of **Command Processing** and **ALC**.

With the default settings, the driver assigns values of the *stVal* data attributes of DPS and DPC in accordance with the following table:

Position value in the end device	zenon Dbpos value - STRING	zenon Dbpos value - UDINT unmapped	zenon Wert - value mapped
Intermediate *(00b)*	*'00'*	*0*	*2*
Off (01b)	*'01'*	*64 (0x40)*	*0*
On (10b)	*'10'*	*128 (0x80)*	*1*
Fault (11b)	*'11'*	*192 (0xC0)*	*3*

The driver only converts values for variables with the names **/stVal* and numerical data type that corresponds to bType *Dbpos* in the SCL language (IEC 61850-6). This means that the values of the **/stVal* variable with a data type set to STRING manually are excluded from mapping.

This means in Runtime (for example):

Position of the switch	UDINT mapped	UDINT unmapped	STRING
off	*0*	*64*	*'01'*
on	*1*	*128*	*'10'*

The variables with names other than *stVal* are excluded from **DPI mapping**. **Example:** in the *Pos* data object (from CDC *DPC*) both **/Pos/stVal[ST]* and the (optional) **/Pos/subVal[SV]* are both *Dbpos*, but the driver will not map the value of the *subVal* variable.

DPI MAPPING IN COMMAND DIRECTION

In contrast to IEC 60870 and DNP3 protocols, in IEC 61850 the commands in Common Data Class for Controllable Double Point (DPC) are the *BOOL* data type, i.e. not Double Point Values. **Example:** although the **CSWI/Pos/stVal[ST]* is a *Dbpos* , the **CSWI/Pos/Oper.ctlVal[CO]* is mapped to an *MMS BOOLEAN* in the IEC 61850 standard - *off (FALSE)* | *on (TRUE)*. The driver thus transfers the *ctlVal* values *False/True* unmapped to the 850 server.

However, there are also the Common Data Classes in the IEC 6180 standard, where a command corresponds to an *MMS bitstring* such as Binary controlled step position information (BSC) and Binary controlled analog process value (BAC) for example. In these CDCs , the *ctlVal* is a bType *Tcmd* , i.e. a *CODED ENUM* with three valid values: *stop (0x00)* | *lower (0x40)* | *higher (0x80)*. Nevertheless, most controllable transformers are only controlled with commands for Change tap position: *lower/higher*; there is thus no need for a *stop* command too.

Example: the variable for **ATCC/TapChg/Oper.ctlVal[CO]* is created for **offline** and **online import** with *UDINT* data type, because it corresponds to an *MMS bitstring* data attribute and should include all possible bits of a *bitstring* value.

After the **import** for such command variables of *UDINT* data type, you can manually change them to *BOOL*. If the **/Oper.ctlVal[CO]* data attributes correspond to an *MMS bitstring*, when writing set values, the driver maps the value *FALSE* to *0x40* (lower) and the value *TRUE* to *0x80* (higher).

8.5 Quality, time stamp and status bits of the variable

Variables in zenon with **FC (on page 140)**=*ST* or **FC**=*MX* (for example **/Pos/stVal[ST]*, **/PhV.phsA/cVal.mag.f[MX]*) get a time stamp and status bits from the accompanying data attributes 'q' and 't'. This happens in the driver automatically. Additional configuration in zenon is not necessary.

The driver always assigns selected Quality Bits (of the 'q' attribute) and TimeQuality Bits (of the 't' attribute) of the corresponding status bits to each zenon variable that has been created for an attribute of the data object and has an **FC (on page 140)**=*ST* or **FC**=*MX*, for example for status bits of the *stVal* variable. The driver also assigns the value of the 't' attribute to the time stamp of all *ST/MX* variables of the data object.

The driver automatically uses the time stamp and the quality of the data object for other variables in this DO. For this reason, no variables for the attributes 'q' and 't' need to be created separately, except if you want to analyze the quality bits that are not assigned to status bits or want to see the updates of the time stamp without changing the position (*stVal*) or measured value (*mag*). If the zenon variables with references to data attributes 'q' or 't' have however also been created, the driver will support the received values 'q' and 't' as variable values.

Example: The time stamp, received as 't' attribute, is used for the corresponding **/stVal[ST]* variable in the **CEL**. If the **/t[ST]* variable has been created in the project, it has the received Unix time as an *LREAL* value, with milliseconds in decimal places.

Info

The driver takes the TimeQuality byte of the 't' attribute into account by default. In addition to 3 status bits for the quality of the time information, the TimeQualitybyte also contains 5 bits for the TimeAccuracy information - the accuracy value (N bits of accuracy - performance class). The theoretically-possible accuracy values are between 0 - 24 and value 31 is defined as "unspecified" (all bits). However only some of the precisions can use a valid 850 server. The lowest precision permitted for an 850 product is class T0 - 7 bits - 10ms.

If TimeAccuracy is not 31 "unspecified", the FractionOfSeconds field of the time value - the binary decimal places - correspond to the precision - N+1 - shortened. The time stamp is then rounded to the milliseconds.

Example:

- TimeAccuracy = 10 bits (class T1, 11 binary decimal places): the driver shortens the received time value to the precision 1/2048=0.00048828125 [s] and rounds up to the milliseconds.
- TimeAccuracy = 0 bits (no valid performance class in the 850-7-2 standard, 1 binary decimal place): the driver shortens the time value received down to the seconds.

If you want to ignore *TimeAccuracy*, activate the **Ignore time accuracy** checkbox in the Server (on page 26) driver configuration dialog.

The selected Quality and TimeQuality bits are assigned to the status bits of the variables in the same data object as follows:

IEC61850 Quality or TimeQuality bits	Status bit in zenon	Notes
Validity = **Invalid** or **Reserved** or **Questionable**	*INVALID*	Identified by a red square on the linked element.

IEC61850 Quality or TimeQuality bits	Status bit in zenon	Notes
Overflow	*OV_870* (*Overflow*)	This is also an IEC 60870 status
OutOfRange	*OR_DRV* (*value outside the valid range*)	
Source = Substituted	*SB_870* (*Substituted*)	This is also an IEC 60870 status
Test	*TEST* (*Test bit*)	This is also an IEC 60870 status
OperatorBlocked	*BL_870* (*Blocked*)	This is also an IEC 60870 status
ClockFailure	*T_INVAL* (*Time invalid*)	The value of the 't' attribute is ignored - **stVal**has the time stamp of the local PC.
ClockNotSynchronized	*T_UNSYNC* (*ClockNotSynchronized*)	The value of the 't' attribute is considered - **stVal** has the time stamp of the IED. **Remark:** version 7.50 and earlier: *T_INVAL* and *T_EXTERN*, since 7.60: *T_UNSYNC*.

The TimeQuality bit **LeapSecondsKnown** is not assigned any status bits.

The variables of a data object without 't' attribute (or with 't' value 0) and the variables with a Functional Constraint other than *ST/MX* receive the time stamp of the local PC clock.

Info

You can evaluate status bits (such as *T_INVAL*) by using a combined element or *reaction matrix* (of type "Multi"). The status bits can be filtered in **CEL** or **AML**.

CAUSE OF TRANSMISSION (COT)

For each variable, the driver provides information about whether the value of the variable was received from polling or by means of a report. The information is written to the status bits *COTx* .

COT value	Status bits	Description
1	COT0	The value was received by means of polling.
2	COT1	The value was received by means of an Integrity Report.

COT value	Status bits	Description
		Note: This only works if Reason-for-inclusion is activated in the optional fields (on page 36) dialog. Otherwise the COT=3
3	COT0, COT1	The value was received by means of a report **Note:** If Reason-for-inclusion is activated in the Optional fields (on page 36) dialog, it is only reports with the trigger option data-change, data-update or quality-change. If Reason-for-inclusion is not activated, it is all reports - including Integrity and GI.
20	COT2, COT4	The value was received by means of an General Interogation Report. **Note:** This only works if Reason-for-inclusion is activated in the optional fields (on page 36) dialog. Otherwise the COT=3

Info

The COT value for theIEC850 driver is orientated towards the IEC60870 standard:

1 - periodic, cyclic

2 - background scan

3 - spontaneous

20 - general interrogation

During a command execution using the **Command Processing** module, the driver updates the status bits of the */Oper.ctlVal[CO] variable as follows:

- Select, SelectWithValue: *SE_870 + COT_act(6)*, then *SE_870 + COT_actcon(7)* possible with *N_CONF*
- Operate: *COT_act(6)*, then *COT_actcon(7)* with possibly *N_CONF*, then possibly *COT_actterm(10)*
- Cancel: *SE_870 + COT_deact(8)*, then *SE_870 + COT_deactcon(9)*

The **watchdog timer** of the **Command Processing** evaluates these status bits of the **Action variable**.

8.5.1 TimeQuality and TimeAccuracy of a command

When sending a command in *SBOw*, *Oper* and *Cancel*, the driver also sends a T attribute. This T attribute contains the time of command execution as well as *TimeQuality* and *TimeAccuracy* at the last octet (in accordance with standard 61850-8-1, 8.1.3.7).

The user can determine manually which values for *TimeQuality* and *TimeAccuracy* are used for this command. To do this, configure two **Settings** driver object type variables. Name these *TimeQuality* and *TimeAccuracy*.

If a command is sent with a time stamp, the values for *TimeQuality* and *TimeAccuracy* from these variables are used.

If not variables have been created or a value was never written to the *TimeQuality* and *TimeAccuracy* variables, the last octet of the T attribute is sent with 0.

TIMEQUALITY:

Bit 0 = *LeapSecondsKnown*

Bit 1 = *ClockFailure*

Bit 2 = *ClockNotSynchronized*

TIMEACCURACY:

Value 0 - 24: Bit number accuracy of the decimal places of the T attribute

Value 31: Accuracy not specified (*unspecified*)

8.6 Filetransfer

Filetransfer is a functionality defined in the IEC 61850 standard for the transfer of files between 850 server and client. For example, you can get the SCL file of the 850 server, or disturbance data after a problem (typically in *COMTRADE* format). Whether, and which files are available for the transfer is decided solely by the IED (850 server).

The transferred files are saved with the same name, format and content as the 850 server forwards them to the driver, for example the IED provides the files in *COMTRADE* format for transfer, the files are already saved in *COMTRADE* format on the driver's drive with the name and content as received by the IED.

There are three functions implemented for **Filetransfer**:

- Request folder information (on page 114)

- Get file from server (on page 114)
- Delete file on the server (on page 115)

ERROR TREATMENT

If the errors occur when carrying out the file transfer, such as the server responding negatively, the command variable changes its value to "*XXX ERROR*" (*XXX* = *DIR*, *GET* or *DEL*) and the driver optionally writes an entry into the LOG file (see also error analysis (on page 137)).

8.6.1 Request folder information

To request folder information from the IED (850 server):

1. Create, in your zenon project, two string variables of the **driver object type** *File Transfer* with the corresponding **net address**:
   a) The first variable, hereafter called the command variable, with the reference (**name** / **symbolic address**) "**!Command*" can also be used to get files and to delete them.
   a) The second variable with the reference "**!Directory*" is only used for the result of the folder query. It receives the folder content as legible text. For this reason, its size should correspond to the maximum size of the file name (including the folder) in the IED.
2. For the command variable, set the value *"DIR"* (for the root directory) or *"DIR <file_spec>"*. <file_spec> is a string that is sent to the IED as a transfer parameter.

If the folder has been successfully received:

- The command variable changes its value to *"DIR OK"*
- The folder variable contains the received folder content as legible text. One line of this text has the following format:

  <File name>;<File length>;<Time stamp>.

8.6.2 Get file from server

To get a file from the IED (850 server), set the value "*GET <file name>*" for the command variable.

If the file has been successfully received:

- It is saved in the folder that was defined as **Directory for file transfer** in the driver dialog **Basic settings** (on page 18).
  Files from a subfolder are also stored in the main folder.
- The command variable changes its value to *"GET OK"*

The transferred files are saved with the same name, format and content as the 850 server forwards them to the driver.

8.6.3 Delete file

To delete a file in the IED (850 server), set the value "*DEL <file name>*" for the command variable.

If the file was deleted successfully, the command variable changes its value to "*DEL OK*"

9 Reporting

Reporting was introduced by the IEC 61850 standard for spontaneous communication. The variables that are linked to a successfully-activated Report Control Block (RCB enable) are no longer polled but are reported by the controller (an 850 server, Intelligent Electronic Device - IED) if a value change occurs.

The variables that are received spontaneously if an 850 client reports a certain Report Control Block (RCB) are defined in the DatSet (data set) attribute of the RCB . The Data Set is defined in the SCL file of the IEDs and consists of references to data objects, whose data - value changes, quality, time stamps - is sent spontaneously by the 850 server

To make activation of reporting possible, the following conditions should be met:

- At least one variable of the Logical Device, in which the RCB is included, must have been created in the project. Otherwise the driver does not take this Logical Device into account at all whilst the connection is established.
- At least one variable of the Logical Node, in which the RCB is included, must have been created in the project. Otherwise the driver will not take this Logical Node into account whilst the connection is established.
  Exception: Logical Node *LLN0*. All RCBs defined in the logical node *LLN0* are automatically taken into account for each Logical Device if the LD has at least one variable that has been created in the project variable list.
- The Data Set and the Reporting Control Block that uses the data set must be in the same Logical Device.
- An RCB is not activated:
  - If no dataset is linked.
  - If an empty data set is linked.
  - If the linked data set does not exist or cannot be found.

Corresponding warning entries are created in the LOG file.

EXAMPLE:

- RCB Name is *IEDNameLD1/LLN0/urcbA* - the RCB is thus in Logical Device *LD1* and Logical Node *LLN0;*
- Its data set contains a reference (FCD) to data object: *IEDNameCTRL/Q0CSWI1/Pos* - the data is thus in logical device *CTRL*, in logical node *Q0CSWI1*.
- The driver will then activate the RCB, however only if at least one variable was created in the zenon project in logical device *LD1*.
- If RCB is in another logical node to *LLN0* - at least one variable must be created in the project for this logical node.

Note: The IEC 61850 standard demands that a system only then uses the services (reporting for example) of a Logical Device if the *Mod*, *Beh* or similar. Has checked *Health*. The activation of an RCBs in logical device with unknown values of the *LLN0/Mod/stVal*, would thus still be **/Beh/stVal*, still **/Heath/stVal*, not compliant with the standard.

AUTOMATIC VS STATIC ASSIGNMENT OF THE RCBS

The configuration of the reporting is carried out in driver configuration - server (on page 26). The driver supports two procedures:

- Automatic searching and activation of the free URCBs - if the **Max. auto used URCBs** > property is *0*. This method is also applicable for Unbuffered Reports. It makes quick, initial operation of spontaneous communication more easy.
- Static assignment of the desired RCBs - in **RCB assignment/dynamic datasets** (on page 42) dialog. This method is applicable for both Buffered and Unbuffered Reports and is intended for use in complete systems.

