

# **61850 Avenue 2.1**

## **Substation Communication Tool**

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### **User guide**

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# INFO TECH sp.j.

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- ❑ Experts in the field of communication solutions for power automation and industrial automation.
- ❑ Renowned supplier of protocol software libraries and tools for communication testing and device simulation.
- ❑ As of October 2023, the licensed INFO TECH software is the basis for implementing IEC 61850 interfaces in the products of 53 companies and institutions from 15 countries of Europe, Asia and North America.
- ❑ INFO TECH offers also:
  - **Hands-on trainings** on IEC 61850 communication,
  - **Conformance testing** of the IEC 61850 interfaces,
  - **Audits and diagnostics of systems** using IEC 61850 communication.

# Product from the renowned supplier of communication software libraries and testing tools for automation systems

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Other known products from this area:

- ❑ **IEC 61850 Software Library (source code)**
- ❑ **61850 CCC** – IEC 61850 client DLL for PC/MS Windows
- ❑ **61850 SCC** – IEC 61850 server DLL for PC/MS Windows
- ❑ **61850 SCL Runner** – simulator of IEC 61850 server devices based on their description in SCL files
- ❑ **61850 GOOSE System Viewer** – visualization and monitoring of GOOSE communication based on SCD file
- ❑ **ProTester** – simulation tools for master and slave stations of protocols operating on serial and TCP/IP based networks (DNP3, IEC-104, IEC-101, IEC-103, Modbus, SPA-bus)
- ❑ **ProtAn** – protocol analyzer for serial asynchronous communication (RS-232, RS-485)
- ❑ **ProtAn for Ethernet** – protocol analyzer for Ethernet networks

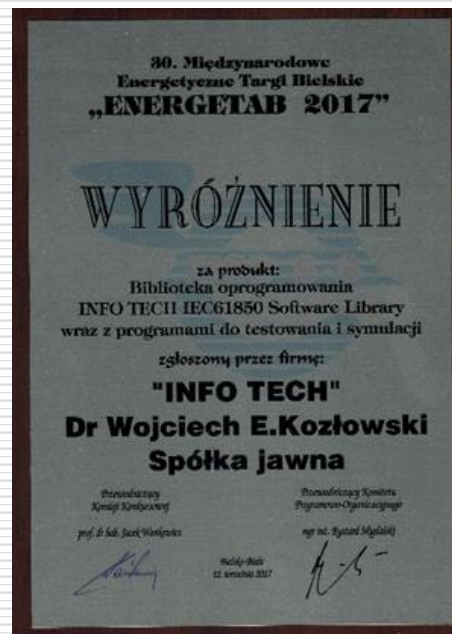
# 61850 Avenue toolset

- ❑ **61850 Avenue:** set of tool programs for testing IEC 61850 communication, developed with the use of **INFO TECH IEC61850 Software Library**
- ❑ First tool of the package - **61850 Avenue client tool:** beta version supplied to selected customers already in January 2007
- ❑ First official release: May 2007 (together with **61850 Relay Simulator**)
- ❑ **GOOSE toolset:** added in January 2008
- ❑ **Sampled Values toolset:** added in December 2011
- ❑ **File Transfer toolset:** added in February 2012
- ❑ **61850 Avenue 2.0:** released in April 2013
  - Added support of **Edition 2.0**
  - Added message logging
  - Added Process Data View
- ❑ **Update of IEC 61850 client GUI:** version **2.1** released in April 2018
- ❑ **Routable GOOSE and Routable SV** options added in September 2019
- ❑ Support of **Edition 2.1** in the release of January 2021
- ❑ **Secure client-server communication (TLS and ACSE)** added in May 2022
- ❑ Added **cyclic data polling** to Process Data View: added in February 2023

The name **61850 Avenue** was adopted to the whole toolset package.

# Awarded product

- INFO TECH IEC61850 Software Library (source code) together with the testing and simulation toolsets (61850 Avenue and 61850 SCL Runner) – was honored with a prestigious award – **Honorable Commendation of the International Power Industry Fair ENERGETAB 2017**



# Wide applicability of the toolset

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- Suitable for:
  - testing devices and systems with IEC 61850 communication,
  - commissioning of IEC 61850 based systems,
  - development projects implementing IEC 61850 communication,
  - verification of product conformance with the IEC 61850 standard,
  - practical learning of the IEC 61850 standard.
- Truly easy to learn and apply ...
- All programs include the **context help function** invokable with **F1** key.

# 61850 Avenue

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Your safe and easy road to learn and use the IEC 61850 standard.

Welcome!



# Installation procedure

Supported platforms:

PC running

**MS Windows**

**7, 8, 10 and 11.**

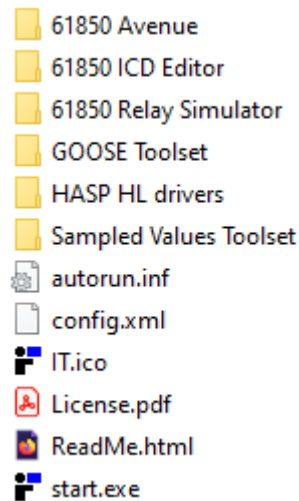


# To install the software

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From the supplied CD: possible start in autorun mode.

Alternatively: invoke the program **start.exe** from the installation package directory



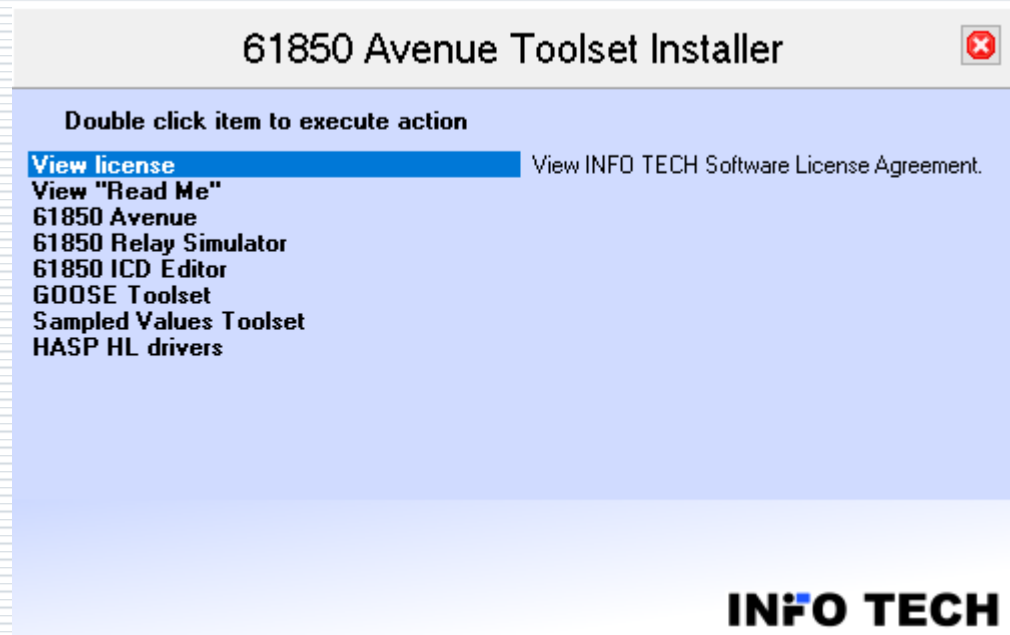
# License

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- ❑ **Before installing the software please learn and accept the licensing terms described in the paper note attached to the CD and/or in the file **License.pdf****
- ❑ Please acknowledge the following notice concerning the USB license key:
  - The supplied license key represents the value you have purchased. Please take care of it and protect it from losing or damaging like any other object of value. Please understand that we cannot replace lost, corrupted or physically damaged keys.

# Installation steps

- ❑ After starting the installation program the following list of documents, applications and drivers will be displayed – it is possible to install only selected tool programs and omit those which will not be used.
- ❑ At first, read the license agreement.



# Third party components

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- ❑ **HASP HL drivers** – to manage the USB license key
- ❑ **WinPcap 4.1.3** used by Relay Simulator, GOOSE toolset, SV toolset (alternatively, it is possible to use Win10Pcap or Npcap if already installed)