  The statically-configured RCBs have a higher priority than any automatically-searched URCBs. If the activation of a pre-defined RCB is unsuccessful, the driver can instead activate a **URCB** automatically, which also contains a data set with the required data. If you do not want the driver to activate the URCBs automatically, set the **Max. auto used URCBs** property to 0.

If the driver cannot activate the reports for any reason, polling is used instead. In this case, in the **Connection State** variable (on page 90), the bit 17 or 25 (*MMS_RCB_ENABLE_FAILED*) is set.

You can find further information on the different possibilities for checking the activation of *RCB*s in the RCB activation - checking possibilities (on page 128) chapter.

You can configure **RCB assignment** manually in the driver or - in **Energy Edition** - with the help of the **IEC850 Driver Configuration** wizard, using an SCL file (SCD, CID, possible ICD etc).

Note: For simplified import of variables from the RCB data sets, the **IEC850 Driver Configuration** provides additional possibilities.

ASSIGNMENT USING REPORT NAME OR REPORT ID

By default, the driver identifies the RCB instances of the 850 server using its name. This process is supported by all - IEC 61850 standard-compliant - IEDs (850 servers).

By activating the **Use Report-ID for RCB assignment** setting in the driver configuration, you can use a special process: the report ID (RCB.RptId) is used instead of the report name. The process is only suitable for special applications. The driver will thus register all RCB instances that have the same ID. The IEC61850 standard also allows different RCBs, with different Data Sets to have the same value in RptID. In Runtime, the driver will search for all RCBs with the respective Report ID and register them. The driver can thus configure in such a way that it registers several RCBs with just one entry in the list and also automatically registers those that did not yet exist at the time of driver configuration.

Attention: If several instances of an RCB have the same ID on the 850 server (which often happens) the driver will register them all, even if they all contain the same Data Sets. Consequently, no further 850 client will have access to the RCBs concerned!

Use of report ID requires corresponding configuration in the SCL file of the 850 server:

- A separate report ID must be defined for each 850 client in the system; also a different ID for each **Hostname** - a different one for the Primary Server, another for the Standby Server.
- With different RCBs, precisely one instance should be configured with the ID in SCL. Instances that need a client are thus marked, for example the first instances of each RCB for drivers on the Primary Server, the second for drivers on the Standby Server, the third for a different 850 client in the system, etc.

Only activate the process using report ID if you are sure that you want to use this special feature in the driver and the IED has also been preconfigured accordingly.

Attention: If this option is subsequently changed, all RCB assignments in the **RCB assignment** dialog are deleted, the driver configuration is closed and opened again, and **RCB assignment** is set up again.

GENERAL INTERROGATION (GI)

The driver also sends, if the RCBs is activated, a General Interrogation (RCB.GI=TRUE) command to get the most recent value of the variables. The first time the RCB is activated (i.e. when Runtime is started) and when the connection is reestablished (after a connection has been lost), it sends a GI. The driver also sends the GI at the same time as requesting the buffered events to be transferred via BRCB.EntryID, in order to ensure the updating of the process data, even if the reason for the loss of the connection was the failure of the 850 server.

However the general query is not sent if it is a repeated attempt to enable a report. This happens after expiry of the time configured in the **RCBs enable retries** property. This avoids data duplicates, because the values have already been received from the polling.

DATA SETS

The IEC850 driver supports reports with the Data Sets predefined in the IED (in the SCL file) or with Dynamic Data Sets - with the RCB.DatSet attribute, which was dynamically defined during activation of the RCB .

As envisaged by the IEC 61850 Standard, for a Report data object with Functional Constraints (FC) the following is available:

- Status - *ST*
- Measurands - *MX*
- Service tracking - *SR*
- Configuration - *CF*
- and further: *SP*, *SV*

If a non-standards-compliant reference has been defined in a Data Set (other than the FCs listed here), the driver nevertheless activates the *RCB*. However the data with invalid FCs is ignored in the reports received. The data objects and data attributes concerned continue to be polled.

In a Data Set:

- Data objects with different FCs can be used together if the 850 server supports this.
- Data objects from different Logical Devices can be contained.

You can find details of dynamic datasets in the Dynamic datasets (on page 131) chapter.

DATA SETS WITH FCD OR FCDA

The dynamic data sets configured in the driver always consist of FCD references:

- Functional Constraints (FC)
- Reference to the Data Object (LD/LN/DO)

Datasets already defined in an IED usually consist of FCD references, but they can also consist of FCDA references.

An FCDA reference consists of:

- FCD reference, and
- Data Attribute (daName)

Note: In a SCL file the elements in a dataset always start with XML keyword "FCDA". This is also true for element which are a FCD reference:

- FCD reference:
  <FCDA ldInst="ANN" prefix="PLT" lnClass="GGIO" lnInst="2" doName="Ind01" fc="ST" />
- FCDA reference:
  <FCDA ldInst="LD0" prefix="X" lnClass="GGIO" lnInst="110" doName="Ind1" daName="stVal" fc="ST" />
  - The difference is the "daName" element.

To preclude data inconsistencies, it is recommended that data sets are always used with FCD references. To do this, the SCL file must always be configured accordingly. The "daName" elements of references must be removed and possible duplicates must be deleted.

Note also that it is only with FCD references where the value changes are contained in the report with the current time stamp of the 850 server in the report. With FCDA references, only the reports with GI or Integrity contain the time stamp of the server.

If the 850 server uses the FCDA references that cannot be reconfigured to FCD references (for example because the server does not accept any updates to the SCL file) the driver will however activate a report with such data sets. **Exception:** Reports with Service Tracking are only supported with FCD!

REPORTS WITH DATA SET WITH FCDA

For reports with a data set with FCDA , the driver works according to the following rules:

- Whilst activating the RCB, the structure of the DataSet is recognized. If there are individual data attributes present here, a check is made to see whether, in this DataSet, an attendant Quality has also been defined at the same time. If no FCDA reference for the corresponding Quality attribute is found, that is however in the data model, the driver writes a LOG entry:

LOG entry	Level	Description
Enabling scan of %s on device %s	MSG	The element given (q attribute) is queried in the cycle of the **Data consistency scan** (Default: 5 min).

  From this point in time, the q attribute missing in the report - depending on the driver configuration in the **Data consistency scan** setting - is polled automatically. This ensures that for each report, measured values received also have the quality information and thus correspond to the IEC61850 standard.
- If the t attribute is contained in a received report, this is also used. If the t attribute is missing in a report, the values of the variables contain an internal time stamp.
- If the q attribute is contained in the received report, the status bits of the variables are updated accordingly. If this q attribute is missing, the status bits of the variables reflect the q attribute as already recognized in the driver. This can be from an earlier report, polling of the registered data object or by a data scan (as configured in **Data consistency scan**).

- If a report that only contains a t attribute is received (without measured value, without q attribute), a LOG entry is created because this is not permitted in the standard. This can only occur if the IED has been configured or structured incorrectly. With an invalid SCL file, for example. The time stamp received is ignored.
  Exception: If a t variable is created in the project and then subsequently registered like the report receipt, the value of the variable reflects the value of the t attribute received.

LOG entry	Level	Description
Received report contains only yyy$t; missing value and quality. Report will be ignored. Probable reason: mistake in IED configuration (SCL)	Warning	A report that has neither measured values nor a q attribute has been received. This indicates that the server has been configured with an invalid SCL file. **Example:** In SCL.DataTypeTemplates, the t data attribute was configured with its own Trigger Options.

TRIGGER OPTIONS

The Trigger Conditions defined in the IEC 61850 standard determine when an 850 server creates a new report and sends it to the client. The driver supports all Trigger Conditions defined in the standard. The Trigger Conditions consist of Trigger Options (**TrgOps**) that are defined in the SCL file of the 850 server in two places:

- at the Report Control Block, for example SCL:

  IED.AccessPoint.Server.LDevice.LN0.ReportControl <TrgOps dchg="true" qchg="true"/>

- For relevant data attributes (DA), for example in SCL:

  DataTypeTemplates.DOType <DA name="stVal" fc="ST" dchg="true" bType="Dbpos"/>

An 850 server only creates a new *dchg*, *dupd* or *qchg* report if both conditions - for RCB and for DA - have been met, the reports GI and Integrity - only depending on **TrgOps** in the RCB. In accordance with the standard, a client (the driver) can only have an influence on TrgOps in RCB , but not on the TrgOps of the data attributes - these are fixed in the SCL, but first determine whether the IED should take the change in value of the data attribute into account as a trigger for reports.

RCB TRIGGER OPTIONS

In the driver configuration, use the **Use preconfigured (SCL) options** to configure whether the driver should activate (enable) the RCB with the TrgOps (and IntgPg, BufTm and OptFlds) already predefined in the SCL file of the IED or that the driver should first overwrite with settings from the driver configuration and only then sign in the RCB.

If the **Use preconfigured (SCL) options** checkbox has not been activated, the driver sends the configured Trigger Options to the 850 server. Possible write errors are ignored and the RCB continues

to be used. **Note**: with a write error to RCB.TrgOps, it would be expected that the 850 server then acts using its TrgOps from the SCL file.

The Trigger Options in the RCB define the conditions under which an IED (the 850 server) creates and sends a new report:

- **TrgOp: data-change** - an IED creates a new report if one of the data attributes that have the dchg or dupd flag in their SCL definition changes the value. For example: *stVal*.
- **TrgOp: quality-change** - an IED creates a new report if one of the data attributes changes its value with the qchg flag. In accordance with the standard, only data attributes *q* can have qchg .
- **TrgOp: data-update** - an IED creates a new report if one of the data attributes is updated with dupd ; even if the value remains the same (and possible only the time stamp has been updated). For example: *mag*.

  Note: for TrgOps: dchg, qchg and dupd ; an IED collects the value changes of individual data attributes using the **Buffer Time** (RCB.BufTm) length, in order to minimize the number of reports created. The BufTm is applicable for URCB (Unbuffered) and BRCB (Buffered). In the event of a connection loss, an IED creates the Buffered Reports, but does not send them. The buffered reports are only sent after the connection has been re-established if the client (the driver) requests them with a valid EntryID.
- **TrgOp: integrity** - an IED creates cyclically - for each **Integrity Period** - a report that contains all values; also those that have already been sent due to dchg, qchg or dupd and those that have not changed in the mean time.
- **TrgOp: general-interrogation** - an IED creates a report that contains all values if the client (the driver) requests the **general query** (RCB.GI).

Note: Not all servers support TrgOps **data-change** and **data-update** together. TrgOp **integrity**can also lead to an unnecessary overload of communication if an IntgPd (**Integrity Period**) that is too short was defined in the server for RCB. In the event of doubt, set TrgOps: **data-change** + **quality-change** + **general-interrogation**. Ensure that TrgOp: **general-interrogation** is activated. Otherwise the driver cannot receive values for the variables present in the report when first started up.

BTYPE TRIGGERCONDITIONS

The *TrigerConditions* data attribute type that was assigned to the *MMS Bitstring(6)* in accordance with the standard if the corresponding *TrgOps[RP|BR] variable was created during import, corresponds to the UDINT data type in zenon by default (Motorola format, bit 0 highest value in its octet). In addition, the driver allows such variables with the data type STRING instead of UDINT. The value of the STRING has the length 6 and only contains the characters "0" and "1"; in the same sequence as the bits are defined in the standard.

Example

Value as string "011111" (as UDINT=124=01111100b) means that all TriggerCondition bits (except bit 0) - are set as '*Reserved*'.

The value "000010" (as UDINT=8=00001000b) means that only the bit *4* - '*intergity*' is set.

REDUNDANT ZENON NETWORK

In a redundant zenon network, both the **Primary Server** and the **Standby Server** start their own IEC850 driver. Both drivers must register different RCB instances (otherwise they are in conflict because an 850 server can only issue a client the RCB instance).

Attention: If you use redundancy in your zenon project (**Network active** property and **Server 1** and **Server 2** have been configured), you must create at least two entries in the driver configuration **RCB assiggment**: a **Hostname** for**Server 1** and second **Hostname** for **Server 2** (Standby). You must then select different instances of the RCB for these entries.
Note: Per default the IEC850 driver creates two host names: *$SCADA_SERVER1* and *$SCADA_SERVER2*.

The *Connection State* variable cannot result in a different evaluation for drivers on the **Server 1** network than that on **Server 2**. For the user, also on the Standby, only the current value of the current **Primary Server** is visible. If you also want to make the current evaluation for **Standby Server** visible - in order, for example, to trigger an alarm if the Standby could not register its RCBs, you can create a copy of the *Connection State* variable - with the same reference (in **Symbolic address**), a different prefix in the **Name** and with the **Read from Standby Server only** property activated.

Note: For **Evaluated network**, you do not need any of the variables requested by the Standby in the **Valuations** property. The evaluation takes place separately on both servers, using the local values of the variables. Therefore in the standby, it is always the value of the *Connection State* variable that is evaluated by its internal image, even if no copy has been created in the project.

9.1 Unbuffered Reporting

The use of Unbuffered Report Control Blocks (URCB) can be configured in the IEC850 driver in two ways:

1. Automatic assignment:
   property **max. auto used URCBs**:
   Automatic assignment makes the use of reporting easier in the test phase of the project already - the driver checks the content of all existing Unbuffered Report Control Blocks (URCB) (data sets). The driver then reports first the URCBs that contain the most variables of the project;

2. Static assignment - **statically assigned RCB** (on page 42) dialog:
   The driver uses the assignment of Report Control Blocks to the computer - **Hostname** - as defined in the driver configuration - client configuration (on page 37). This is applicable for URCB and BRCB.

AUTOMATIC ASSIGNMENT

Automatic assignment works with data sets and linkings of data sets with Report Control Blocks that are already predefined in the 850 server - using its SCL file.

During the establishment of a connection to the 850 server, the driver reads all data sets that are present in the 850 server and assigns them according to their usability - according to the number of variables from the project included. This sorting indicates the sequence in which the driver attempts to activate free URCBs for reporting (enable). At most, only as many URSBs per Logical Device are activated as are defined in Driver configuration (on page 26) in the **max. auto used URCBs** property. All data objects of the data set that are successfully linked to an activated URCB are no longer polled but are reported in the event of a value change.

The **dynamic datasets** are not supported for automatic assignment.

Note: automatic assignment makes the use of reporting easier in the test phase of the project already - even before the static assignments have been set. However, before you approve the project, also configure the static assignment for URCB - in the **RCB assignment** dialog and set the **max. auto used URCBs** property to 0. The standard proposes that in a system, the client that uses a certain instance of an RCB should be clearly regulated. It prevents possible conflicts between several 850 clients.

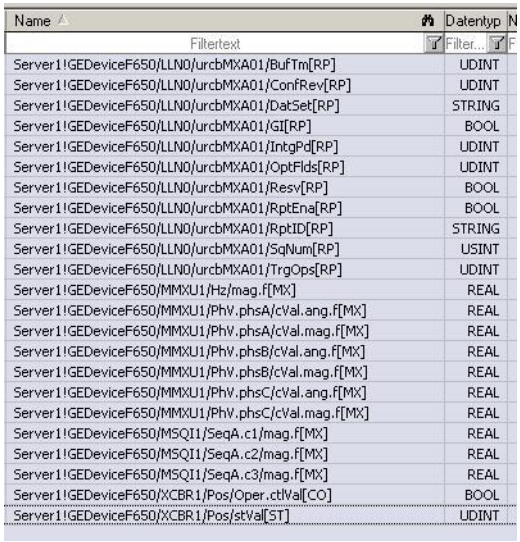
RULES FOR CONFLICTS THAT OCCUR

When activating reporting, the driver also recognizes URCBs with the same content; the name of these reports can be different. Before the URCBs are sorted for the zenon project according to their usability, the driver first sorts the data objects of the data sets of each URCB and compares them in order to avoid duplicates. The following applies for conflicts when activating the URCBs:

- For the same reports - with identical or different sequences of the same data objects: only one URCB is activated.
- If an URCB is already occupied by another client, the next free URCB is activated.
- If all URCBs are already occupied by other clients, the data points are polled.

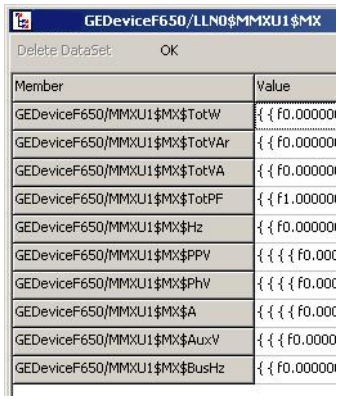
EXAMPLE OF AUTOMATIC ALLOCATION

The following variables are available in your project



Name	Datentyp
Filtertext	Filter...
Server1!GEDeviceF650/LLN0/urcbMXA01/BufTm[RP]	UDINT
Server1!GEDeviceF650/LLN0/urcbMXA01/ConfRev[RP]	UDINT
Server1!GEDeviceF650/LLN0/urcbMXA01/DatSet[RP]	STRING
Server1!GEDeviceF650/LLN0/urcbMXA01/GI[RP]	BOOL
Server1!GEDeviceF650/LLN0/urcbMXA01/IntgPd[RP]	UDINT
Server1!GEDeviceF650/LLN0/urcbMXA01/OptFlds[RP]	UDINT
Server1!GEDeviceF650/LLN0/urcbMXA01/Resv[RP]	BOOL
Server1!GEDeviceF650/LLN0/urcbMXA01/RptEna[RP]	BOOL
Server1!GEDeviceF650/LLN0/urcbMXA01/RptID[RP]	STRING
Server1!GEDeviceF650/LLN0/urcbMXA01/SqNum[RP]	USINT
Server1!GEDeviceF650/LLN0/urcbMXA01/TrgOps[RP]	UDINT
Server1!GEDeviceF650/MMXU1/Hz/mag.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsA/cVal.ang.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsA/cVal.mag.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsB/cVal.ang.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsB/cVal.mag.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsC/cVal.ang.f[MX]	REAL
Server1!GEDeviceF650/MMXU1/PhV.phsC/cVal.mag.f[MX]	REAL
Server1!GEDeviceF650/MSQI1/SeqA.c1/mag.f[MX]	REAL
Server1!GEDeviceF650/MSQI1/SeqA.c2/mag.f[MX]	REAL
Server1!GEDeviceF650/MSQI1/SeqA.c3/mag.f[MX]	REAL
Server1!GEDeviceF650/XCBR1/Pos/Oper.ctlVal[CO]	BOOL
Server1!GEDeviceF650/XCBR1/Pos/stVal[ST]	UDINT

The **/urcbMXA01/** variables are for information only. The variables for the RCB attributes need not necessarily exist in the zenon project in order for reporting to work. The IED contains some data sets, for example a *GEDeviceF650/LLN0$MMXU1$MX* data set with the following content:

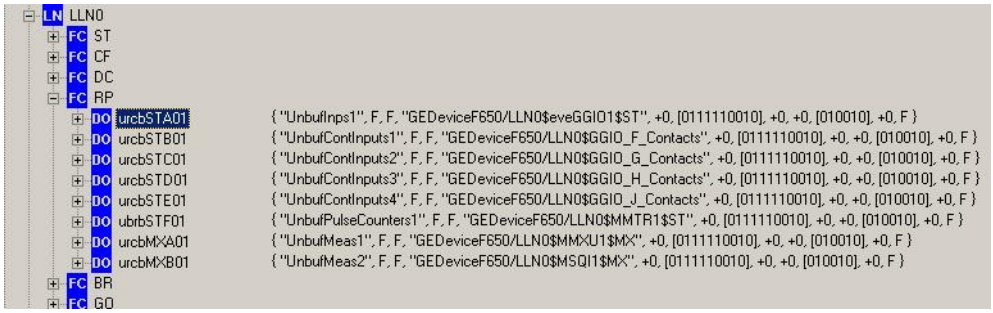


GEDeviceF650/LLN0$MMXU1$MX

Delete DataSet OK

Member	Value
GEDeviceF650/MMXU1MXTotW	{ { f0.00000
GEDeviceF650/MMXU1MXTotVAr	{ { f0.00000
GEDeviceF650/MMXU1MXTotVA	{ { f0.00000
GEDeviceF650/MMXU1MXTotPF	{ { f1.00000
GEDeviceF650/MMXU1MXHz	{ { f0.00000
GEDeviceF650/MMXU1MXPPV	{ { { { f0.000
GEDeviceF650/MMXU1MXPhV	{ { { { f0.000
GEDeviceF650/MMXU1MXA	{ { { { f0.000
GEDeviceF650/MMXU1MXAuxV	{ { { f0.0000
GEDeviceF650/MMXU1MXBusHz	{ { f0.00000

In the IED, this data set is assigned to the *LLN0RPurcbMXA01* RCB - the name of the data set is in the DatSet attribute of this RCB.



- LN LLN0
  - FC ST
  - FC CF
  - FC DC
  - FC RP
    - DO urcbSTA01 { "UnbufInps1", F, F, "GEDeviceF650/LLN0$eveGGIO1$ST", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbSTB01 { "UnbufContInputs1", F, F, "GEDeviceF650/LLN0$GGIO_F_Contacts", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbSTC01 { "UnbufContInputs2", F, F, "GEDeviceF650/LLN0$GGIO_G_Contacts", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbSTD01 { "UnbufContInputs3", F, F, "GEDeviceF650/LLN0$GGIO_H_Contacts", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbSTE01 { "UnbufContInputs4", F, F, "GEDeviceF650/LLN0$GGIO_J_Contacts", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO ubrbSTF01 { "UnbufPulseCounters1", F, F, "GEDeviceF650/LLN0$MMTR1$ST", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbMXA01 { "UnbufMeas1", F, F, "GEDeviceF650/LLN0$MMXU1$MX", +0, [0111110010], +0, +0, [010010], +0, F }
    - DO urcbMXB01 { "UnbufMeas2", F, F, "GEDeviceF650/LLN0$MSQI1$MX", +0, [0111110010], +0, +0, [010010], +0, F }
  - FC BR
  - FC GO

The URCBs *LLN0RPurcbMXA01* and *LLN0RPurcbMXB01* are signed in when the driver starts (if they are still free).
Because there are no further suitable URCBs that have project variables in their datasets, the remaining URCBs are not used. If the project also contains a variable that is included in the data set *GEDeviceF650/LLN0$eveGGIO1$ST*, this would mean the *LLN0RPurcbSTA01* is also activated.

STATIC ASSIGNMENT

For static assignment, the Report Control Blocks that are used are defined and fixed in the driver configuration - **statically assigned RCB** (on page 42). The driver attempts to activate all listed RCBs, regardless of their content.
If a Dynamic Data Set was also entered in the driver configuration, the driver in the PLC of this data set allocates this set to the RCB, in that it changes the value of the DatSet attribute before the report is activated.
If no Dynamic Data Set was entered, the data set pre-defined in the PLC is valid (as with automatic allocation).

If an RCB was activated successfully, all data objects that are contained in its data set are no longer polled. In this case, the driver expects that the IED reports the value changes spontaneously.

If no dataset name was sent with the received Report, teh corresponding dataset is found using RptID . This is only possible if the RptIDs is unique.

Information

The driver can only assign the data received in a Report to variables if a dataset name is available in the Report or if the RptID of the Report is unique.

If the Report does not include a dataset name, you have two possibilities:

- An IED can only send Reports without dataset name if in the RCB the **Optional Field** *Data set name* is not enabled.
  If **Optional Field** *Data set name* can be activated dynamically depends on the 850 server.
- Each Report includes RptID.
  If the IDs are unique for each RCB, the data can be evaluated correctly.
  If the RptID can be changed dynamically depends on the 850 server.
- In the SCL file of the 850 server in section Services it is defined if the Optional Fields and RptID can be changed dynamically. In the runtime a client can only make changes if the server permits it.

You can find further information about static assignment of the RCBs in the chapter about **buffered reporting**.

9.2 Buffered Reporting

For Buffered Reports, an 850 server (IED) saves the changes in the time in which a connected 850 client cannot be reached. If the client (the IEC850 driver) is online again (if the connection is reestablished, for example), the driver reads all buffered changes from the IED and processes them; it creates omitted alarms, for example.

There is no **automatic allocation** for Buffered Reporting. The allocation of BRCBs to the driver is always static:

- Either via the driver configuration, as described in the section about static assignment for Unbuffered Reporting (on page 122);
- Or for reasons of compatibility with older versions of the driver/IED (from the earliest times of Edition 1 of the standard), via the the *Report ID* of the BRCB that was configured in the SCL file and contains certain text. To do this, the **Use Report-ID for RCB assignment** property should be activated in the driver configuration.
  If the assignments are to be configured in the SCL file, the assigned report ID (RptID) of the BRCB must contain a string with the following nomenclature 'zenon_Computername_*'; for example: zenon_MyPC_Measurands1. The driver then signs in the RCB driver and uses the RCB data set that is defined in the SCL file.

The IEC 61850 standard stipulates that a Buffered Report can only be activated by a host (an 850 client). To prevent the driver from activating all Buffered Report Control Block and blocking access for other 850 clients, these must be explicitly defined in the driver configuration (on page 9).

Regardless of buffered events, the basic behavior is the same as described in the section about **unbuffered reporting - static assignment**.

Information

Once Runtime is started, the driver first reads the RCB attributes and only writes to enable if the RCB:

- Is free
- Is not yet enabled (for example by another 850 client)
- Is not reserved
- Contains a valid dataset

In the event of repetitions - from the **RCBs enable retries** properties - the driver no longer reads the RCB. In this case, it always writes RCB.RptEna=TRUE and then checks whether the PLC confirms success or returns an error.

GET OR DELETE BRCB BUFFER

If the RCB of the previously-used BRCB is activated again (**RCB enable**) (i.e. another establishment of the connection after a loss of the connection), the driver sends a saved **EntryID** to the 850 server to get the buffered value changes from the IED . This procedure is defined as such in the IEC 61850 standard. The **Do not purge BRCB buffer at start** option has no influence on this.

The first time an attempt to enable a report is made (i.e. when Runtime is started), the driver can also send the value of the **EntryID**. However, the driver only does this if the **Do not purge BRCB buffer at start** option is activated and if the driver has saved an **EntryID** beforehand.

Hint: The driver saves the last-received **EntryID** for each *ObjectReference* to BRCB first internally and then - each minute or if Runtime is closed - to a TXT file in the directory of the Runtime data.

In the following situations however, the driver sends the **purge buffer** command to delete the buffer on the IED :

- It is the first connection after Runtime has been started and the **Do not purge BRCB buffer at start** option in the basic settings (on page 18) is deactivated.
- The driver has not previously received a valid **EntryID** value (or the .TXT file does not contain an EntryID).
- It is a repeated attempt to sign in a report - after the **RCBs enable retries** time has expired. The BRCB.PurgeBuf command is always sent with a repeated attempt. This avoids data duplicates, because the values have already been received from the polling. The **Do not purge BRCB buffer at start** option has no effect on repetitions.

> **Attention**
>
> An 850 server is obliged to first confirm the writing of **EntryID** and only then to send the buffered values. The reports are ignored as long as the BRCB activation has not yet been confirmed.

BUFFERED REPORTS AND ZENON REDUNDANCY

Because zenon supports redundancy (see zenon network) and a BRCB can only be activated once by a PC, you must define separately, for the project **Server 1** and **Server 2** (Standby Server) which PC is to activate which report. The driver is started on both the Primary Server and the Standby and checks the driver configuration (**Hostname** property), to see if it finds a configuration that corresponds to the computer name that is running on Runtime.

For this reason, you need two copies of the Buffered Report in the IED (850 server) in the event of a redundant configuration; one for the driver that runs on the project server and one for the driver that runs on the Standby Server. You also create two entries in the RCB assignment (on page 42) list in the driver configuration. One with the computer name of the project server and one with the computer name of the Standby Server.

Note: With the configuration entry for the computer name of **Server 1**, you can enter the first instance of the BRCB ("brcbA01" for example) and for the configuration entry of **Server 2** - the second instance ("brcbA02" for example).

Attention

Even if you do not use redundancy, you must nevertheless define which reports are used for the PC (**Hostname** property) in the driver configuration on which zenon Runtime runs.

BRCB.RESVTMS HANDLING

The driver only handles the data attribute *BRCB.ResvTms* if no **ClientLN.iedName** has been defined in the driver configuration. You configure this **ClientLN.iedName** in the client configuration (on page 37) driver dialog or with the **IEC850 Driver Configuration** wizard from an SCD file.

If **ClientLN.iedName** has been configured, then it is assumed that the 850 server has also been pre-configured with the same SCD file. i.e. the 850 server obliges all exclusively-reserved BRCBs to set *ResvTms* to -1 and to only issue the BRCBs to the envisaged clients.

If no **ClientLN.iedName** is defined in the driver configuration, when the connection to the server is established, the BRCBs that are to be enabled are checked to see if there is the optional attribute *ResvTms*. In doing so, the value -1 in *ResvTms* means that this BRCB is exclusively reserved in the SCD for a different client. In this case there is an incorrect configuration and a warning is issued in the LOG.

Possible cause of the error:

- The driver was not configured with the correct *Client IED name*.
- In the driver, BRCBs were configured statically that were however reserved for another client according to the SCD file.

If no **ClientLN.iedName** has been configured in the driver, the driver sets the *ResvTms* attribute to 32767 seconds (7fff hex) in order to reserve this BRCB for the longest possible time in the event of a connection failure. This time is approximately 9 hours and ensures that no other client can sign this BRCB in during the time that the connection has failed.

URCB.RESV HANDLING

The driver only takes the data attribute *URCB.Resv* into account if no **ClientLN.iedName** has been defined in the driver configuration.

9.3 RCB activation - verification possibilities

To find out if a certain RCB has been activated, read the value of the **RptEna[RP/BR]* data attribute.

If the value of this variable is *TRUE*, then the RCB is assigned by a client. This information is only meaningful and reliable if only one single client communicates with the 850 server (IED).

Otherwise you do see that the report has been enabled, but there is no information about the client that activated this report. Additional information on the fact that one of the RCBs could not be activated can be read from the values of the **Connection State** variable (on page 90).