# IEC 61850 client tool (**61850 Avenue**)

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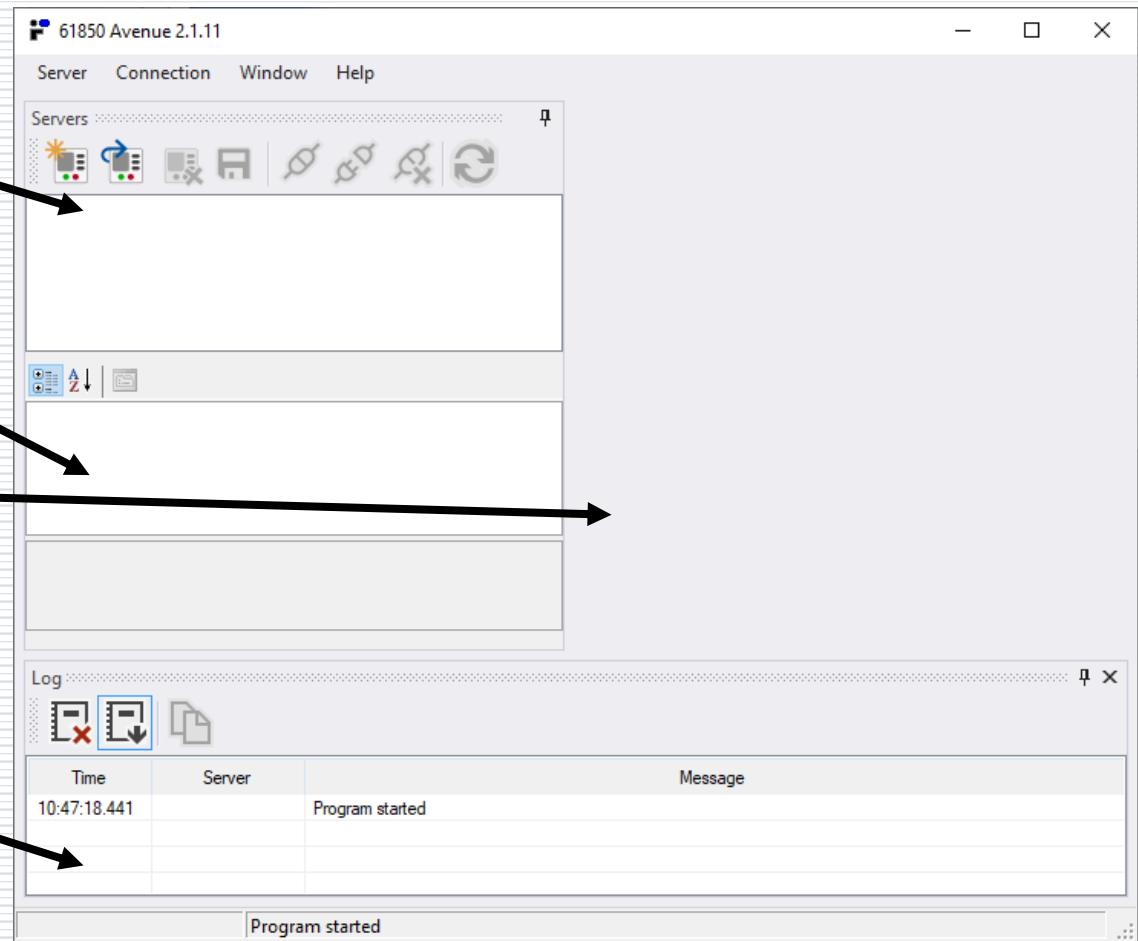
# Initial view after the first start-up of 61850 Avenue client

**Servers** – window with the list of server devices to communicate with.

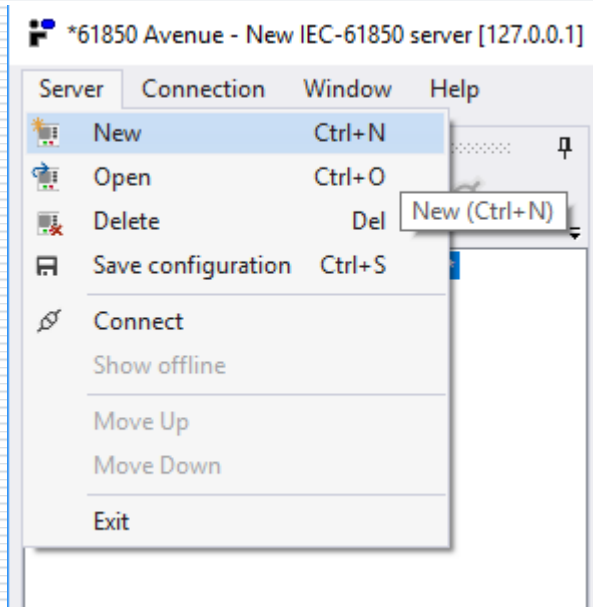
**Properties** – window with the list of connection parameters of the selected server (connection parameters can be saved in the configuration file).

**Main operation view** – for folders with server data models.

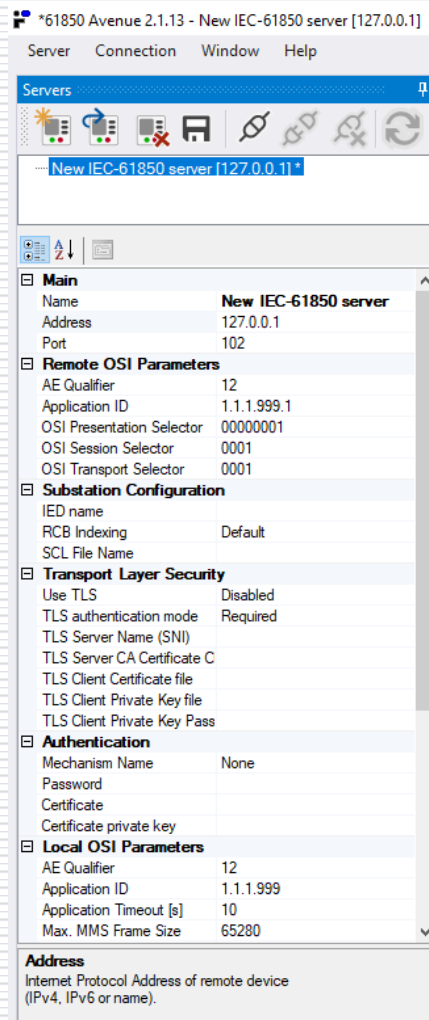
**Log view** – chronological view of operations (commands, responses and events) occurring during the interactions with server devices.



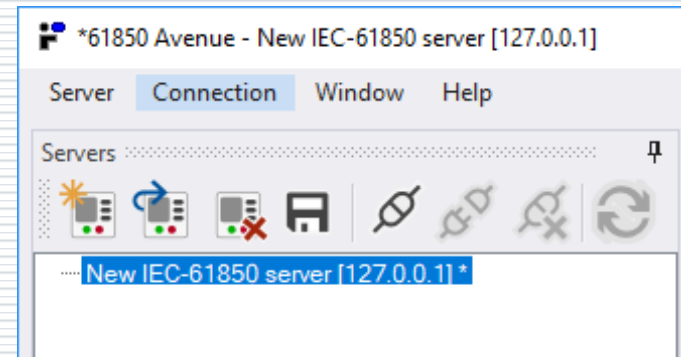
# Connection to a new server device with data model browsing



From **Server** menu select **New** command to define a new server device.



A new server IED with the name **New IEC-61850 server** and IP address **[127.0.0.1]** will appear in **Properties** window.



\* **after** the name of the IED server device means **unsaved configuration**.

# Assigning target name and IP address to a new server device for browsing

In **Servers** window write the target device name in place of default **New** **IEC-61850 server** and the target IP address in place of **127.0.0.1**.

The screenshot shows the 'Servers' window with a list of servers. The selected server is 'Tested\_Relay [127.0.0.1]'. The configuration details are as follows:

Main	
Name	Tested_Relay
Address	127.0.0.1
Port	102

Remote OSI Parameters	
AE Qualifier	12
Application ID	1.1.1.999.1
OSI Presentation Selector	00000001
OSI Session Selector	0001
OSI Transport Selector	0001

Substation Configuration	
IED name	
RCB Indexing	Default
SCL File Name	

Transport Layer Security	
Use TLS	Disabled
TLS authentication mode	Required
TLS Server Name (SNI)	
TLS Server CA Certificate C	
TLS Client Certificate file	
TLS Client Private Key file	
TLS Client Private Key Pass	

Authentication	
Mechanism Name	None
Password	

**Name**  
Name of the server for easy identification.



Now the client-server connection can be established: in **Server** window from context menu of the selected device invoke the command **Connect**

# Secure communication using TLS (encryption)

For using TLS to connect to the server, set the **Use TLS** parameter to **Enabled**. This parameter is part of the **Transport Layer Security** section of the Server Communication Profile.

Enabling TLS changes automatically communication port to default for TLS (3782). Disabling TLS returns the default port to 102. Other TLS configurable parameters:

**TLS authentication mode** – selection between **Required** authentication using TLS CA certificate or **Optional**.

**TLS Server Name (SNI)** – TLS Server Name Indication.

**TLS CA certificates files** – file with a chain of certificates used to verify the certificate of the server to which the client connects.

**TLS Server CRL Chain** – file with a chain of certificates used to verify the revocation status of SSL/TLS certificates.

**TLS own certificates files** – client's certificate file.

**TLS private key** – client's private key file.

**TLS private keyphrase** – the password used to decrypt the client's private key.

**TLS Session Keys file** – path to a file containing the TLS session keys.

The screenshot shows the configuration window for a 'New IEC-61850 server' with IP 127.0.0.1. The 'Main' section shows the name 'New IEC-61850 server', address '127.0.0.1', and port '3782'. The 'Transport Layer Security' section is expanded and highlighted with a blue box, showing the following settings:

Parameter	Value
Use TLS	Enabled
TLS authentication mode	Required
TLS Server Name (SNI)	
TLS Server CA Certificate Chain	D:\certificates\ca.pem
TLS Server CRL Chain	D:\certificates\crl.pem
TLS Client Certificate file	D:\certificates\client.pem
TLS Client Private Key file	D:\certificates\client.key
TLS Client Private Key Passphrase	
TLS Session Keys file	D:\session key file.TXT

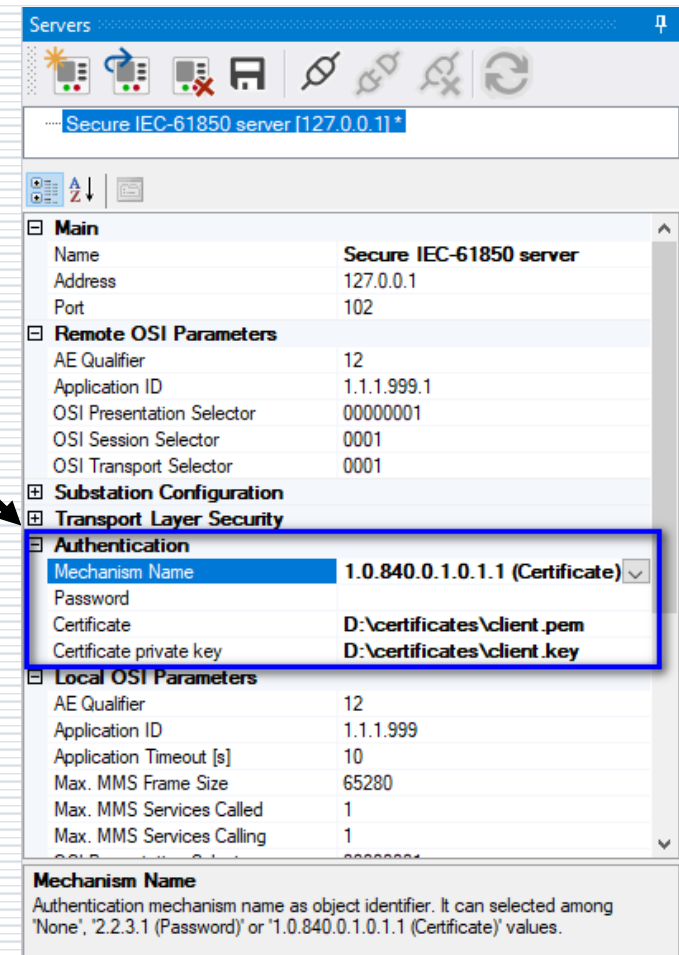
Below this, the 'Authentication' section shows 'Mechanism Name' as 'None'. The 'Local OSI Parameters' section shows 'AE Qualifier' as '12' and 'Application ID' as '1.1.1.999'. At the bottom, there is a 'Use TLS' checkbox labeled 'TLS usage.'.