If the driver cannot activate the statically-assigned reports for any reason, polling is used instead for variables from missing RCBs. In this case, in the **Connection State** variable, bit 17 or 25 (*MMS_RCB_ENABLE_FAILED*) is set and the driver will - after the **RCBs enable retries** time has elapsed - attempt to write the *RptEna* data attribute with *true* again. As soon as the 850 server, after another attempt, accepts the missing sign ins for RCB, the driver no longer polls the variables. After all RCBs have been signed in, the *MMS_RCB_ENABLE_FAILED* bit of the **Connection State** variable is reset.

DIAGNOSIS VIEWER

You can get more details if you read the LOG file with the **Diagnosis Viewer**. In the LOG file, the corresponding information on the enabling of the reports by the driver (IEC850 client) is logged at *MSG* level. The attendant LOG entry:

- "*Trying to enable xxx on device nnn*".
  Example for xxx: *LLN0BRbrcbA01*.

Only the ERROR level is logged by default in the **Diagnosis Viewer**. You must configure the corresponding **Messagelevel** in the **Diagnosis Viewer**. This configuration in the **DiagViewer** is only possible if the corresponding driver tasks have already been started. This is then the case if Runtime is running or the driver configuration is open in the zenon Editor.

If the *MSG* level has been activated in the **Diagnosis Viewer**, but the "*Trying to enable xxx on device nnn*" LOG entry is not there, then ensure that the "**Hostname** " property of the driver configuration has been configured correctly.

This configuration must be configured either with a keyword *$SCADA_SERVER1* (*$SCADA_SERVER2*) or with the computer name on which the driver runs (= zenon Runtime).
Note: You configure the **Hostname** configuration in the **Client configuration** (on page 37) driver dialog.

Also ensure that there is at least one **[ST|MX]* variable in your zenon project whose value is signed in by this report.

Additional LOG entries

- Enabling of the report is refused by the 850 server - 'ERROR' LOG entry with the number of the MMS error code as received by the server.
- Enabling the report is accepted by the 850 server:
  - 'MSG' LOG entry with text: "*Successfully enabled xxx on device yyy*"

- 'DEBUG' LOG entries with the list of data objects with text: "*Disabled ST polling for zzz on device nnn*".
  Example for zzz: **/XCBR1STPos*.
  These data objects are now only expected via a report and will not be polled.

> **Information**
>
> If the driver is configured for the use of certain RCBs and these RCBs have an incorrect dataset definition, the report is activated but some data objects still need to be polled. In the LOG file, you can find entries via enabling of RCB, but not the entries via deactivated polling.

CAUSE OF TRANSMISSION (COT)

For each variable, the driver provides information about whether the value of the variable was received from polling or by means of a report. The information is written to the status bits *COTx* .

COT value	Status bits	Description
1	COT0	The value was received by means of polling.
2	COT1	The value was received by means of an Integrity Report. **Note:** This only works if Reason-for-inclusion is activated in the optional fields (on page 36) dialog. Otherwise the COT=3
3	COT0, COT1	The value was received by means of a report **Note:** If Reason-for-inclusion is activated in the Optional fields (on page 36) dialog, it is only reports with the trigger option data-change, data-update or quality-change. If Reason-for-inclusion is not activated, it is all reports - including Integrity and GI.
20	COT2, COT4	The value was received by means of an General Interogation Report. **Note:** This only works if Reason-for-inclusion is activated in the optional fields (on page 36) dialog. Otherwise the COT=3

Info

The COT value for theIEC850 driver is orientated towards the IEC60870 standard:

1 - periodic, cyclic

2 - background scan

3 - spontaneous

20 - general interrogation

Info

You can evaluate *COTx* status bits by using a combined element or reaction matrix ('multi' type). They are also visible in the **variable diagnosis** screen.

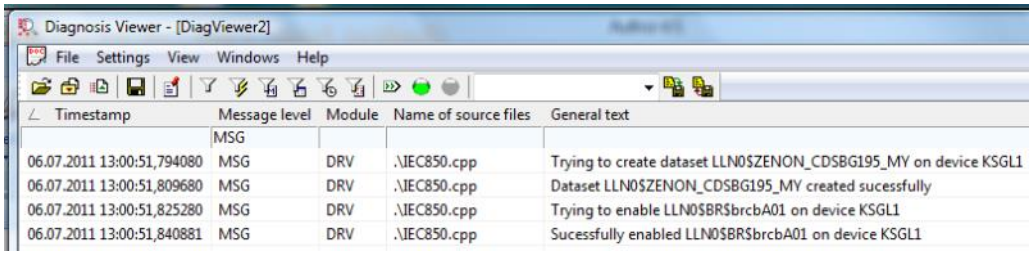
9.4 Dynamic Data Sets

To use Dynamic Data Sets, the two services *CreateDataSet* and *DeleteDataSet* must be supported by the IEC 61850 server and the DatSet attribute must be able to be written to in the Reporting Control Blocks (RCB) (SCL: ReportSettings.datSet="Dyn"). ReportSettings.datSet="Dyn"). When configuring, you must take into account all possible server restrictions such as the maximum number of elements in the data set (SCL: DynDataSet.max and maxAttributes).

Dynamic Data Sets lists data objects and are configured in the dynamic DataSet configuration (on page 48) dialog. They can be used for Unbuffered Reporting and for Buffered Reporting, but only if static assignments with RCBs were configured in the driver configuration - client configuration (on page 37). If no Dynamic Data Set has been linked in the RCB configuration of the driver, the pre-defined, static data set in the IEDs is valid.

If, in the driver configuration, a Dynamic Data Set was entered for an RCB, the driver in the IED (in the 850 server) assigns this data set to the RCB , by changing the value of the DatSet attribute of this block before the Report is activated.

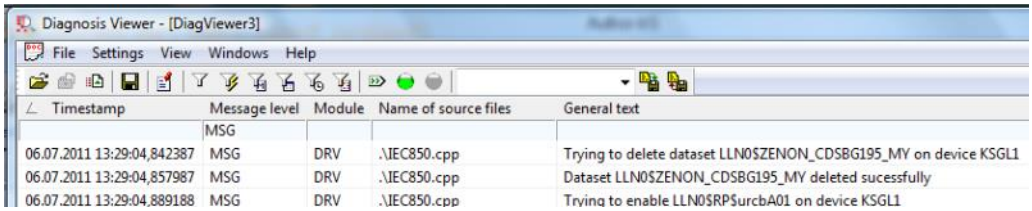
The creation of a dynamic data set can be checked in the Diagnosis Viewer (on page 137):



If a dynamic date set cannot be created, all RCBs that use this dynamic data set are not activated in Runtime. If the data set has been successfully created in the IED but the driver cannot update the DatSet attribute in the RCB, the assigned RCB is activated with the data set already present.

Before the statically assigned Reporting Control Blocks are activated, all dynamic data sets that are linked to them via driver configuration - client configuration (on page 37) are compared to those on the IEC 850 server. All Dynamic Data Sets available on the server that are not (or no longer) required are deleted. All Dynamic Data Sets not available on the server are created and all data sets that are available on both sides are checked to see that they have the same content. If the content is different, they are deleted and created again. However, the driver only deletes the data sets that it has created itself.

The deletion of a dynamic data set can be checked in the Diagnosis Viewer (on page 137):



The dynamic data sets that the driver creates on the IED (using the *CreateDataSet* service) receive a client-dependent name on the IED, in order for them to be easily found again. The nomenclature of the Dynamic Data Set name is as follows:

LLN0$ZENON_hostname_datasetname. Here:

Hostname is the computer name of the client as it is defined in the driver configuration.
You can find this configuration in the client configuration (on page 37) under **Hostname**.
datasetname is the name that was defined in the driver configuration.
You can find this configuration in the client configuration (on page 37) in the dynamic dataset configuration (on page 42).

Note: Define short names of the data sets and only use alphanumerical characters. The RCB.DatSet parameter has, in accordance with the IEC 61850 standard Edition 2, a maximum length of 32 (more precisely: 64/16$32 - LD/LN$Name). These 32 characters are assigned with prefix, host name and name of the data set, so the excess characters may be cut off with longer names and the names may no longer unique.

10 Changing the driver mode in Runtime

The zenon **Driver commands** function is to influence drivers using zenon.
You can do the following with a driver command:

- Start

- Stop
- Shift a certain driver mode
- Instigate certain actions

Note: This chapter describes standard functions that are valid for most zenon drivers.
Not all functions described here are available for every driver. For example, a driver that does not, according to the data sheet, support a modem connection also does not have any modem functions.

Attention

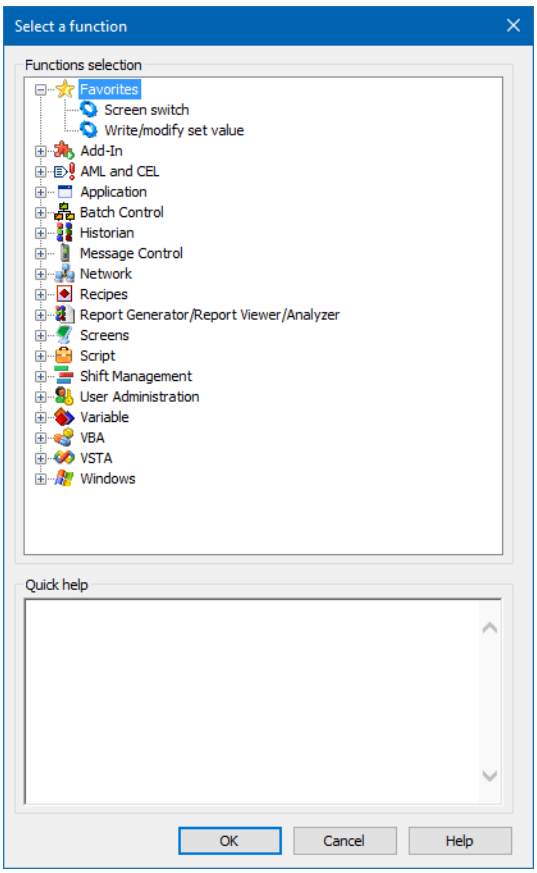
The zenon **Driver commands** function is not identical to driver commands that can be executed in the Runtime with Energy drivers!

CONFIGURATION OF THE FUNCTION

Configuration is carried out using the **Driver commands** function.
To configure the function:

1. Create a new function in the zenon Editor.

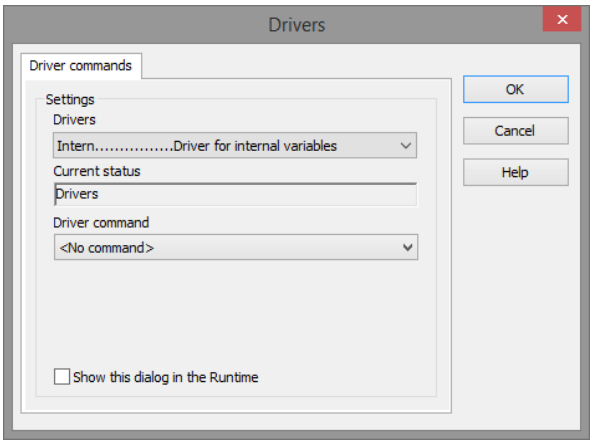
   The dialog for selecting a function is opened



2. Navigate to the node **Variable.**

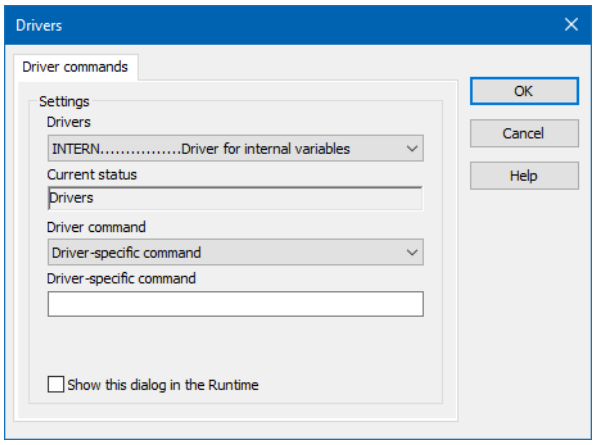
3. Select the **Driver commands** entry.

   The dialog for configuration is opened



4. Select the desired driver and the required command.
5. Close the dialog by clicking on **OK** and ensure that the function is executed in the Runtime. Heed the notices in the **Driver command function in the network** section.

DRIVER COMMAND DIALOG



Option	Description
Driver	Selection of the driver from the drop-down list. It contains all drivers loaded in the project.
Current condition	Fixed entry that is set by the system. Has no function in the current version.
Driver command	Selection of the desired driver command from a drop-down list. For details on the configurable driver commands, see the **available driver commands** section.

Option	Description
Driver-specific command	Entry of a command specific to the selected driver. **Note:** Only available if, for the **driver command** option, the *driver-specific command* has been selected.
Show this dialog in the Runtime	Configuration of whether the configuration can be changed in the Runtime: ▸ *Active*: This dialog is opened in the Runtime before executing the function. The configuration can thus still be changed in the Runtime before execution. ▸ *Inactive*: The Editor configuration is applied in the Runtime when executing the function. Default: *inactive*

CLOSE DIALOG

Options	Description
OK	**Applies settings and closes the dialog.**
Cancel	Discards all changes and closes the dialog.
Help	Opens online help.

AVAILABLE DRIVER COMMANDS

These driver commands are available - depending on the selected driver:

Driver command	Description
<No command>	No command is sent. A command that already exists can thus be removed from a configured function.
Start driver (online mode)	Driver is reinitialized and started. **Note:** If the driver has already been started, it must be stopped. Only then can the driver be re-initialized and started.
Stop driver (offline mode)	Driver is stopped. No new data is accepted. **Note:** If the driver is in offline mode, all variables that were created for this driver receive the status *switched*

Driver command	Description
	off (*OFF*; Bit *20*).
Driver in simulation mode	Driver is set into simulation mode. The values of all variables of the driver are simulated by the driver. No values from the connected hardware (e.g. PLC, bus system, ...) are displayed.
Driver in hardware mode	Driver is set into hardware mode. For the variables of the driver the values from the connected hardware (e.g. PLC, bus system, ...) are displayed.
Driver-specific command	Entry of a driver-specific command. Opens input field in order to enter a command.
Activate driver write set value	Write set value to a driver is possible.
Deactivate driver write set value	Write set value to a driver is prohibited.
Establish connection with modem	Establish connection (for modem drivers) Opens the input fields for the hardware address and for the telephone number.
Disconnect from modem	Terminate connection (for modem drivers)
Driver in counting simulation mode	Driver is set into counting simulation mode. All values are initialized with *0* and incremented in the set update time by *1* each time up to the maximum value and then start at *0* again.
Driver in static simulation mode	No communication to the controller is established. All values are initialized with *0*.
Driver in programmed simulation mode	The values are calculated by a freely-programmable simulation project. The simulation project is created with the help of the zenon Logic Workbench and runs in the zenon Logic Runtime.

DRIVER COMMAND FUNCTION IN THE NETWORK

If the computer on which the **Driver commands** function is executed is part of the zenon network, further actions are also carried out:

- A special network command is sent from the computer to the project server.
  It then executes the desired action on its driver.

- In addition, the Server sends the same driver command to the project standby.
  The standby also carries out the action on its driver.

This makes sure that Server and Standby are synchronized. This only works if the Server and the Standby both have a working and independent connection to the hardware.

11 Error analysis

Should there be communication problems, this chapter will assist you in finding out the error.

11.1 Analysis tool

All zenon modules such as Editor, Runtime, drivers, etc. write messages to a joint log file. To display them correctly and clearly, use the Diagnosis Viewer (main.chm::/12464.htm) program that was also installed with zenon. You can find it under **Start/All programs/zenon/Tools 8.10 -> Diagviewer.**

zenon driver log all errors in the LOG files.LOG files are text files with a special structure. The default folder for the LOG files is subfolder **LOG** in the folder **ProgramData**. For example:

%ProgramData%\COPA-DATA\LOG.

Attention: With the default settings, a driver only logs error information. With the Diagnosis Viewer you can enhance the diagnosis level for most of the drivers to "Debug" and "Deep Debug". With this the driver also logs all other important tasks and events.

In the Diagnosis Viewer you can also:

- Follow newly-created entries in real time
- customize the logging settings
- change the folder in which the LOG files are saved

Note:

1. The Diagnosis Viewer displays all entries in UTC (coordinated world time) and not in local time.
2. The Diagnosis Viewer does not display all columns of a LOG file per default. To display more columns activate property **Add all columns with entry** in the context menu of the column header.
3. If you only use **Error-Logging**, the problem description is in the column **Error text**. For other diagnosis level the description is in the column **General text**.
4. For communication problems many drivers also log error numbers which the PLC assigns to them. They are displayed in **Error text** or **Error code** or **Driver error parameter** (**1** and **2)**. Hints on the meaning of error codes can be found in the driver documentation and the protocol/PLC description.

5. At the end of your test set back the diagnosis level from **Debug** or **Deep Debug**. At **Debug** and **Deep Debug** there are a great deal of data for logging which are saved to the hard drive and which can influence your system performance. They are still logged even after you close the Diagnosis Viewer.

> **Attention**
>
> In Windows CE errors are not logged per default due to performance reasons.

You can find further information on the Diagnosis Viewer in the Diagnose Viewer (main.chm::/12464.htm) manual.

11.2 Check list

Check your system for errors using the driver documentation; for example correct driver configuration, addressing of the variables in zenon projects, report settings in the control unit, etc.

Check most of all:

1. Is the device (IEC 61850 server) connected to the power grid and ready for use?
   a) Can a TCP connection to the device be created (check this using a 'ping') via the defined port (check this via Telnet)?
   a) Is communication between this device and another IEC 61850 client possible?
   b) Is the driver in hardware mode and not in simulation mode?
2. Have you analyzed the errors which are protocoled in the LOG file (for more information refer to manual Tools in chapter Diagnosis Viewer) of the drivers?
   a) Which ERROR entries occurred?
   b) Have you checked the information in the columns: **Error Text** and **General Text**?
   - In the **General Text** column, the "... failed due to error *N*" information shows the error number (N) - defined in the MMS protocol - with which the IED responded, e.g.: 3 - "access-violation", 5 - "parameter-value-inconsistent", 11 - "value-out-of-range" etc.

   a) Was the logging activated, for the correct driver, at least for the error level and for all driver modules?
   b) Have you taken into account that the times in the **Diagnosis Viewer** are always UTC?
   c) Are the entries in the LOG comparable to recordings in **Wireshark**?
   - The driver is logging in addition to (not instead of) information that **Wireshark** is showing with the filter set to "mms".

   a) Is the **Diagnosis Viewer** set so that all registered and all columns are diplayed with the content (without filtering)?

3. Variable addressing (if the variables have been created manually or by means of offline import from the SCL file):

   a) Have you tried to import the variable online?

   b) Do all variables have the correct **net addresses**?

   c) Are the **symbolic addresses** (or names, identifications) of the variables valid (SERVER!LD/LN/DO/DA[FC])?

   d) Do the variables have the correct **driver object type** (*PLC marker*), **data type** and **value range**?

4. General information and reporting:

   a) Was at least one variable for each Logical Device created in the project?

   ▶ For performance reasons, the driver in Runtime skips all Logical Devices for which no variables exist in the project; the statically-configured RCBs can also be ignored in the process.

   a) Has at least one Logical Device variable been polled or is **automatic watchdog** activated?

   ▶ If, with **automatic watchdog** activated, no MMS.Read is sent periodically, MMS is blocked (MaxOustandingCallings has been reached) - the 850 server has reacted with TCP.ACK but did not respond to the MMS request PDUs. An 850 client can then send no further MMS requests; it must wait. The situation occurs if the IED has an error (reacts with a delay and does not send and Abort by Reset).
   The driver creates an error entry in the LOG file and the connection is canceled.

   a) If an RCB that is not in the *LLN0* is not taken into account: was at least one variable from the Logical Node of the RCB created in the project?

   ▶ For performance reasons, the driver skips Logical Nodes except *LLN0* in Runtime for which there are no variables in the project.

   a) Has, in the driver configuration, the **use Report ID** property has been activated but not used or not synced with the SCL file of the IED?

   ▶ If **use Report ID** has been changed: was the **static assignment** of the RCBs configured again as required?

   a) Have, in the driver configuration - in the **host name** - the keywords *$SCADA_SERVER1* or *$SCADA_SERVER2* or the names of Runtime computers been entered and linked to other instances of the RCB?

   ▶ The network server and standby server must not use the same instances.

   ▶ The **host name** must also be entered in projects without a network.

   a) Does the **max. auto used URCBs** property have the correct value?

   ▶ If you have already configured the **static assignment** for RCBs in the driver - then 0;

- If the **static assignment** has not yet been configured - a value that leaves all 850 clients in the system with sufficient RCB instances.

a) Is reporting available for the device?

- A standard-compliant 850 server can, but must not necessarily support reporting. For example, its ICD file (file from the manufacturer) can contain incomplete configurations for RCBs and it is expected that the complete CID files are uploaded in the IED for finished systems.

a) Do the RCBs, in DatSet parameter, contain the names of existing data sets?

- In the event of doubt, create the */DatSet[RP|BR] and */RptEna[RP|BR] variables and check their value, in the **variable diagnosis** screen for example.

a) Is the TrgOp 'general interrogation' active?

- Without GI, it is impossible for the driver to request the initial value of variables from the IED.

a) Is the IED also able to detect short interruptions to the connection and the automatically unlock all RCBs (RptEna to false)?

5. Dynamic Data Set

a) Is the DataSet attribute in the RCB writeable on the IED?

b) Have you taken into account the limitations of the IED, such as the maximum number of elements in the data set or the maximum length of the name etc.?

12 Appendix A - Description of the 'Functional Constraints' (FCs):

FC	Semantics IEC 61850-7-2	Description
ST	Status information	Stands for status information, position of a switch for example. The value can be read, replaced or reported but not written. In the data model of an 850 server, in *ST* data attributes of a data object, *t* (time stamp) and *q* (Quality) must be present. However, these must not be created as zenon variables. **Example:** Variable for **/stVal[ST]* automatically has the status bits from *q* and time stamp from *t*.
MX	Measurands (analogue values)	Stands for status information, the measured size of which can be read, replaced, reported, but not written.

FC	Semantics IEC 61850-7-2	Description
		In the data model of an 850 server, in *MX* data attributes of a data object, *t* (time stamp) and *q* (Quality) must be present. However, these must not be created as zenon variables. **Example:** Variable for **/cVal.mag.f[MX]* automatically has the status bits from *q* and time stamp from *t*.
CO	Control	Stands for control information of a command (according to current Control Model of the data object). The value can only be written, not read. **Example:** ▸ Write set value to a variable that corresponds to a */Oper.ctlVal[CO] data attribute, is automatically implemented in the IEC850 driver for an Operate command or the Select Before Operate process. ▸ Write set value to a variable that corresponds to a */Oper.Test[CO] data attribute is used in the IEC850 driver for test parameters of the next command.
CF	Configuration	Stands for configuration information, the value of which can be read, reported and written. **Example:** The value of the variable that corresponds to a **/cltModel[CF]* data attribute shows the object's current Control Model .
SP	Setting (outside setting group)	Stands for a parameter the value of which can be read, reported and written. **Example:** A Setting Group Control Block (*SGCB*) contains *SP* data attributes in order to control the *SG/SE* data attributes.
SG /SE	Setting Group (/editable)	Stands for additional data attributes whose values serve as parameters, controlled via a Setting Group Control Block (*SGCB*). An *SG* value can be read, the *SE* can also be written. **Note:** in the data model of an 850 server, the *SG* and *SE* data attributes can occur in any desired data objects in order to set the parameters of these data objects.
RP/ BR	Unbuffered / Buffered Report Control Block	Stands for data attributes in Report Control Block: ▸ *RP* - Unbuffered ▸ *BR* - Buffered

FC	Semantics IEC 61850-7-2	Description
		The value can be read and - to a limited extent (61850-7-2) - written. **Example:** Write set value *1* (*true*) to a variable that corresponds to a **/GI[RP|BR]* data attribute is manual triggering of the general query. **Note:** the *RP* and *BR* variables can be created via **online import**.
LG	Log Control Block	Stands for data attributes in Log Control Block. The value can be read and - to a limited extent (61850-7-2) - written.
GO	GOOSE Control Block	Stands for data attributes in GOOSE Control Block. The value can be read and - to a limited extent (61850-7-2) - written. **Example:** Write set value *0/1* (*false/true*) to a variable that corresponds to a **/GoEna[GO]* data attribute is manual deactivation/activation of a GOOSE Publishers.
MS/ US	Multicast / Unicast Sampled Values Control Block	Stands for data attributes in Sampled Values Control Block: ▸ *MS* - Multicast ▸ *US* - Unicast The value can be read and - to a limited extent (61850-7-2) - written.
SV	Substitution	Stands for additional data attributes whose values can serve as substitute vales of the process. The value can be read and written. **Note:** in the data model of an 850 server, the *SV* data attributes can occur in any desired data objects in order to replace the relevant process data in this data object if necessary.
DC	Description	Stands for descriptions, usually the *STRINGs*. The value can be read; it can also be written in rare cases - if *DA* has not been configured as '*RO*' (read-only) in *SCL*.
EX	Extended definition	Stands for references in the data model. The value can be read.
SR	Service Response	Stands for Service Tracking information, the value of which can be read and reported, but not written.

FC	Semantics IEC 61850-7-2	Description
		Note: ▸ In the data model of an 850 server, *SR* data is solely possible in Logical Node *LTRK*. ▸ In the IEC850 driver, there are additional **driver object type** *service tracking* variables with FC=*SR*. These additional *SR* variables can be created in any desired data objects or Control Blocks in order to evaluate Service Tracking using them.
OR	Operate received	Stands for information relevant during command execution; specifically for the data object. The value can be read.
BL	Blocking	Stands for data attributes for *operator-block* interlockings in the IED. The value can be read.

13 Appendix B - Abbreviations for data object/data attribute

> **Information**
>
> Appendix B - Data object / data attribute is only available in English.

Term	Description
f	floating point (analog value)
i	integer (analog value)
d	Visible String(255)
q	Quality
t	Timestamp
A	Current
Acs	Access

Term	Description
ACSI	Abstract Communication Service Interface
Acu	Acoustic
Age	Ageing
Alm	Alarm
Amp	Current non phase related
To	Analogue
Ang	Angle
Auth	Authorization
Auto	Automatic
Aux	Auxiliary
Av	Average
B	Bushing
Bat	Battery
Beh	Behaviour
Bin	Binary
Blk	Block, blocked
Bnd	Band
Bo	Bottom
Cancel	Cancel
Cap	Capability
Capac	Capacitance
Car	Carrier
CB	Circuit Breaker
CDC	Common Data Class

Term	Description
CE	Cooling Equipment
Cf	Crest factor
Cfg	Konfiguration
CG	Core Ground
Ch	Channel
Cha	Charger
Chg	Change
Chk	Check
Chr	Characteristic
Cir	Circulating
Clc	Calculate
Clk	Clock, clockwise
Cls	Close
Cnt	Counter
Col	Coil
Cor	Correction
Crd	Coordination
Crv	Curve
CT	Current Transducer
Ctl	Control
Ctr	Center
Cyc	Cycle
Dea	Dead
Den	Density
Det	Detected

Term	Description
DExt	De-excitation
Diag	Diagnostics
Dif	Differential, difference
Dir	Richtung
Dis	Distance
Dl	Delay
Dlt	Delete
Dmd	Demand
Dn	Down
DPCSO	Double point controllable status output
DQ0	Direct, Quadrature, and zero axis quantities
Drag	Drag hand
Drv	Drive
DS	Device State
Dsch	Discharge
Dur	Duration
EC	Earth Coil
EE	External Equipment
EF	Earth Fault
Ena	Enabled
Eq	Equalization, Equal
Ev	Evaluation
Ex	External
Exc	Exceeded
Excl	Exclusion

Term	Description
Ext	Excitation
FA	Fault Arc
Fact	Factor
Fan	Fan
Flt	Fault
Flw	Flow
FPF	Forward Power Flow
Fu	Fuse
Fwd	Forward
Gen	General
Gn	Generator
Gnd	Ground
Gr	Group
Grd	Guard
Gri	Grid
H	Harmonics (phase related)
H2	Hydrogen
H2O	Water
Ha	Harmonics (non phase related)
Hi	High, highest
HP	Hot point
Hz	Frequency

Term	Description
IEEE	Institute of Electrical and Electronic Engineers
Imb	Imbalance
Imp	Impedance non phase related
In	Input
Ina	Inactivity
Incr	Increment
Ind	Indication
Inh	Inhibit
Ins	Insulation
Int	Integer
ISCSO	Integer status controllable status output
Km	Kilometer
L	Lower
LD	Logical Device
LDC	Line Drop Compensation
LDCR	Line Drop Compensation Resistance
LDCX	Line Drop Compensation Reactance
LDCZ	Line Drop Compensation Impedance
LED	Light Emitting Diode
Len	Length
Lev	Level
Lg	Lag
Lim	Limit
Lin	Line

Term	Description
Liv	Live
Lo	Low
LO	Lockout
Loc	Local
Lod	Load, loading
Lok	Locked
Los	Loss
Lst	List
LTC	Load Tap Changer
M	minutes
M/O	Data Object is Mandatory or Optional
Max	Maximum
Mem	Memory
Min	Minimum
Mod	Mode
Mot	Motor
Ms	Milliseconds
Mst	Moisture
MT	Main Tank
N	Neutral
Nam	Name
Net	Net sum
Ng	Negative
Nom	Nominal, Normalizing