# Secure communication using ACSE (authentication)

Use of ACSE for authentication:

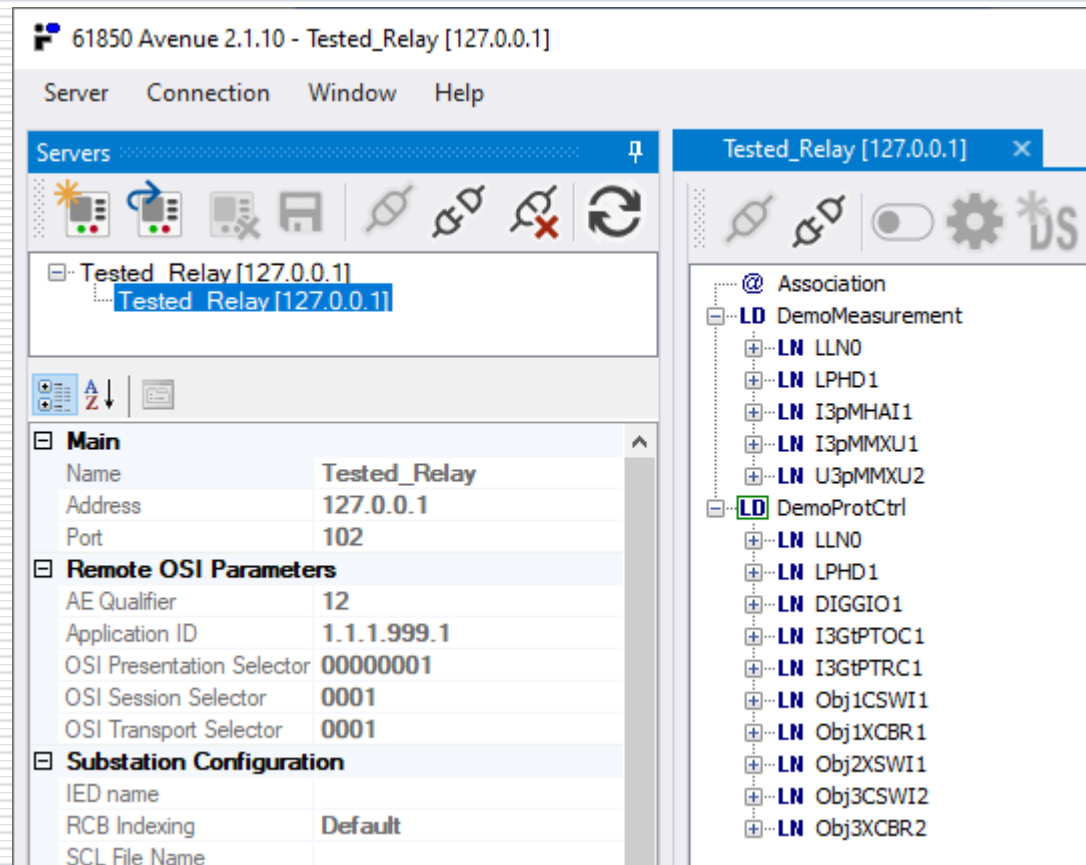
- select mechanism based on certificates\*,
- provide certificate of the client,
- provide private key of the client.

\*Integration of the IEC 62351 standard, specifically adhering to the IEC 62351-4:2018/AMD1:2020. This amendment of Part 4 presents supplementary guidance and updates designed to strengthen the security of communication within industrial automation and control systems.

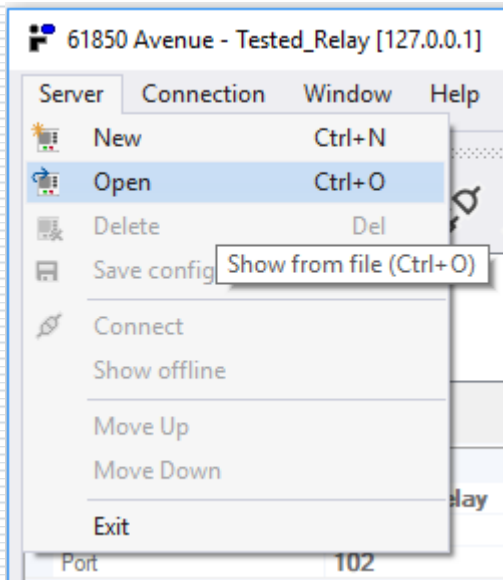


# Server device data model displayed after connecting and browsing

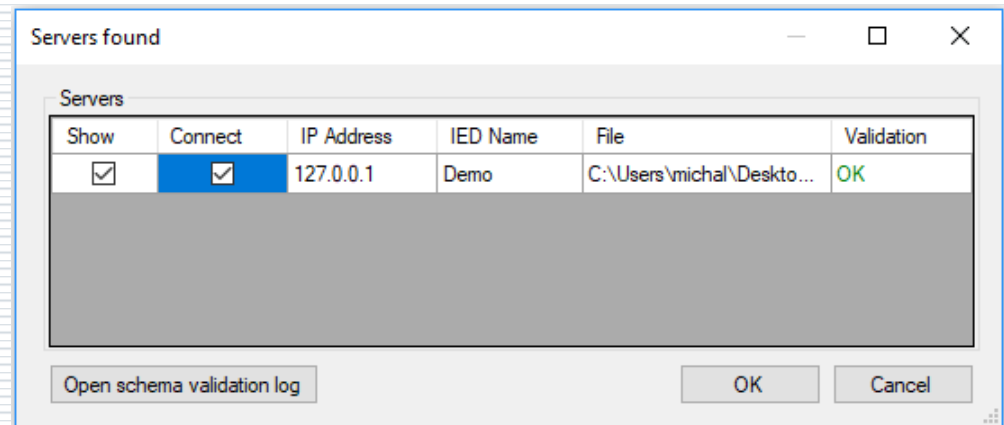
Fast exploration of the server device data model.



# Connection to a new server device using its SCL description file



Invoke **Open** command and select an SCL file describing the server device.



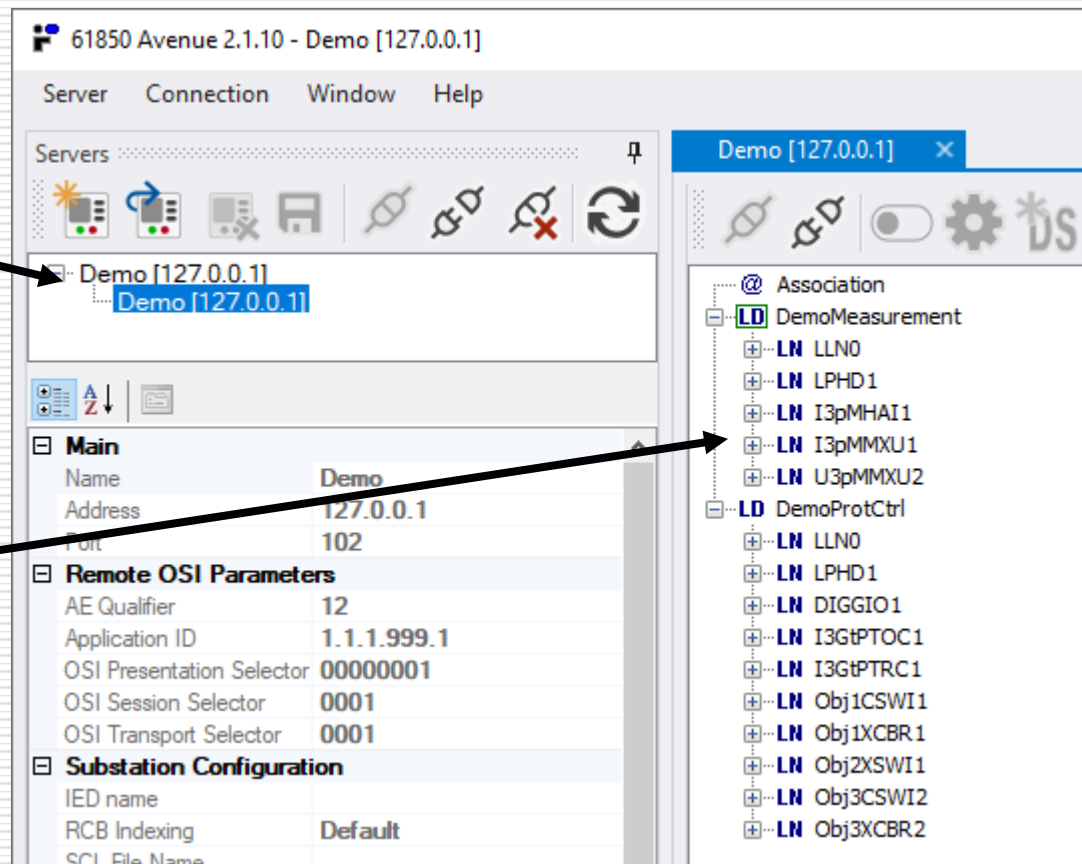
After selecting the file set check boxes:

- **Show** - to display the server preview (offline mode),
- **Connect** - to automatically connect to the server.