Term	Description
Num	Number
Ofs	Offset
Op	Operate, Operating
Oper	Operate*
Opn	Open
Out	Output
Ov	Over, Override, Overflow
Pa	Partial
Par	Parallel
Pct	Percent
Per	Periodic
PF	Power Factor
Ph	Phase
Phy	Physical
Pls	Pulse
Plt	Plate
Pmp	Pump
Po	Polar
Pol	Polarizing
Pos	Position
POW	Point on wave switching
PP	Phase to phase
PPV	Phase to phase voltage
Pres	Pressure

Term	Description
Prg	Progress, in progress
Pri	Primary
Pro	Protection
Ps	Positive
Pst	Post
Pwr	Power
Qty	Quantity
R	Raise
R0	Zero sequence resistance
R1	Positive sequence resistance
Rat	Winding ratio
Rcd	Record, recording
Rch	Reach
Rcl	Reclaim
Re	Retry
React	Reactance; Reactive
Rec	Reclose
Red	Reduction
Rel	Release
Rem	Remote
Res	Residual
Ris	Resistance
Rl	Relation, relative
Rms	Root mean square

Term	Description
Rot	Rotation, Rotor
Rs	Reset, Resetable
Rsl	Result
Rst	Restraint
Rsv	Reserve
Rte	Rate
Rtg	Rating
Rv	Reverse
Rx	Receive, received
S1	Step one
S2	Step two
SBO	Select before operate*
SBOw	Select with value*
Sch	Scheme
SCO	Supply change over
SCSM	Specific Communication Service Mapping
Sec	Security
Seq	Sequence
Set	Setting
Sh	Shunt
Spd	Speed
SPl	Single Pole
SPCSO	Single point controllable status output
Src	Source
St	Status

Term	Description
Stat	Statistics
Stop	Stop
Std	Standard
Str	Start
Sup	Supply
Svc	Service
Sw	Switch
Swg	Swing
Syn	Synchronisation
Tap	Tap
Td	Total distortion
Tdf	Transformer derating factor
Test	Test
Thd	Total Harmonic Distortion
Thm	Thermal
TiF	Telephone influence factor
Tm	Time
	• Tmh = Time in h
	• Tmm = Time in min
	• Tms = Time in s
	• Tmms = Time in ms
Tmp	Temperature (°C)
To	Top
Tot	Total
TP	Three pole

Term	Description
Tr	Trip
Trg	Trigger
Ts	Total signed
Tu	Total unsigned
Tx	Transmit, transmitted
Typ	Type
Un	Under
V	Voltage
VA	Volt Amperes
Vac	Vacuum
Val	Value
VAr	Volt Amperes Reactive
Vlv	Valve
Vol	Voltage non phase related
VT	Voltage Transducer
W	Active Power
Wac	Watchdog
Watt	Active Power non phase related
Wei	Weak End Infeed
Wh	Watt hours
Wid	Width
Win	Window
Wrm	Warm

Term	Description
X0	Zero sequence reactance
X1	Positive sequence reactance
Z	Impedance
Z0	Zero sequence impedance
Z1	Positive sequence impedance
Zer	Zero
Zn	Zone
Zro	Zero sequence method

* SBO, SBOw, Oper, und Cancel are defined in IEC 61850-8-1:

Data attribute name	Semantics
SBO	Select – returns ACSI name of control
SBOw	SelectWithValue – receives service parameters
Oper	Operate – receives service parameters and control values
Cancel	Cancel – receives service parameters and control values

14 Appendix C - Conformance statement

> **Information**
>
> The Confirmance Statement of the **iec850 driver** for the IEC61850 protocol is in English only.

14.1 Protocol implementation conformance statement (PICS)

This document specifies the PICS of the IEC 61850 interface in the client system: "**zenon Supervisor**/*Energy Edition*", Version *8.00*, further referred to as "Client". The zenon Editor and Runtime are further referred to as "HMI".

A.1 - BASIC ACSI CONFORMANCE STATEMENT

Client-Server roles		**Client / subscriber**	**Server / publisher**	**Value / comments**
B11	Server side (of TWO-PARTY-APPLICATION-ASSOCIATION)	--	N	for Server see zenon Logic
B12	Client side of (TWO-PARTY-APPLICATION-ASSOCIATION)	Y	--	
SCSMs supported		**Client / subscriber**	**Server / publisher**	**Value / comments**
B21	SCSM: IEC 61850-8-1 used	Y		
B22	SCSM: IEC 61850-9-1 used	N		deprecated
B23	SCSM: IEC 61850-9-2 used	N		
B24	SCSM: other	N		
Generic substation event model (GSE)		**Client / subscriber**	**Server / publisher**	**Value / comments**
B31	Publisher side	--	Y	see zenon Logic
B32	Subscriber side	Y	--	see zenon Logic
Transmission of sampled value model (SVC)		**Client / subscriber**	**Server / publisher**	**Value / comments**
B41	Publisher side	-	N	
B42	Subscriber side	N	-	for 90-5 see zenon Logic
- = not applicable **Y** = supported				

Client-Server roles	Client / subscriber	Server / publisher	Value / comments
N or **empty** = not supported			

A.2 - ACSI MODELS CONFORMANCE STATEMENT

IF SERVER SIDE (B11) AND/OR CLIENT SIDE (B12) SUPPORTED

		Client / subscriber	Value / comments
M1	Logical device	Y	
M2	Logical node	Y	
M3	Data	Y	
M4	Data set	Y	
M5	Substitution	Y	
M6	Setting group control	Y	
Reporting		**Client / subscriber**	**Value / comments**
M7	Buffered report control	Y	
M7-1	sequence-number	Y	
M7-2	report-time-stamp	Y	
M7-3	reason-for-inclusion	Y	
M7-4	data-set-name	Y	
M7-5	data-reference	Y	
M7-6	buffer-overflow	Y	
M7-7	entryID	Y	
M7-8	BufIm	Y	
M7-9	IntgPd	Y	
M7-10	GI	Y	
M8	Unbuffered report control	Y	

		Client / subscriber	Value / comments
M8-1	sequence-number	Y	
M8-2	report-time-stamp	Y	
M8-3	reason-for-inclusion	Y	
M8-4	data-set-name	Y	
M8-5	data-reference	Y	
M8-6	BufIm	Y	
M8-7	IntgPd	Y	
M8-8	GI	Y	
Logging		**Client / subscriber**	**Value / comments**
M9	Log control	N	
M9-1	IntgPd	N	
M10	Log	N	
general		**Client / subscriber**	**Value / comments**
M11	Control	Y	
M17	File Transfer	Y	
M18	Application association	Y	
M19	GOOSE Control Block	Y	
M20	Sampled Value Control Block	Y	

IF GSE (B31/B23) IS SUPPORTED

		publisher & subscriber	Value / comments
M12	GOOSE	Y	
M13	GSSE	N	

IF SVC (B41/B42) IS SUPPORTED

		Client / subscriber	Value / comments
M14	Multicast SVC	N	
M15	Unicast SVC	N	

FOR ALL IEDS

		Client / subscriber	Value / comments
M16	Time	Y	Time of Operating System must be available with required accuracy

Y = service is supported

N or **empty** = service is not supported

A.3 - ACSI SERVICE CONFORMANCE STATEMENT

SERVER

		AA: TP/MC	Client (C)	Comments
S1	GetServerDirectory (LOGICAL-DEVICE)	TP	Y	driver start
Application association		**AA: TP/MC**	**Client (C)**	**Comments**
S2	Associate		Y	driver start
S3	Abort		Y	stop / exit
S4	Release		N	
Logical device		**AA: TP/MC**	**Client (C)**	**Comments**
S5	GetLogicalDeviceDirectory	TP	Editor: Y Runtime: N	only for **Online Import** in Editor

		AA: TP/MC	Client (C)	Comments
Logical node		**AA: TP/MC**	**Client (C)**	**Comments**
S6	GetLogicalNodeDirectory	TP	Y	only for data sets
S7	GetAllDataValues	TP	N	

DATA

		AA: TP/MC	Client (C)	Comments
S8	GetDataValues	TP	Y	variable(s) value ▸ polling: FCD ▸ watchdog, scan, SBO: FCDA
S9	SetDataValues	TP	Y	write set value
S10	GetDataDirectory	TP	Y	driver start
S11	GetDataDefinition	TP	N	
Data set		**AA: TP/MC**	**Client (C)**	**Comments**
S12	GetDataSetValues	TP	N	
S13	SetDataSetValues	TP	N	
S14	CreateDataSet	TP	Y	dynamic data set in RCB
S15	DeleteDataSet	TP	Y	dynamic data set in RCB
S16	GetDataSetDirectory	TP	Y	driver start
Substitution		**AA: TP/MC**	**Client (C)**	**Comments**
S17	SetDataValues	TP	Y	write set value
Setting group control		**AA: TP/MC**	**Client (C)**	**Comments**
S18	SelectActiveSG	TP	Y	write set value */LLN0/SGCB/ActSG[SP]

		AA: TP/MC	Client (C)	Comments
S19	SelectEditSG	TP	Y	write set value */LLN0/SGCB/EditSG[SP]
S20	SetSGValues	TP	Y	write set value *[SG], *[SE]
S21	ConfirmEditSGValues	TP	Y	write set value */LLN0/SGCB/CnfEdit[SP]
S22	GetSGValues	TP	Y	variable(s) value *[SG], *[SE]
S23	GetSGCBValues	TP	Y	variable(s) value */LLN0/SGCB/*[SP]

REPORTING

Buffered report control block (BRCB)		AA: TP/MC	Client (C)	Comments
S24	Report	TP	Y	variable(s) value
S24-1	*data-change (dchg)*		Y	
S24-2	*quality-change (qchg)*		Y	
S24-3	*data-update (dupd)*		Y	
S25	GetBRCBValues	TP	Y	variable(s) value *[BR]
S26	SetBRCBValues	TP	Y	write set value *[BR]
Unbuffered report control block (URCB)		**AA: TP/MC**	**Client (C)**	**Comments**
S27	Report	TP	Y	variable(s) value
S27-1	*data-change (dchg)*		Y	
S27-2	*quality-change (qchg)*		Y	

Buffered report control block (BRCB)		AA: TP/MC	Client (C)	Comments
S27-3	*data-update (dupd)*		Y	
S28	GetURCBValues	TP	Y	variable(s) value *[RP]
S29	SetURBCValues	TP	Y	write set value *[RP]

LOGGING

Log control block		AA: TP/MC	Client (C)	Comments
S30	GetLCBValues	TP	Y	variable(s) value *[LG]
S31	SetLCBValues	TP	Y	write set value *[LG]
Log		**AA: TP/MC**	**Client (C)**	**Comments**
S32	QueryLogByTime	TP	N	
S33	QueryLogAfter	TP	N	
S34	GetLogStatusValues	TP	Y	variable(s) value

GENERIC SUBSTATION EVENT MODEL (GSE)

GOOSE-CONTROL-BLOCK		AA: TP/MC	publisher, subscriber	Comments
S35	SendGOOSEMessage	MC	Y	see zenon Logic
S36	GetGoReference	TP	N	
S37	GetGOOSEElementNumber	TP	N	
S38	GetGoCBValues	TP	client Y	variable(s) value *[GO]
S39	SetGoCBValues	TP	client Y	write set value *[GO]

GOOSE-CONTROL-BLOCK		AA: TP/MC	publisher, subscriber	Comments
GSSE-CONTROL-BLOCK		**AA: TP/MC**	**Client (C)**	**Comments**
S40	SendGSSEMessage	MC	N	deprecated
S41	GetGsReference	TP	N	deprecated
S42	GetGSSEDataOffset	TP	N	deprecated
S43	GetGsCBValues	TP	Y	deprecated
S44	SetGsCBValues	TP	Y	deprecated

TRANSMISSION OF SAMPLED VALUE MODEL (SVC)

Multicast SVC		AA: TP/MC	Client (C)	Comments
S45	SendMSVMessage	MC	N	
S46	GetMSVCBValues	TP	Y	variable(s) value *[MS]
S47	SetMSVCBValues	TP	Y	write set value *[MS]
Unicast SVC		**AA: TP/MC**	**Client (C)**	**Comments**
S48	SendUSVMessage	TP	N	
S49	GetUSVCBValues	TP	Y	variable(s) value *[SV]
S50	SetUSVCBValues	TP	Y	write set value *[SV]

CONTROL

		AA: TP/MC	Client (C)	Comments
S51	Select	TP	Y	automatically before Operate
S52	SelectWithValue	TP	Y	automatically before Operate
S53	Cancel	TP	Y	cancel of first-stage of an **Action** if DO selected
S54	Operate	TP	Y	write set value */Oper.ctlVal[CO]
S55	Command-Termination	TP	Y	automatically
S56	TimeActivated-Operate	TP	N	

FILE TRANSFER

		AA: TP/MC	Client (C)	Comments
S57	GetFile	TP	Y	FT!Command *GET*
S58	SetFile	TP	N	
S59	DeleteFile	TP	Y	FT!Command *DEL*
S60	GetServerDirectory (FILE-SYSTEM)	TP	Y	FT!Command *DIR*

TIME

		Client (C)	Comments
T1	Time resolution of internal clock	Operating System (T1)	Microsoft Windows PC resolution, default 1ms
T2	Time accuracy of internal clock	Operating System (T1)	T0 (10ms), T1 (1ms), T2 (100µs), T3 (25µs), T4 (4µs), T5 (1µs)

		Client (C)	Comments
T3	Supported TimeStamp resolution	T1 (1ms)	or decimal places of LREAL when t-attribute created as variable (T3)

14.2 Model implementation conformance statement (MICS)

This document specifies the MICS of the IEC 61850 interface in the client system: "**zenon Supervisor**/*Energy Edition*", Version *8.00*, further referred to as "Client". The zenon Editor and Runtime are further referred to as "HMI".

- All logical nodes, common data classes and data attribute types - as defined in IEC 61850-7-3 and IEC 61850-7-4 - are supported.
- Data types INT64 and INT128 are fully supported on MMS, but their values in the Runtime only in range of lowest 52 bits as mapped to **LINT** or mapped to **LREAL** with eventual loss of precision.
- Data type ARRAY OF - only single-level arrays on data attribute level are supported; items of this data type are read-only. **Hint:** deactivate variable property **Set value**.
- Object References in received Service Tracking data are not supported with '@' wildcard instead the IED Name.

15 Appendix D - PIXIT

> **Info**
>
> The PIXIT document for the certification test of the IEC850 driver "**zenon Supervisor**/*Energy Edition*", Version *8.00* is only available in English.
>
> PIXIT based on a template provided by the UCA International Users Group.

INTRODUCTION

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in the client system: "**zenon Supervisor**/*Energy Edition*", Version *8.00*, further referred to as "Client". The zenon Editor and Runtime are further referred to as "HMI".

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10.

The following chapters specify the PIXIT for each applicable ACSI service model as structured in IEC 61850-10 and the "Conformance Test Procedures for Client System with IEC 61850-8-1 Edition 2 interface" **by UCA International Users Group**.

15.1 PIXIT for Configuration

ID	Description	Value / Clarification
Cf1	Describe how the client handles nameplate configuration revision mismatches	**The client reads out data model at each associate and therefore does not need to check configuration revision.**
Cf2	Describe how the client handles report control block configuration revision mismatches	**RCB configuration is read out at each associate.**
	<additional items>	**The client does not use items of pre-defined data model if online read of data model fails. Preconfigured items are used according current online definition or omited if not available online.** **The SCL-file is used in Editor for pre-configuration of HMI projects, e.g. in driver configuration Wizard and in offline import of variables. Please refer client documentation for more details.**

15.2 PIXIT for Association model

ID	Description	Value / Clarification
As1	Garanteed number of servers that can set-up an association simultaneously (one association per server)	**per design: 65535** **tested: 1000**
As2	Lost connection detection time range (default range of TCP_KEEPALIVE is 1 – 20 seconds)	**current TCP timeout of Operating System and Ethernet equipment or, while no new MMS requests - TCP KeepAliveTime is 20s with 10 retries.**
As3	Describe the behavior when association fails	**Retry each 30 seconds** ▸ **if was associated longer as 30s: the**

ID	Description	Value / Clarification
		first retry is immediately; ▸ **else: 30s since previous TCP socket (re)open**
As4	Is authentication supported?	**Y**
As5	What is the maximum and minimum MMS PDU size?	Max MMS PDU size **65535** Min MMS PDU size **depends on size of largest DO in server's data model**
As6	What is the typical startup time after a power supply interrupt?	**The client works only together with the zenon Runtime, these are Windows applications.** **zenon Runtime + client may work on redundant PCs then by power loss or Hardware problem on main PC the secundary (standby) system takes (seamless) over.** 1. **Windows does not guarantee the files will be not corrupted after power failure. We recommend to use Redundant systems and/or an UPS to prevent loss of data stored on HDD.** 2. **The start-up time for the client depends of HMI project design and PC performance. In typical HMI projects client opens TCP/IP session to a server after few (1-4) seconds since application start.**
As7	How does the client disconnect from the server?	**service: Abort**

15.3 PIXIT for Server model

ID	Description	Value / Clarification
Sr1	Maximum object identification length?	**LD: 128 chars/octets** **FC: 2 chars/octets** **LN: 16 chars/octets**

ID	Description	Value / Clarification
		DO: 128 chars/octets **DA: 128 chars/octets** **in sum max 256 chars/octets (Symbolic Address)**
Sr2	Does client support autodescription?	**Y** **During association client always reads current data model of server via online services: GetServerDirectory and GetDataDirectory. During this process client skips not present LD and reads LN of created HMI variables; then skips not present DO and DA.** **After association client does not use items not present on server. The HMI variables, if created but mirroring non-existing items - have I-Bit*.**
Sr3	Describe how to view data values	**as value of HMI variable**
Sr4	What analogue value (MX) quality bits are used in the client?	▸ Y Good, ▸ Y Invalid, ▸ Y Reserved, ▸ Y Questionable ▸ Y Overflow ▸ Y OutofRange ▸ Y BadReference ▸ Y Oscillatory ▸ Y Failure ▸ Y OldData ▸ Y Inconsistent ▸ Y Inaccurate ▸ Y Process ▸ Y Substituted ▸ Y Test ▸ Y OperatorBlocked

ID	Description	Value / Clarification
Sr5	Which status value (ST) quality bits are used in the client?	▸ Y Good, ▸ Y Invalid, ▸ Y Reserved, ▸ Y Questionable ▸ Y BadReference ▸ Y Oscillatory ▸ Y Failure ▸ Y OldData ▸ Y Inconsistent ▸ Y Inaccurate ▸ Y Process ▸ Y Substituted ▸ Y Test ▸ Y OperatorBlocked
Sr6	Describe how to view/display quality values	1. **the status bits of */stVal variable in HMI, if created (only selected bits; please refer client documentation for more details)** 2. **the value of */q variable in HMI, if created**
Sr7	Describe how to force a SetDataValues request	**Set value to the variable created in HMI, e.g. via screen element or write set value function.**
Sr8	Describe how to force a GetDataValues request	**no need to force - client does automatically:** ▸ **client does GetDataValues periodically for all not reported FC$DO when at least one DA is mirrored to currently advised HMI variable.** ▸ **when no variables are currently advised, client uses GetDataValues(LLN0STMod$stVal) as automatic watchdog for**

ID	Description	Value / Clarification
		connection loss detection.
Sr9	Describe how to force a GetAllDataValues request	**service not used**
Sr10	Does the client support writing blkEna values?	Y
Sr11	Describe how the client behaves in case of:	**see also Sr2**
	▸ GetDataDefinition response-	▸ **service not used**
	▸ GetDataDefinition response+ with more or less attributes as expected	▸ **service not used**
	▸ GetLogicalDeviceDirectory response-	▸ **service not used**
	▸ GetAllDataValues response-	▸ **service not used**
	▸ GetAllDataValues response+ with more or less attributes as expected	▸ **service not used**
	▸ GetDataValues response-	▸ **log error entry; value of HMI variable will be not updated - have previously received value or null**
	▸ GetDataValues response+ with more or less attributes as expected	**to request process data the client uses GetDataValues on FC$DO, not DA level (see Sr8).** ▸ **HMI variables mirroring items not present in server's data model have I-Bit* (see Sr2) and are not requested** ▸ **items present in data model are requested but if not included in GetDataValue response then adequate HMI variables are not updated** ▸ **additional items are ignored.**
	▸ SetDataValues response-	▸ **log error entry**
Sr12	Which time quality attributes from the server are used in the client	▸ N Leap Second Known, ▸ Y ClockFailure

ID	Description	Value / Clarification
		▸ Y Clock not synchronized ▸ Y Accuracy
Sr13	Describe how to view time quality attributes	**client maps time quality bits received in t-attribute to status bits of HMI variables responding the same FC$DO as following:** ▸ **ClockNotSynchronised - status bit T_UNSYNC** ▸ **ClockFailure - status bit T_INVAL and HMI variable values have local timestamp** ▸ **Accuracy < 11111b - client truncates fraction of seconds of timestamp of HMI variable (option)**
	***I-Bit is status bit INVALID of HMI variables mirroring DO/DA. Please refer HMI documentation for more details.**	

15.4 PIXIT for Data set model

ID	Description	Value / Clarification
Ds1	Describe how to force a GetDataSetValues request	**service not used**
Ds2	Describe how to force a SetDataSetValues request	**service not used**
Ds3	Describe how to force a DeleteDataSet request	**client does it automatically when in client configuration user changes name and members for Dynamic Data Sets.**
Ds4	Describe how the client handles following dataset mismatches between the SCL and the data sets exposed via MMS: ▸ new dataset element ▸ missing dataset element ▸ Reordered dataset members in a dataset of a different data type	**No mismatch possible - client uses autodescription (see Sr2)**

ID	Description	Value / Clarification
	▸ Reordered dataset members in a dataset of the same data type	
Ds5	Describe how the client behaves in case of: ▸ GetLogicalNodeDirectory(DATA-SET) response- ▸ GetDataSetDirectory response- ▸ GetDataSetValues response- ▸ SetDataSetValues response-	**LOG entry + data will be polled (no reporting)**
Ds6	Maximum name length: ▸ for dataset ▸ for dataset member, including LD and FC	▸ **MMS: 128/16$128, HMI: 256** ▸ **MMS: 128/128, HMI: 256**
Ds11	Describe how to force a CreateDataSet request: 1. persistent 2. non-persisten	1. **client creates automatically new dataset before it enables the RCB where client is configured to use Dynamic Data Set; and when this dataset does not exist in IED yet.** 2. **not used**
Ds12	Describe how to force a DeleteDataSet request: 1. persistent 2. non-persisten	1. **before RCB enabling, client deletes automatically previously created datasets (having name with client's prefix) when this dataset is not to be used anymore.** 2. **not used**
Ds13	Describe how the client behaves in case of: ▸ CreateDataSet response- ▸ DeleteDataSet response-	▸ **log entry, RCB will be not enabled and data will be polled** ▸ **client retries to delete the data set by each next association**

15.5 PIXIT for Substitution model

ID	Description	Value / Clarification
Sub 1	Describe how to substitute a value	**following steps:** 1. **create HMI variables for attributes with FC=SV (*/subEna, subQ, subID and e.g. subVal)** 2. **set values in HMI variables (*/subVal, subQ, subID) to values the IED then shall use while substituting** 3. **set value TRUE to HMI variable */subEna.** **Please refer HMI documentation for more details about setting variable values**
	<additional items>	**Hint: when IED does not support substitution there is an alternative method in the HMI to substitute HMI variable values: a HMI variable can be switched to "alternative value" and than the HMI - and not IED - substitutes the value.** **Please refer description of status bit ALT_VAL in the HMI documentation for more details.**

15.6 PIXIT for Setting group control model

ID	Description	Value / Clarification
Sg1	How can the client be forced to send a GetLogicalNodeDirectory(SGCB) request	**service not used** **Note: to (re)read data model via GetDataDirectory force reconnect, e.g. using HMI "driver commands" to stop and start client**
Sg2	Describe how to change the active setting group	**set value of adequate variable in HMI project (ActSG or EditSG)**

ID	Description	Value / Clarification
Sg3	Describe how to get the actual setting group values	**create variables in the HMI project for adequate attributes and advise these variables**
Sg4	Describe how to edit setting group values	**set value of adequate variables in HMI project**
Sg5	Describe how the client behaves in case of: ▸ GetSGCBValues response- ▸ SelectEditSG response- ▸ SetEditSGValue response- ▸ SelectActiveSG response- ▸ ConfirmEditSGValues response-	**client uses autodescription and then requests only attributes present in server's data model. By write failure client logs error; by negative responses HMI variables are not updated.**
Sg6	Does the client read the optional ResvTms value?	**Yes, only if attribute is present and adequate variable is created in the HMI project**
	<additional items>	

15.7 PIXIT for Reporting model

ID	Description	Value / Clarification
Rp1	Does the client search for RCB in all logical nodes? If not, specify the logical nodes	**Y - All logical nodes** ▸ **LLN0 automatically by sufficient PDU size** ▸ **any LN when RCB name is defined in the client configuration and at least one variable in this LN with FC=BR/RP exists in HMI** ▸ **in addition: BRCBs in all LDevices/LN - if BRCB.RptID=zenon_computername_***
Rp2	Which dynamic RCB attributes are/can be configured by the client	**by client configuration:** ▸ **Y RptID**

ID	Description	Value / Clarification
		▸ Y DataSet ▸ Y Optional fields ▸ Y Trigger conditions ▸ Y Buffer time ▸ Y Integrity period
Rp3	Does the client support IED's with indexed and non-indexed report control blocks (RCB)	**Y Buffered RCB indexed** **Y Buffered RCB not indexed** **Y Unbuffered RCB indexed** **Y Unbuffered RCB not indexed**
Rp4	The supported trigger conditions are	**Y integrity** **Y data change** **Y quality change** **Y data update** **Y general interrogation**
Rp5	The minimum required optional fields are	**N sequence-number** **N report-time-stamp** **N reason-for-inclusion** **Y* data-set-name (*if RptID is not unique)** **N data-reference** **N buffer-overflow** **Y** entryID (**BRCBs only)** **N conf-rev** **client can process reports with any additional optional field, not only the minimum; the optional fields not required may be ignored.**
Rp6	Does the client support segmented reports	**Y**
Rp7	Does the client support pre-assigned RCB	**Y** **for more details see manual of IEC850 driver configuration wizard**
Rp8	Does the client support reported data set containing structured data objects or data attributes?	**Y reporting of data objects** **Y* reporting of data attributes** ***not recommended as this kind of dataset does not assure that each trigged report will contain current q and t attribute**

ID	Description	Value / Clarification
		values.
Rp9	Describe how the client does respond when an URCB is reserved by another client	**log entry + trying to use free one but only if configured to use automatic (not statical) enabling of URCBs.** **for statically assigned URCB see Rp10**
Rp10	Describe how the client does respond when a BRCB is reserved by another client	**log entry and 'connection state' indicator about failure; data will be polled** **optionally, per default each 7s, the client tries periodically to enable the RCB.**
Rp11	Describe how the client does respond on a SetBRCBValues(EntryID) respond-	**error log entry; as next client tries to enable BRCB anyway and sends GI; and process buffered data if IED reports whole contents of buffer**
Rp12	Describe how the client does respond when a report has an unknown: dataset, RptId, unexpexted number of dataset entries, and/or unexpexted data type format entries	**mismatches are not possible - client uses autodescription - see Sr2**
Rp13	Describe how the client detect reporting configuration changes (mismatches). Does it check the "configuration revision" attributes and/or does it check the dataset members? Is the dataset update done online or offline?	▸ **N* Check ConfRev** ▸ **Y Check dataset members** ▸ **online update at each associate** ***optionally, an unexpected change of ConfRev value, if created adequate HMI variable, may produce e.g. an user alarm**
Rp14	Describe how to force the client to change the RCB buffertime	**BufTm is a setting in the client configuration** **see also <addititonal items>**
Rp15	Does client set server TrgOps.GI prior to first issuance of GI command?	**Yes, if use of client's TrgOps is configured in the client configuration**
Rp16	Describe how to force the client to send the GI request	▸ **client does it automatically by enabling of RCB and by reconnect.** ▸ **GI on user demand - see <addititonal items>**
Rp17	Describe how to force the client to enable a	**settings in the client configuration**

ID	Description	Value / Clarification
	RCB	
Rp18	Describe how the client does respond when a report control block is renamed or deleted ▸ Does it prevent reading the deleted RCB ▸ If it reads the missing RCB, how does it handle the GetURCBValues or GetBRCBValues response-	▸ **no reading of deleted RCB** **during autodescription (see Sr2) client checks if all in client (statically) configured RCBs are existing in the IED's data model; if not: log entry and 'connection state' indicator about failure; data will be polled**
Rp19	Describe how the client behaves in case of: ▸ SetURCBValues response- ▸ Unsupported optional fields ▸ Unsupported trigger condition(s)	▸ **if SetURCBValues(RptEna) fails -> see Rp9 and Rp10** ▸ **if SetURCBValues(DataSet) fails -> error log entry; even when RCB is enabled data will be polled** ▸ **if SetURCBValues fails for other attributes -> client uses enabled RCB (like it is).** ▸ **client supports all OptFlds and TrgOps**
Rp20	Describe how the client behaves in case of: ▸ Buffer overflow	**LOG entry** **Note: by reconnect client acquires buffered data (EntryID) automatically and sends also GI. Buffer purge when EntryID not stored or by an option.**
Rp21	Describe how to force the client to send SetBRCBValues request for ▸ EntryID ▸ PurgeBuf	▸ **client sends by reconnect the last received EntryID auromaticaly** ▸ **client sends PurgeBuf automatically, but only by HMI start; this may be deactivated.** ▸ **PurgeBuf on user demand - see <addititonal items>**
Rp22	Does the client support writing resvTms	**Y** **only when client configuration ClientLN.iedName is empty**
Rp23	Does the client support reading owner	**N***