# Explanation of Show and Connect options

After selecting the **Connect** option, the client will be automatically connected to the server.

When the **Show** option is checked, the device data model will appear in the **Main** operation view.



# Connection establishing after importing SCL file

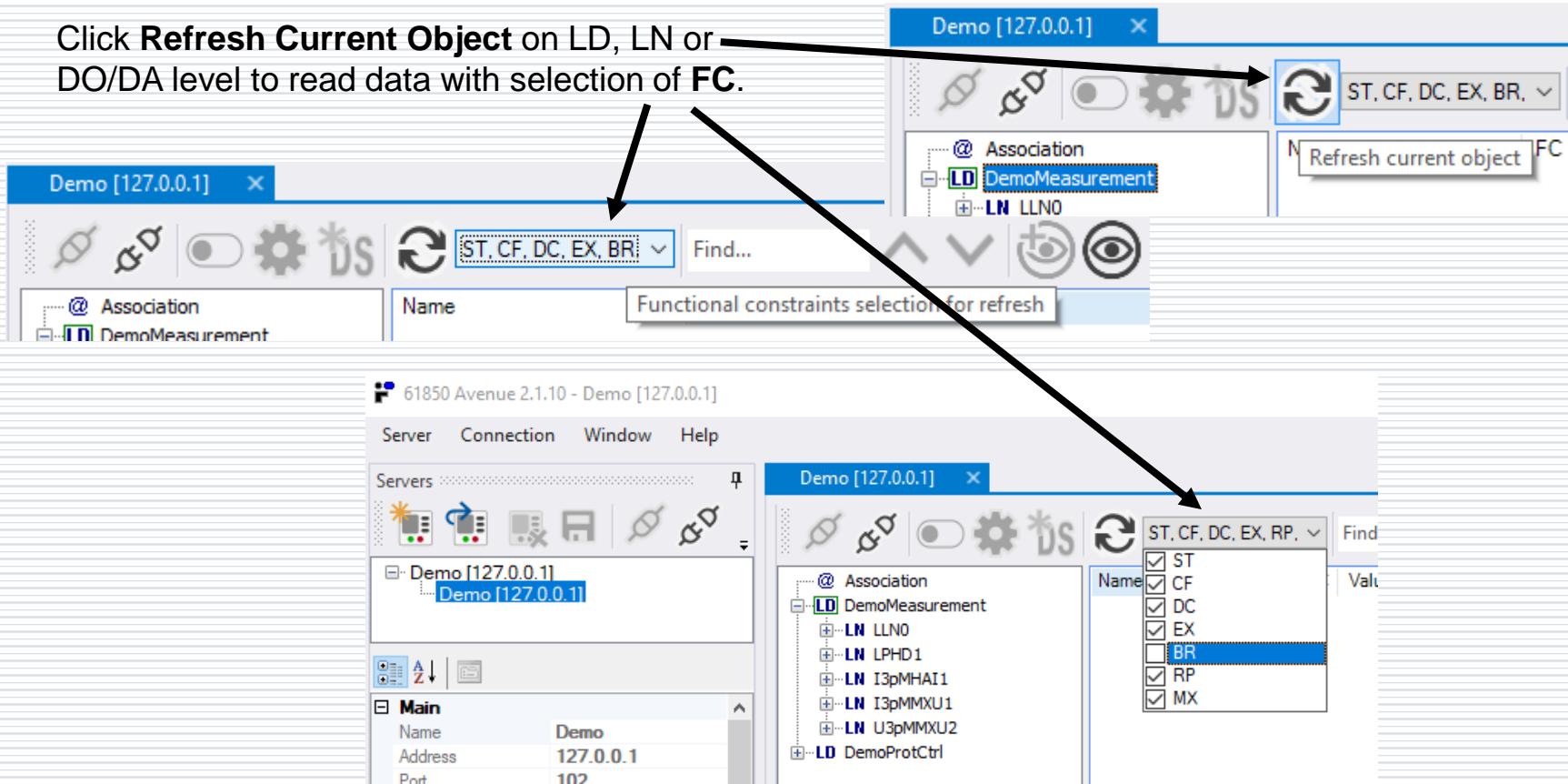
Click **Connect** icon to connect with the device in the network

The screenshot displays the 61850 Avenue 2.1.10 - Demo [127.0.0.1] software interface. The main window shows a tree view of the demo structure, including 'Demo [127.0.0.1]' and 'DemoProtCtrl'. The 'DemoProtCtrl' node is expanded, showing a list of objects and their values. The 'Connect' icon (a blue circle with a white 'X') is highlighted in the top right corner of the interface. An arrow points from the text 'Click **Connect** icon to connect with the device in the network' to this icon. Another arrow points from the text 'Off-line model browsing possible.' to the 'DemoProtCtrl' node in the tree view.

Name	FC	Value
DemoProtCtrl/Ob...	ST	{stVal=1
DemoProtCtrl/Ob...	ST	{stVal=1
DemoProtCtrl/LL...	ST	{stVal=f
DemoProtCtrl/I3...	ST	{stVal=c
DemoProtCtrl/I3...	ST	{general
DemoProtCtrl/I3...	ST	{general
DemoProtCtrl/I3...	ST	{general
DemoProtCtrl/Ob...	ST	{stVal=1
DemoProtCtrl/Ob...	ST	{stVal=1

# Refresh Current Object on LD, LN or DO/DA

Click **Refresh Current Object** on LD, LN or DO/DA level to read data with selection of **FC**.



# Data model view

**True data model** as defined in IEC 61850-7.

No confusion with MMS Named Variable space.

The tool can maintain connections to multiple server devices.

The screenshot displays a software interface for a data model. The left pane shows a hierarchical tree structure under the root '@ Association'. The tree includes nodes for 'DemoMeasurement' (with sub-nodes LLN0, LPHD1, I3pMHAI1, and I3pMMXU1), 'DemoProtCtrl' (with sub-nodes LLN0, LPHD1, DIGGIO1, I3GtPTOC1, I3GtPTRC1, LTRK1, and Obj1CSWI1), and 'U3pMMXU2'. The 'I3pMMXU1' node is expanded, showing sub-nodes 'Mod', 'Beh', 'Health', 'NamPlt', and 'A'. The 'A' node is further expanded, showing 'phsA', 'phsB', and 'phsC'. The 'phsC' node is selected, and its details are shown in the right pane.

Name	FC	Value
Mod		{stVal=on, q=00000000000000 {Good, Process}, t=20...
Beh		{stVal=on, q=00000000000000 {Good, Process}, t=20...
Health		{stVal=Ok, q=00000000000000 {Good, Process}, t=20...
NamPlt		{vendor=INFO TECH, swRev=1.0, d=Current measur...
A		{phsA={cVal={mag={f=0}}, q=00000000000000 {Good, ...
phsA		{cVal={mag={f=0}}, q=00000000000000 {Good, Proce...
phsB		{cVal={mag={f=0}}, q=00000000000000 {Good, Proce...
phsC		{cVal={mag={f=0}}, q=00000000000000 {Good, Proce...
cVal	MX	{mag={f=0}}
q	MX	00000000000000 {Good, Process}
t	MX	2020-12-14 07:17:59.403 [Leap Second Known][Tim...
units	CF	{SIUnit=A}
d	DC	Phase C current
d	DC	3 phase current

# Possible simultaneous connections with multiple servers

In **Main operation view** the tabs of server devices can be arranged as preferred by the tool user.

The screenshot displays the INFO TECH software interface with multiple server connection tabs open. The tabs include 'Demo [127.0.0.1]', 'RegrTestEd2 [192.168.11.158]', and 'mo [127.0.0.1]'. The 'Demo [127.0.0.1]' tab is active, showing a tree view of the server structure with nodes like 'Association', 'DemoMeasurement', 'LLNO', 'LPHD1', 'I3pMHAI1', 'I3pMMXU1', 'Mod', 'Beh', 'Health', 'NamPlt', 'A', 'phsA', 'phsB', 'phsC', 'U3pMMXU2', 'DemoProtCtrl', 'LLNO', 'LPHD1', 'DIGGIO1', and 'I3GtPTOC1'. The 'RegrTestEd2 [192.168.11.158]' tab is also visible, showing a similar tree view. The 'mo [127.0.0.1]' tab is partially visible, showing a tree view with nodes like 'Association', 'DemoMeasurement', 'LLNO', 'LPHD1', 'I3pMHAI1', 'I3pMMXU1', 'Mod', 'Beh', 'Health', 'NamPlt', 'A', 'phsA', 'phsB', 'phsC', 'U3pMMXU2', 'DemoProtCtrl', 'LLNO', 'LPHD1', 'DIGGIO1', and 'I3GtPTOC1'. The interface also includes a 'Servers' list, a 'Connection' panel, and a 'Window' panel. The 'Connection' panel shows details for the selected server, including 'Name', 'IP Address', 'Port', 'OSI Parameters', 'Station Configuration', and 'Transport Layer Security'. The 'Window' panel shows a list of server devices and their properties.

**Server List:**

Name	IP Address	Port
Demo	127.0.0.1	102

**Station Configuration:**

Parameter	Value
Name	Demo
Indexing	Default
File Name	

**Transport Layer Security:**

Parameter	Value
Authentication	Required
CA certificates	
Own certificates	
Private key	

# Reporting function in IEC 61850

Reporting services as defined in IEC 61850-7-2.