ID	Description	Value / Clarification
		see <additional items>; *compare Rp13
Rp24	Does the device function only as test equipment?	**N**
	<additional items>	**In addition to settings for RCBs in the client configuration, a user may create HMI variables for any attribute with FC=BR|RP (manually or by online import). Then in HMI the current value of RCB's attribute may be read; and may be written (e.g. GI)** **Note: written eventually only while RptEna is set to FALSE as else IED should refuse the updates of e.g. RptId, ResvTms etc.**

15.8 PIXIT for Logging model

ID	Description	Value / Clarification
	<additional items>	**logging services are not supported**

15.9 PIXIT for GOOSE control block model

ID	Description	Value / Clarification
	<additional items>	**system user may create HMI variables for any attribute with FC=GO (manually or by online import). Then in HMI the current values of GoCB's attributes may be read; and may be written (e.g. GoEna)** **Note: written eventually only while GoEna is set to FALSE as else IED should refuse the updates of e.g. GoID etc.**

15.10 PIXIT for Control model

ID	Description	Value / Clarification
Ctl1	What control modes are supported?	**Y status-only** **Y direct-with-normal-security** **Y sbo-with-normal-security** **Y direct-with-enhanced-security** **Y sbo-with-enhanced-security** **client checks current ctlModel value automatically and then executes command in corresponding control model; no need for additional configuration steps or pre-configuration from SCL** **see client documentation for more details**
Ctl2	Is Time activated operate (operTm) supported?	**N**
Ctl3	Is "operate-many" supported?	**N**
Ctl4	Can the client set the test flag?	**Y**
Ctl5	What check conditions can be set?	**Y** synchrocheck **Y** interlock-check **there are two methods to set check conditions:** **1. by setting a value to HMI variable */Oper.Check[CO] if created** **2. by configuring in Command Processing modul of HMI property 'Qualifier of Command'** **see HMI documentation for details**
Ctl6	Which originator categories are supported and what is the originator identification?	**orCat =2 (station control)*** **orIdent ='zenon: nnn'*** **where: nnn - computer name** **' - apostrophe (CHAR(27))** ***default value; is a setting in the Client configuration**
Ctl7	Describe if and how the client sets/increments the ctlNum	**by each use* of ctlVal the client increments ctlNum from 0 to 127 and next**

ID	Description	Value / Clarification
		turns to 0. *** also by ctlModel=0 (no control possible)**
Ctl8	What does the client when its receives a LastApplicationError and describe how to view the additional cause?	**HMI user may create an internal "Command Info" variable (pro */Oper structure) for received AddCause item value and variables ControlRun and ControlState showing current state and success/fail of command. These internal variables can be displayed and/or stored** **see client documentation for more details**
Ctl9	What does the client when its receives a Select, SelectWithValue or Operate respond negative ?	**client sets corresponding values to intern "Command Info" (see Ctl8) variables ControlRun (-1=error) and AddCause; optionally writes a log entry and sets by HMI variable Oper.ctlVal status bit N_CONF** **see client documentation for more details**
Ctl10	Can the client change the control model via online services?	**Y**
Ctl11	What does the client when the ctlModel is not initialized in the SCL?	**client does not need ctlModel value in SCL; client checks current ctlModel value automatically via online services each time before is executing command; no mismatch possible**
Ctl12	What does the client when the ctlModel in SCD and in SERVER SIMULATOR is different?	**see Ctl11**
Ctl13	Describe how to view a - CommandTermination request+ - CommandTermination request- - TimeActivatedOperateTermination request+ and request-	- **CommandTermination reception is visible in 'Command Info' internal HMI variables (see Ctl8); it may ends action timeout in HMI modul Command Processing, if used** - **service TimeActivatedOperate is not supported** **Note: there is no special handling for**

ID	Description	Value / Clarification
		negative response, only AddCause update (if server sends some). By use of Command Processing module for final success (or failure) of commnand the change of related ST/MX attribute cares.
	<additional items>	

15.11 PIXIT for Time and time synchronization model

ID	Description	Value / Clarification
Tm1	Described how to view the internal time & quality or how to expose the timestamp and timestamp quality via the IEC 61850 interface	▸ **View: client uses Windows time (local PC clock) and does not cooperate directly with a SNTP application. In HMI a user may create additional dynamical elements to view internal PC time and check clock quality using tools of own choice, e.g. SCADA Logic.** ▸ **Expose: in Operate and SelectWithValue services, client uses current value of additional HMI variables 'Settings': TimeQuality and TimeAccuracy.**
Tm 2	What time quality bits are supported?	**In Operate and SelectWithValue services variable TimeQuality may* update:** ▸ **Y LeapSecondsKnown** ▸ **Y ClockFailure** ▸ **Y ClockNotSynchronized** ***depending e.g. SNTP agent installed on the PC with HMI and user-implemented solution.**
Tm 3	What is the behavior when the time synchronization signal/messages are lost?	▸ **PC (Windows) internal clock runs not synchronized anymore** ▸ **local SNTP agent can detect the signal loss and this information can be processed in HMI**

ID	Description	Value / Clarification
		▸ **as result in HMI the variable TimeQuality may change value, if user adequate designed HMI project**
Tm 4	When is the quality bit "Clock failure" set?	**Optionaly HMI may force the Client to set ClockFailure (TimeQuality bit 1) when PC clock was reseted or for test purpose.** **see <additional items>**
Tm 5	When is the quality bit "Clock not synchronised" set?	**TimeQuality bit 2 set if SNTP agent informs HMI that it detects the loss of time synchronization signal**
	<additional items>	**Note: practical use for commands given from HMI on Windows PC has only ClockNotSynchronized:** ▸ **PC having severe Hardware problem - resulting in ClockFailure - is probably no more able to work in general. We recommend to use Redundant systems - compare As6.**

15.12 PIXIT for File transfer model

ID	Description	Value / Clarification
Ft1	Describe when or how to force the client to request GetServerDirectory(FILE) and what it does with the responded filenames	**client gives possibility to create two internal 'File transfer' string variables: a Command and a Directory variable. Setting value of Command to: "DIR <fileSpec>" results with the name or list of files in Directory variable** **see client documentation for more details**
Ft2	Does the client uses a wildcard in the GetServerDirectory(FILE) request	**No**
Ft3	Does the client support IED's that include the path in the file name in the GetServerDirectory(FILE) respond?	▸ **Y path included** ▸ **Y path not included**

ID	Description	Value / Clarification
		▸ **Y list of files with a char separator**
Ft4	Does the client support IED's that use the fileseparator	▸ **N** "/" ▸ **Y** "\"
Ft5	What is the maximum file name size including path	**Operating System limit (Windows)**
Ft6	Can the client read a file with size 0	**Y**
Ft7	Are directory/file name case sensitive	**Not case sensitive** **only Command value is case sensitive: "DIR <fileSpec>" or "GET <fileSpec>", the <fileSpec> is not case sensitive**
Ft8	Maximum file size	**per design 4 GB** **tested* 25 MB** *** transfer of 25 MB may take about 30 seconds, bigger transfer per single file wasn't tested**
Ft9	Describe how the client behaves in case of: ▸ GetFile response- ▸ GetFileAttributes response- ▸ SetFile response-	▸ **Command variable value changes to "GET ERROR" or "DIR ERROR" (or "DEL ERROR" by service DeleteFile)** ▸ **SetFile is not supported**
	<additional items>	**For DeleteFile set Command variable value to "DEL <fileSpec>"**

15.13 PIXIT for Service Tracking model

ID	Description	Value / Clarification
Tr1	Which tracking services are supported by the client: ▸ BrcbTrk ▸ UrcbTrk ▸ LocbTrk ▸ GocbTrk	▸ Y* - BrcbTrk ▸ Y* - UrcbTrk ▸ Y* - LocbTrk ▸ Y* - GocbTrk ▸ Y* - MsvcbTrk

ID	Description	Value / Clarification
	▸ MsvcbTrk ▸ UsvcbTrk ▸ SgcbTrk ▸ SpcTrk ▸ DpcTrk ▸ IncTrk ▸ EncTrk ▸ ApcFTrk ▸ ApcIntTrk ▸ BscTrk ▸ IscTrk ▸ BacTrk ▸ GenTrk	▸ Y* - UsvcbTrk ▸ Y* - SgcbTrk ▸ Y - SpcTrk ▸ Y - DpcTrk ▸ Y - IncTrk ▸ Y - EncTrk ▸ Y - ApcFTrk** ▸ Y - ApcIntTrk** ▸ Y - BscTrk ▸ Y - IscTrk ▸ Y - BacTrk ▸ Y - GenTrk ***) per default only CST attributes, the rest of data attributes optionally.** ****) hint: attributes ctlVal.i and ctlVal.f are not included in "allCTS[SR]", create separatelly.** **See Tr2 and client documentation for more details.**
Tr2	Describe how to view the tracking objects or their attributes	**in additional HMI variables with reference: *LN/DO_xxx[SR] and 'driver object type' = 'service tracking', where xxx is "allCTS" or name of data attribute in CTS class or in another common data class possible in LTRK.** **See client documentation for more details**
	<additional items>	

16 Appendix E - TICS

This document specifies the TICS of the IEC 61850 interface in the client system: "**zenon Supervisor**/*Energy Edition*", Version *8.00*, further referred to as "Client". The zenon Editor and Runtime are further referred to as "HMI".

MANDATORY EDITION 2 TISSUES

Below tables give an overview of the applicable mandatory Tissues.

SUPPORTED BY CLIENT:

- **"Y":** means that the client supports servers that have implemented the respective tissue.
- **"ni":** No impact on testing
- **"na":** not applicable if the client does not support the corresponding ACSI service(s)

16.1 Part 6

Tissue	Description	Supported by client
658	Tracking related features	Y
663	FCDA element cannot be a "functionally constrained logical node"	Y
668	Autotransformer modeling	Y
719	ConfDataSet - maxAttributes definition is confusing	na
721	Log element name	na
768	bType VisString65 is missing	Y
779	object references	na
788	SICS S56 from optional to mandatory	Y
789	ConfLdName as services applies to both server and client (supportsLdname)	Y
804	valKind and IED versus System configuration (valimport)	na
806	Max length of log name inconsistent between -6 and -7-2	ni
807	Need a way to indicate if "Owner" present in RCB	Y

Tissue	Description	Supported by client
822	Extension of IED capabilities	Y
823	ValKind for structured data attributes	Y
824	Short addresses on structured data attributes	Y
825	Floating point value	Y
845	SGCB ResvTms	Y
853	SBO and ProtNs	Y
855	Recursive SubFunction	na
856	VoltageLevel frequency and phases	ni
857	Function/SubFunction for ConductingEquipment	na
886	Missing 8-1 P-types	Y
901	tServices as AP or as IED element	Y
936	SupSubscription parameter usage is difficult	na
1175	IPv6 address lowercase only	na

16.2 Part 7-1

Tissue	Description	Supported by client
828	Data model namespace revision IEC 61850-7-4:2007[A]	Y
1151	simulated GOOSE disappears after 1st appearance when LPHD.Sim = TRUE	na
1196	Extensions to standardized LN classes made by third parties	na

16.3 Part 7-2

Tissue	Description	Supported by client
778	AddCause values – add value not- supported	Y
780	What are unsupported trigger option at a control block?	na
783	TimOper Resp- ; add Authorization check	na
786	AddCause values 26 and 27 are switched	Y
820	Mandatory ACSI services (use for PICS template)	Y
858	typo in enumeration ServiceType	ni
861	dchg of ConfRev attribute	Y
876	GenLogiclNodeClass and SGCB, GoCB, MsvCB, UsvCB	ni
1038	Loss of Info Detection After Resynch	Y
1062	Entrytime not used in CDC	ni
1071	Length of DO name	ni
1091	The sentence "The initial value of EditSG shall be 0", has to be stated in part 7.2 not in 8.1	Y
1127	Missing owner attribute in BTS and UTS	Y
1163	Old report in URCB	ni
1202	GI not optional	ni

16.4 Part 7-3

Tissue	Description	Supported by client
697	persistent command / PulseConfig	Y
698	Wrong case is BAC.dB attribute	Y
722	Units for 'h' and 'min' not in UnitKind enumeration.	ni
919	Presence Condition for sVC	ni

Tissue	Description	Supported by client
925	Presence of i or f attribute - Problem with writing	Y
926	Presence Conditions within RangeConfig	Y

16.5 Part 7-4

Tissue	Description	Supported by client
671	mistake in definition of Mod & Beh	Y
674	CDC of ZRRC.LocSta is wrong	Y
675	SIML LN	ni
676	Same data object name used with different CDC	Y
677	MotStr is used with different CDC in PMMS and SOPM LN classes	Y
679	Remove CycTrMod Enum	Y
680	SI unit for MHYD.Cndct	ni
681	Enum PIDAlg	ni
682	ANCR.ParColMod	ni
683	Enum QVVR.IntrDetMth	ni
685	Enum ParTraMod	ni
686	New annex H - enums types in XML	Y
694	Data object CmdBlk	ni
696	LSVS.St (Status of subscription)	ni
712	interpretation of quality operatorBlocked	Y
713	DO Naming of time constants in FFIL	Y
724	ANCR.Auto	Y
725	Loc in LN A-group	Y
734	LLN0.OpTmh vs. LPHD.OpTmh	Y

Tissue	Description	Supported by client
735	ISAF.Alm and ISAF.AlmReset	Y
736	PFSign	Y
742	GAPC.Str, GAPC.Op and GAPC.StrVal	Y
743	CCGR.PmpCtl and CCGR.FanCtl	Y
744	LN STMP, EEHealth and EEName	Y
772	LPHD.PwrUp/PwrDn shall be transient	Y
773	Loc, LocKey and LocSta YPSH and YLTC	Y
774	ITCI.LocKey	Y
775	KVLV.ClsLim and OpnLim	ni
776	LPHD.OutOv/InOv and LCCH.OutOv/InOv	ni
800	Misspelling in CSYN	Y
802	CCGR and Harmonized control authority	Y
808	Presence condition of ZMOT.DExt and new DOs	Y
831	Setting of ConfRevNum in LGOS	Y
838	Testing in Beh=Blocked	Y
844	MFLK.PhPiMax, MFLK.PhPiLoFil, MFLK.PhPiRoot DEL->WYE	Y
849	Presence conditions re-assessing in case of derived statistical calculation	Y
877	QVUB -settings should be optional	Y
909	Remove ANCR.ColOpR and ColOpL	Y
920	Resetable Counter is NOT resetable	Y
932	Rename AVCO.SptVol to AVCO.VolSpt	Y
939	Change CDC for ANCR.FixCol	Y
991	LGOS: GoCBRef (as well as LSVS.SvCBRef) should be mandatory	ni
1007	PTRC as fault indicator - Update of description required	ni

Tissue	Description	Supported by client
1044	TapChg in AVCO	Y
1077	Rename DOnames within LTIM	Y

Information

Tissues 675, 735, 772, 775, 776, 878 are not relevant for conformance testing

16.6 Part 8-1

Tissue	Description	Supported by client
784	Tracking of control (CTS)	Y
817	Fixed-length GOOSE float encoding	Y
834	File dir name length 64	Y
951	Encoding of Owner attribute	Y
1040	More associate error codes	Y
1178	Select Response+ is non-null value	Y