Reporting configuration can be invoked from the context menu of a chosen rcb or using the program icon.

The screenshot displays the IEC 61850 configuration software interface. The top toolbar contains icons for various functions, including a gear icon for configuration. The left pane shows a hierarchical tree view of the configuration, with 'Demo [127.0.0.1]' selected. The right pane shows a table of parameters and their values.

Name	FC	Value
RptID	BR	
RptEna	BR	false
DatSet	BR	DemoMeasurement/LLN0.DS1_Measurement
ConfRev	BR	1
OptFlds	BR	0111111111 {sequence-number, report-time-stam...
BufTm	BR	1000
SqNum	BR	0
TrgOps	BR	011111 {data-change, quality-change, data-update...
	BR	0
	BR	false
	BR	false
	BR	0000000000000001
	BR	2020-12-14 07:17:59.655

The context menu is open over the 'Parameters...' option in the tree view, showing options: Report Enable, Parameters..., Purge Buffer, General Interrogation, and Get BRCB Values.

# Configuration of the reporting function

**BR / RP:** dedicated windows for review and modification of reporting parameters of BRCB / URCB.

**Demo [127.0.0.1]: DemoProtCtrl/LLN0.brcb01**

Report Identifier:

Data Set Reference:

Configuration Revision:  Integrity Period [ms]:

Buffer Time [ms]:  Entry Identifier:

Sequence Number:  Time Of Entry:

Reservation Time [s]:

**Optional Fields**

<input checked="" type="checkbox"/> Sequence Number	<input checked="" type="checkbox"/> Data Reference
<input checked="" type="checkbox"/> Report Time Stamp	<input checked="" type="checkbox"/> Buffer Overflow
<input checked="" type="checkbox"/> Reason For Inclusion	<input checked="" type="checkbox"/> Entry Identifier
<input checked="" type="checkbox"/> Data Set Name	<input checked="" type="checkbox"/> Configuration Revision

**Trigger Options**

- ☒ Data Change (dchg)
- ☒ Quality Change (qchg)
- ☒ Data Update (dupd)
- ☒ Integrity
- ☒ General Interrogation

# Selection of dataset for reporting

Selection from dropdown list of all datasets present in the device.

The list results from the imported or explored device data model and includes also dynamically created datasets.

The screenshot shows a software window titled "Demo [127.0.0.1]: DemoProtCtrl/LLN0.brcb01". It contains several input fields and a dropdown menu. The "Data Set Reference" dropdown is open, showing a list of datasets. The selected dataset is "DemoProtCtrl/LLN0.DS1\_Disconnector".

Report Identifier:

Data Set Reference: **DemoMeasurement/LLN0.DS2\_All** (selected)

Configuration Revision: DemoMeasurement/LLN0.DS1\_Measurement  
DemoMeasurement/LLN0.DS2\_All  
**DemoProtCtrl/LLN0.DS1\_Disconnector**  
DemoProtCtrl/LLN0.DS2\_Protection  
DemoProtCtrl/LLN0.DS3\_GOOSE  
DemoProtCtrl/LLN0.DS4\_GOOSE

Buffer Time [ms]:

Sequence Number:

Reservation Time [s]:

Optional Fields

<input checked="" type="checkbox"/> Sequence Number	<input checked="" type="checkbox"/> Data Reference
<input checked="" type="checkbox"/> Report Time Stamp	<input checked="" type="checkbox"/> Buffer Overflow
<input checked="" type="checkbox"/> Reason For Inclusion	<input checked="" type="checkbox"/> Entry Identifier
<input checked="" type="checkbox"/> Data Set Name	<input checked="" type="checkbox"/> Configuration Revision

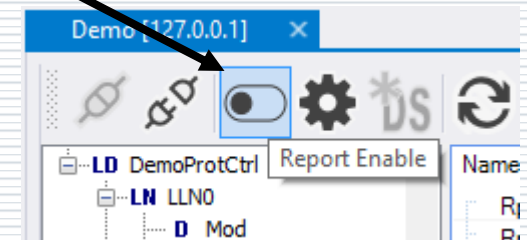
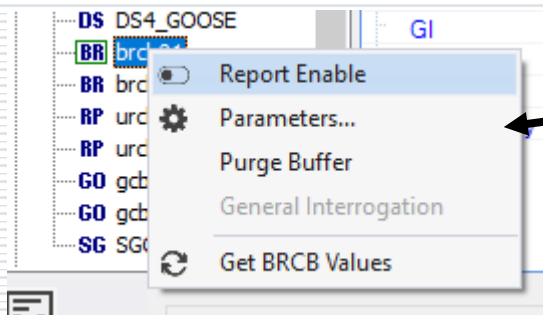
Trigger Options

<input checked="" type="checkbox"/> Data Change (dchg)
<input checked="" type="checkbox"/> Quality Change (qchg)
<input checked="" type="checkbox"/> Data Update (dupd)
<input checked="" type="checkbox"/> Integrity
<input checked="" type="checkbox"/> General Interrogation

Buttons: Apply, Enable, GI, Refresh, Close

# Activation of the reporting function and reports viewing

Report control block (BRCB or URCB) can be enabled by invoking **Report Enable** command from the context menu or using the program icon.

A screenshot of the report viewing interface. It features a table of incoming reports and a detailed view of a selected report.

#	Report ID	Reason code
0	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg
1	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg
2	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg
3	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg
4	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg
5	DemoProtCtrl/LLNO\$BRCB\$brcb01	dchg

Sequence Number: 0		Data Set: DemoProtCtrl/LLNO\$DS1_Disconnector	
<input checked="" type="checkbox"/> Buffer Overflow		Configuration Revision: 1	ID: DemoProtCtrl/LLNO\$BRCB\$brcb01
Entry Identifier: 0000000000000001		Time of Entry: 2020-05-06 11:25:06.645	
Data Reference	FC	Value	
DemoProtCtrl/Obj2XSW11.Pos		ST	Reason code: dchg
stVal	ST	01	{off}
q	ST	0000000000000000	{Good, Process}
t	ST	2020-05-06 11:25:06.628	[Leap S...

Incoming reports are displayed in a traceable list.  
A selected report content can be easily viewed.

# List of reports

All incoming reports are collected into a list and presented with the following information:

**#** - report number in the list,

**Report ID** – report identifier,

**Received** – reception timestamp,

**SN** – report sequence number set by the reporting server (other formats in case of segmented reports:

SN.s - where s is a segment number,

SN.sF - where s is a segment number and F indicates the last segment),

**Data Set** – reference name of the dataset used for reporting,

**Details off/on** – show/hide the details of the selected report.

The screenshot displays the 'Tested\_Relay [127.0.0.1]' application. The top section shows a tree view of the device structure on the left and a table of parameters on the right. The bottom section is divided into two panes: a 'List of reports' table on the left and a 'Detailed view of selected report' on the right.

**List of reports table:**

#	Report ID	SN	BOvF	Data Set
19	DemoMeasurement/LLN0\$BR\$brcb01	25	false	DemoMeasurement/LLN0.DS1_Measureme
20	DemoMeasurement/LLN0\$BR\$brcb02	21	false	DemoMeasurement/LLN0.DS2_All
21	DemoMeasurement/LLN0\$BR\$brcb01	26	false	DemoMeasurement/LLN0.DS1_Measureme
22	DemoMeasurement/LLN0\$BR\$brcb02	22	false	DemoMeasurement/LLN0.DS2_All
23	DemoMeasurement/LLN0\$BR\$brcb01	27	false	DemoMeasurement/LLN0.DS1_Measureme
24	DemoMeasurement/LLN0\$BR\$brcb01	28	false	DemoMeasurement/LLN0.DS1_Measureme
25	DemoMeasurement/LLN0\$BR\$brcb02	23	false	DemoMeasurement/LLN0.DS2_All
26	DemoMeasurement/LLN0\$BR\$brcb02	24	false	DemoMeasurement/LLN0.DS2_All
27	DemoProtCtrl/LLN0\$BR\$brcb02	10	false	DemoProtCtrl/LLN0.DS2_Protection
28	DemoMeasurement/LLN0\$BR\$brcb01	29	false	DemoMeasurement/LLN0.DS1_Measureme
29	DemoMeasurement/LLN0\$BR\$brcb02	25	false	DemoMeasurement/LLN0.DS2_All
30	DemoProtCtrl/LLN0\$BR\$brcb02	11	false	DemoProtCtrl/LLN0.DS2_Protection

**Detailed view of selected report:**

Sequence Number: 29 Data Set: DemoMeasurement/LLN0.DS1\_Me...

☐ Buffer Overflow Configuration Revision: 1 ID: DemoMeasuremen

Entry Identifier: 00000000000000001E Time of Entry: 2023-02-27 09:47:!!

Data Reference	FC	Value
DemoMeasurement/13pMHA11.HA	MX	Reason code: DataUp...
phsAHar		{0={cVal={mag={f=0}}...
0		{cVal={mag={f=0}}}, q...
cVal	MX	{mag={f=0}}
mag	MX	{f=0}
f	MX	0
q	MX	0000000000000000 {Goo...
t	MX	2023-02-27 09:47:56...
1		{cVal={mag={f=0}}}, q...
2		{cVal={mag={f=0}}}, q...

List of reports

Detailed view of  
selected report

# Report detailed content viewing

For each report from the list its detailed content can be examined. The following information is presented:

**Sequence Number** – report sequence number set by the server,

**Data Set** – reference name of the dataset,

**ID** – report identifier,

**Buffer Overflow** – indication of buffer overflow occurrence (for reports from BRCB only),

**Configuration Revision** – version of RCB configuration,

**Time of Entry** – time of report generation (report time stamp – equal to Time of Entry for BRCB),

**Entry Identifier** – report identifier (for reports from BRCB only),

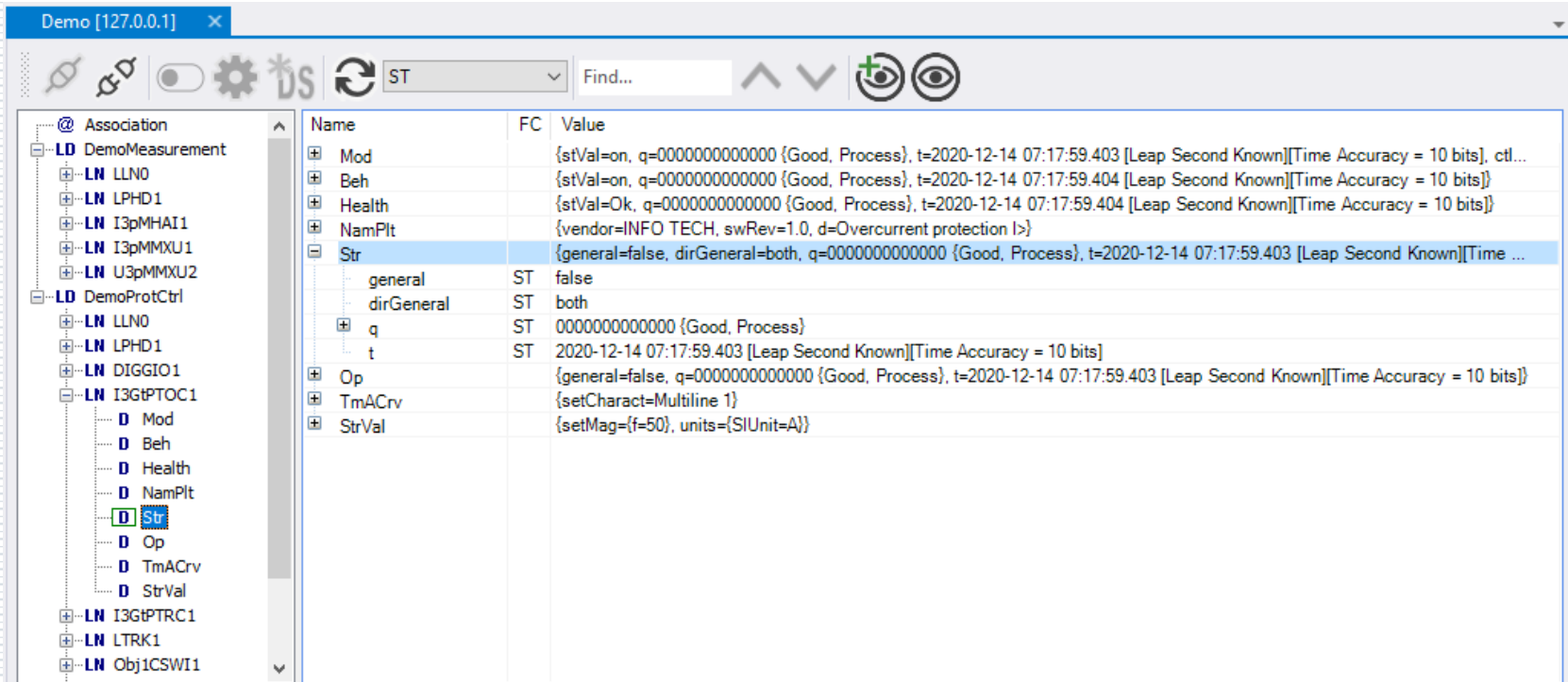
and the **view of reported data** including:

- reference name of reported data (**Data Reference**) with functional constraint (**FC**),
- reason (**Reason Code**) of including data in the report,
- names and values of data components.

Sequence Number:	12	Data Set:	DemoProtCtrl/LLN0.DS2_Protection
<input type="checkbox"/> Buffer Overflow	Configuration Revision:	1	ID: DemoProtCtrl/LLN0\$BR\$brcb02
Entry Identifier:	0000000000000000D	Time of Entry:	2023-02-27 09:51:38.216
Data Reference		FC	Value
DemoProtCtrl/Obj1CSWI1.Pos		ST	Reason code: DataChange
stVal		ST	10 {on}
position		ST	on
q		ST	00000000000000 {Good, Process}
Validity		ST	Good
Overflow		ST	false
OutOfRange		ST	false
BadReference		ST	false
Oscillatory		ST	false
Failure		ST	false
OldData		ST	false
Inconsistent		ST	false
Inaccurate		ST	false
Source		ST	Process
Test		ST	false
OperatorBlocked		ST	false
t		ST	2023-02-27 09:51:38.210 [Leap Second Known][Time Accur...
DemoProtCtrl/I3GtPTOC1.Str		ST	Reason code: DataChange
general		ST	true
dirGeneral		ST	both
q		ST	00000000000000 {Good, Process}
t		ST	2023-02-27 09:51:38.242 [Leap Second Known][Time Accur...
DemoProtCtrl/Obj1XCBR1.Pos		ST	Reason code: DataChange
stVal		ST	10 {on}
position		ST	on
q		ST	00000000000000 {Good, Process}
Validity		ST	Good
Overflow		ST	false
OutOfRange		ST	false
BadReference		ST	false
Oscillatory		ST	false
Failure		ST	false
OldData		ST	false

# Data model view updates by reports

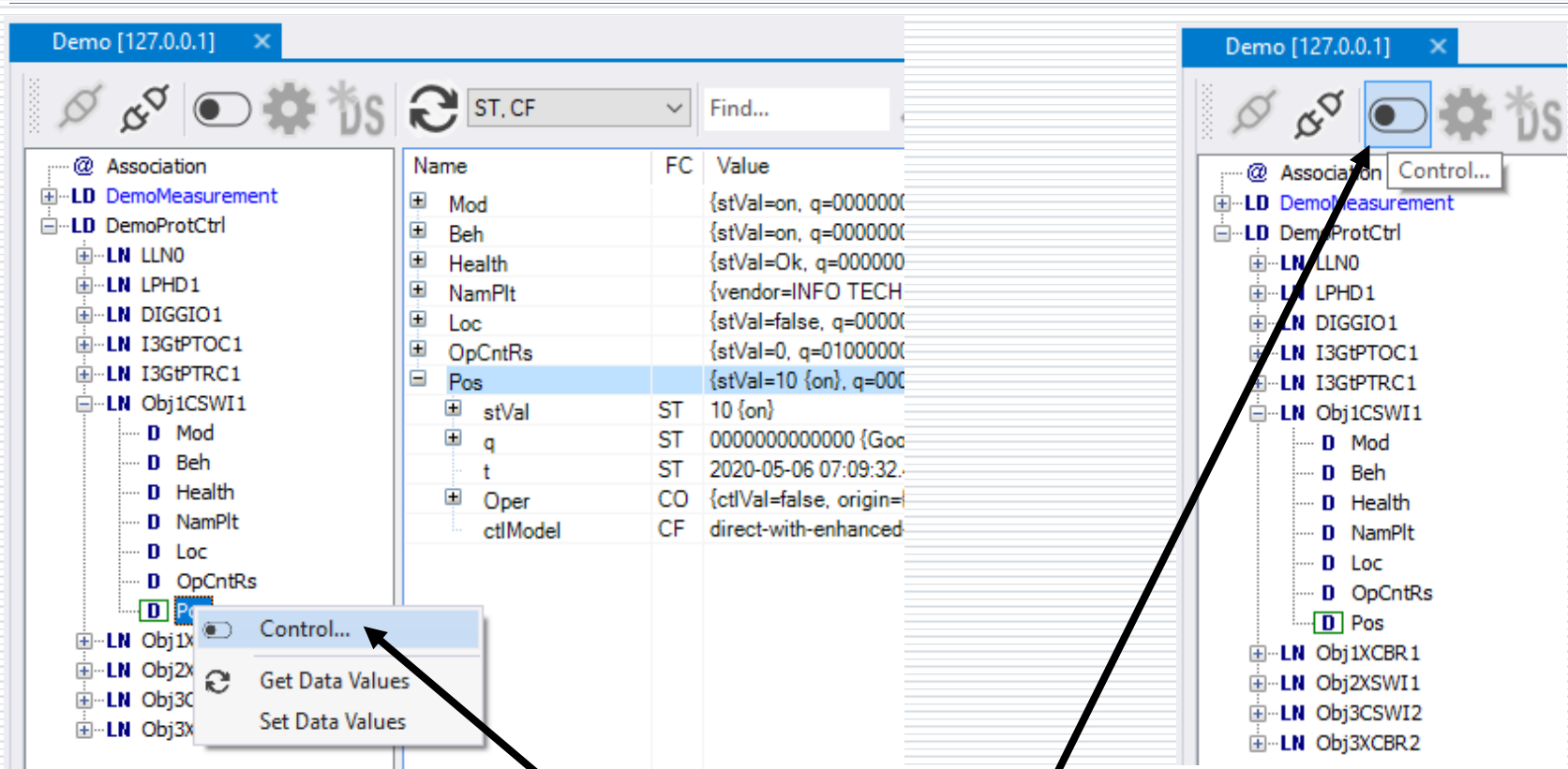
Data values received in reports update also the view of the data model. The name and value of each updated data is emphasized using **blue font**. The same visualization is applied to updates obtained upon read requests.



The screenshot displays the INFO TECH software interface. On the left, a tree view shows the data model structure under 'Demo [127.0.0.1]'. The tree includes nodes like 'Association', 'DemoMeasurement', 'LLN0', 'LPHD1', 'I3pMHAI1', 'I3pMMXU1', 'U3pMMXU2', 'DemoProtCtrl', 'LLN0', 'LPHD1', 'DIGGIO1', 'I3GtPTOC1', 'I3GtPTRC1', 'LTRK1', and 'Obj1CSWI1'. The 'Str' node under 'I3GtPTOC1' is selected and highlighted in blue. On the right, a table displays the data for the selected node. The table has three columns: 'Name', 'FC', and 'Value'. The 'Str' row is highlighted in blue, and its value is also in blue font. The 'StrVal' row is also highlighted in blue, and its value is also in blue font.

Name	FC	Value
Mod		{stVal=on, q=00000000000000 {Good, Process}, t=2020-12-14 07:17:59.403 [Leap Second Known][Time Accuracy = 10 bits], ctl...
Beh		{stVal=on, q=00000000000000 {Good, Process}, t=2020-12-14 07:17:59.404 [Leap Second Known][Time Accuracy = 10 bits]}
Health		{stVal=Ok, q=00000000000000 {Good, Process}, t=2020-12-14 07:17:59.404 [Leap Second Known][Time Accuracy = 10 bits]}
NamPlt		{vendor=INFO TECH, swRev=1.0, d=Overcurrent protection I>}
Str		{general=false, dirGeneral=both, q=00000000000000 {Good, Process}, t=2020-12-14 07:17:59.403 [Leap Second Known][Time ...
general	ST	false
dirGeneral	ST	both
q	ST	00000000000000 {Good, Process}
t	ST	2020-12-14 07:17:59.403 [Leap Second Known][Time Accuracy = 10 bits]
Op		{general=false, q=00000000000000 {Good, Process}, t=2020-12-14 07:17:59.403 [Leap Second Known][Time Accuracy = 10 bits]}
TmACrv		{setCharact=Multiline 1}
StrVal		{setMag={f=50}, units={SIUnit=A}}

# Control services in IEC 61850



Services as defined in IEC 61850-7-2.

Control services can be invoked in the context menu of the data model or using the program icon.

# Control models and control command parameters

Control command window **CO** shows:

- present status of an object to be controlled,
- parameters of control command,
- buttons for control procedure steps in accordance with assigned control model,
- log of the control procedure performance with client requests, server responses and reports with control results.

Demo [127.0.0.1]: DemoProtCtrl/Obj1CSWI1.Pos

Status Information

Value: 01 {off} Control Number:

Quality: 00000000000000 {Good, Process}

Time Stamp: 2018-03-26 13:14:14.016 [Leap Second Known][Time Accuracy = 10 bits]

Originator

Category: Id:

Control

Value: on (true) Control Number: 0

Time

Time Stamp: 2018-03-26 15:14:21 ☐ Use Current Time

Originator

Category: remote-control Id: C0A80862 HEX

☐ Test

☐ Check

☐ Synchrocheck

☐ Interlock Check

Select With Value Select Operate Cancel Refresh Close

Log

Time	Service	Message
------	---------	---------

# Control commands in test mode

The tool user should be aware of consequences of sending control commands to devices.

When a server device is intentionally switched to TEST or TEST-BLOCKED mode, it is possible to set **Test** flag for control commands and perform control operation as specified for this mode.

Demo [127.0.0.1]: DemoProtCtrl/Obj1CSWI1.Pos

Status Information

Value: 01 {off} Control Number:

Quality: 00000000000000 {Good, Process}

Time Stamp: 2018-03-26 13:14:14.016 [Leap Second Known][Time Accuracy = 10 bits]

Originator

Category: Id:

Control

Value: on (true) Control Number: 0

Time

Time Stamp: 2018-03-26 15:14:21 ☐ Use Current Time

Originator

Category: remote-control Id: C0A80862 HEX

☐ Test

Check

☐ Synchrocheck

☐ Interlock Check

Select With Value Select Operate Cancel Refresh Close

Log

Time	Service	Message
------	---------	---------

# Tracing control commands performance

If the new controlled object position is reported, the status information will be updated in the **CO** window and in the data model view.

Command execution and its result are easy to trace in the log.

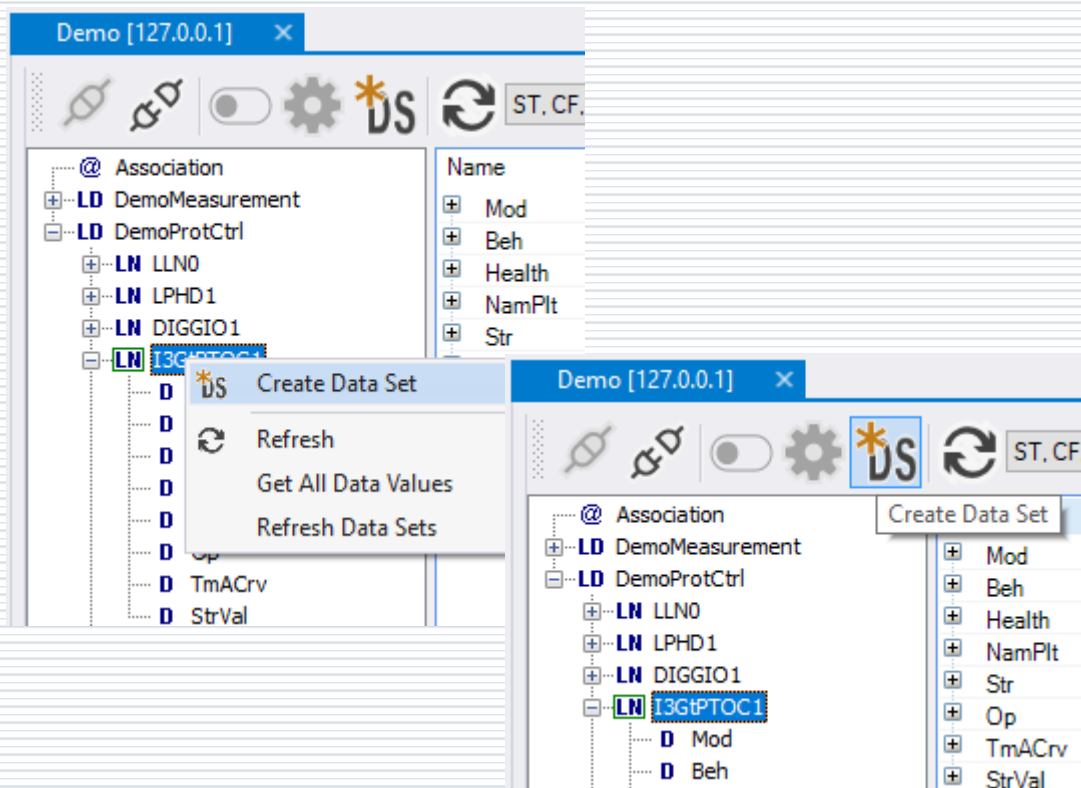
The screenshot shows a software window titled "Demo [127.0.0.1]: DemoProtCtrl/Obj1CSWI1.Pos". It contains several sections:

- Status Information:** Includes fields for Value (01 {off}), Control Number, Quality (000000000000 {Good, Process}), and Time Stamp (2018-03-26 13:14:14.016 [Leap Second Known][Time Accuracy = 10 bits]).
- Originator:** Includes fields for Category and Id.
- Control:** Includes a Value dropdown (on {true}), Control Number (0), and checkboxes for Test, Check, Synchrocheck, and Interlock Check.
- Time:** Includes a Time Stamp field (2018-03-26 15:14:21) and a checkbox for Use Current Time.
- Originator:** Includes a Category dropdown (remote-control), Id field (C0A80862), and a HEX dropdown.
- Buttons:** Select With Value, Select, Operate, Cancel, Refresh, and Close.
- Log:** A table showing command execution history.

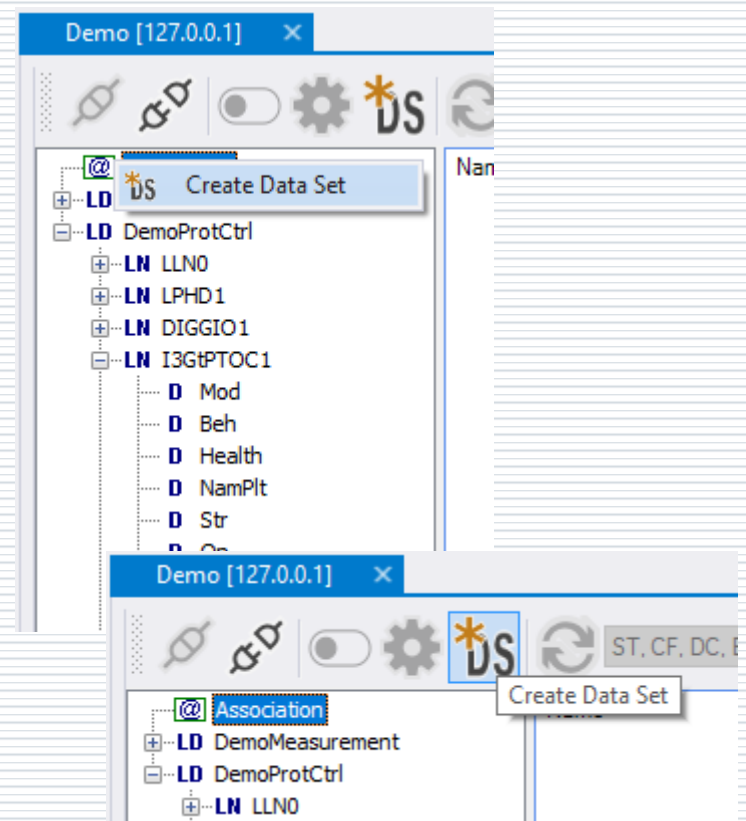
Time	Service	Message
03:15:35.393	Operate	Request (ctlValue.true)
03:15:35.426	Operate	Response positive
03:15:35.427	Command Tem.	Positive (ctlValue.true)

# Creating dynamic data sets

Persistent – created in LN context



Non-persistent – created in Association context



# Steps of defining a new dataset

Upon invoking **Create Data Set** command a dedicated window pops up to enable dataset definition. The created dataset can be given a name and its elements can be selected from the data model by the command from context menu or by drag-and-drop operation.

The screenshot displays the 'Create data set' dialog box in the software. The dialog box has a title bar 'Demo [127.0.0.1] \*: Create data set'. It contains two main sections: 'Data Set Reference' and 'Data Set Members'.

**Data Set Reference:**

- Scope: DemoProtCtrl/I3GtPTOC1
- Name: NewDataSet

**Data Set Members:**

Name	FC
DemoProtCtrl/I3GtPTOC1.Str	ST
DemoProtCtrl/I3GtPTOC1.Op	ST
DemoProtCtrl/I3GtPTRC1.Tr	ST

The background shows the 'Demo [127.0.0.1]' window with a tree view of the data model. The 'I3GtPTOC1' node is selected, and a context menu is open with the 'Add to Data Set' option highlighted. The 'Add to Data Set' option is pointing to the 'NewDataSet' entry in the 'Data Set Members' table.

When the list of elements is complete press **Create** button – a command will be sent to the server device.

# Activation and edition of Setting Groups

The data model of a server device implementing setting groups includes a Setting Group Control Block object (**SGCB**), placed always in LLN0 logical node.

SGCB attributes:

- NumOfSG – how many setting groups are included in the logical device (LD),
- ActSG – which setting group (number) is currently in use,
- EditSG – which setting group is currently available for editing values.

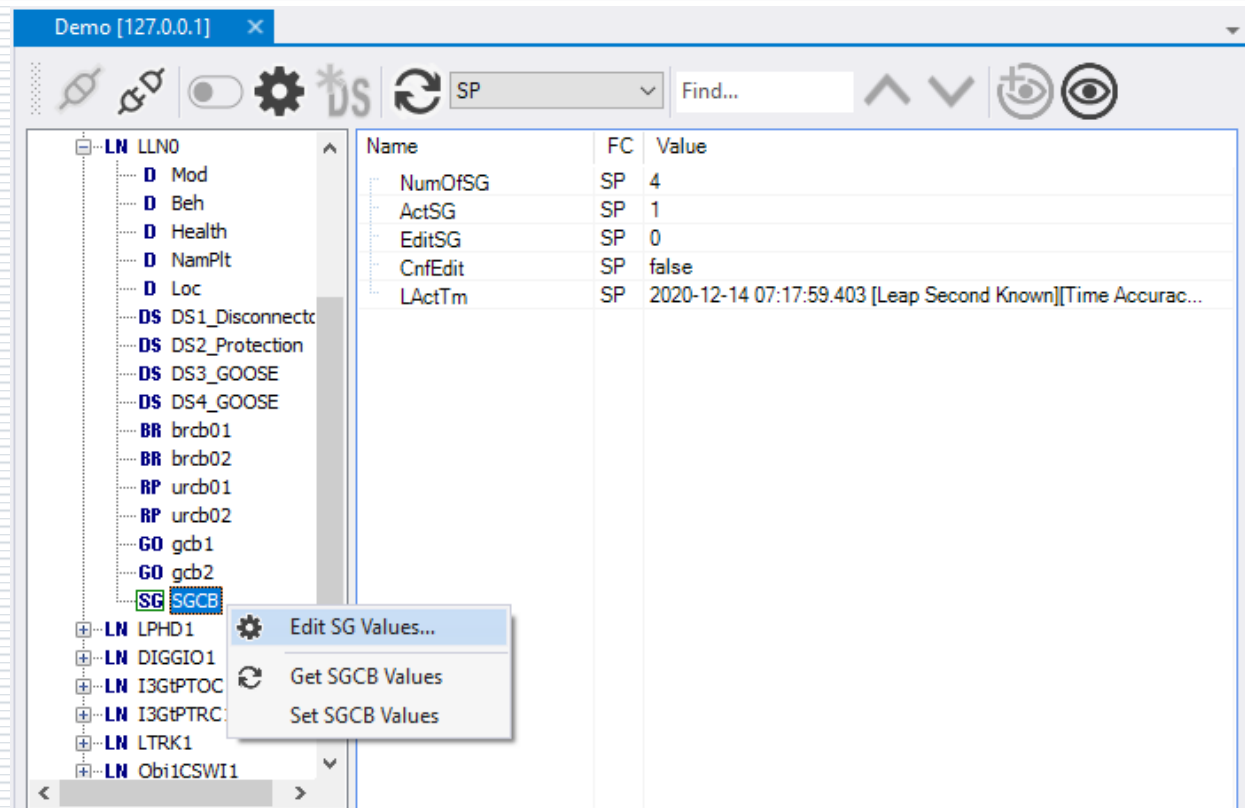
The screenshot shows the 'Demo [127.0.0.1]' application window. On the left is a tree view of the data model. Under the 'LD DemoProtCtrl' node, the 'LN LLN0' node is expanded, showing various sub-nodes including 'SG SGCB'. On the right is a table displaying the attributes of the selected 'SGCB' object.

Name	FC	Value
NumOfSG	SP	4
ActSG	SP	1
EditSG	SP	0
CnfEdit	SP	false
LActTm	SP	2020-12-14 07:17:59.403 [Leap Second Known][Time Accuracy = 10 bits]

# Operations on SGCB

SGCB context menu allows to read all attribute values and to write attributes ActSG, EditSG, CnfSG, ResvTms. A new value should be set in **Value** field of the attribute and confirmed with a proper command.

But a more user-friendly option to configure SGCB and edit settings is to invoke **Edit SG Values** command.



# Setting Group Control window

Upon invoking **EditSGValues** command a dedicated **Setting Group Control** window pops up to enable all operations on SGCB as well as editing of values of the selected setting group.

The screenshot displays the 'Setting Group Control' window for 'Demo [127.0.0.1]'. The window is divided into several sections:

- Tree View:** A hierarchical tree on the left showing the device structure. The 'SG' (Setting Group) is selected under 'LLN0'.
- Table:** A table in the center showing the values of the selected setting group. The table has columns 'Name', 'FC', and 'Value'.
- Control Panel:** A panel on the right with controls for the setting group, including 'Active Group', 'Last Activation Time', 'Edit Group', and 'Reservation Time'.
- Settings Table:** A table at the bottom right showing the settings for the selected setting group. The table has columns 'Setting Name', 'tive Bufl', 'Edit Buffer', and 'Buffer'.

Name	FC	Value
NumOfSG	SP	4
ActSG	SP	1
EditSG	SP	0
CnfEdit	SP	false
LActTm	SP	2020-...

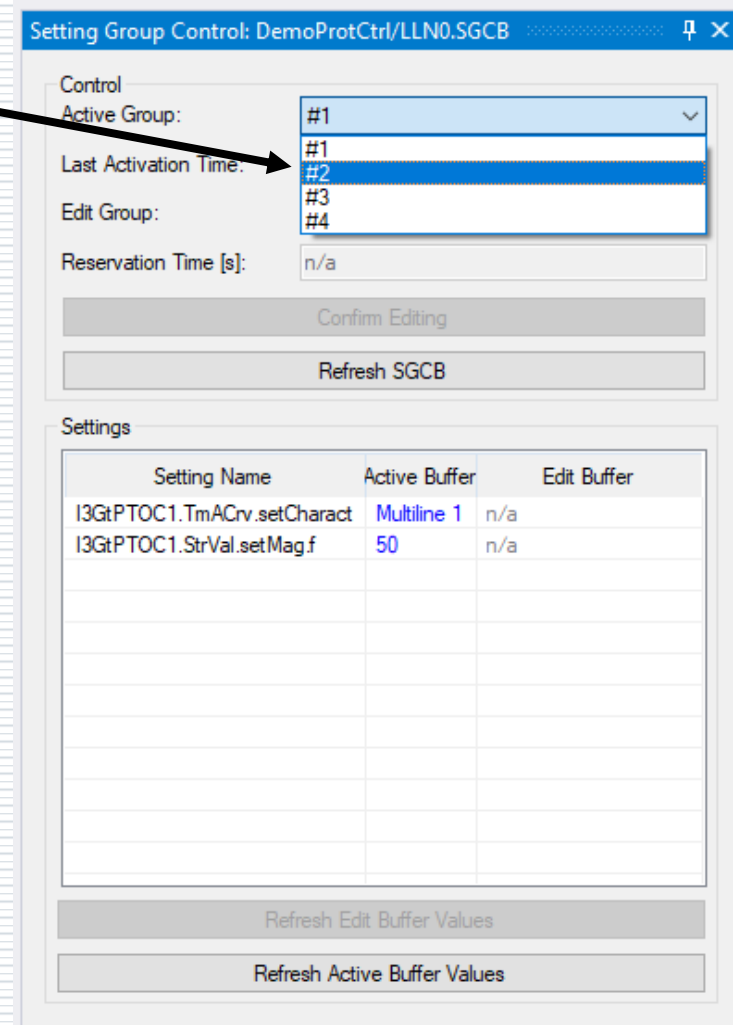
Setting Name	tive Bufl	Edit Buffer	Buffer
I3GtPTOC1.TmACrv.setCharact	none	n/a	
I3GtPTOC1.StrVal.setMag.f	0	n/a	

# Change of the active setting group

Selection of an active setting group is made from the drop-down list with assigned numbers of all groups implemented in the device.

After changing the active setting group the device should set a new value of **Last Activation Time**.

Setting values from the active group are presented in the list below (**Active** column informs that these are the attributes of FC=SG) – there is no need to search this information in the data model.



Setting Group Control: DemoProtCtrl/LLN0.SGCB

Control

Active Group: #1

Last Activation Time:

Edit Group:

Reservation Time [s]: n/a

Confirm Editing

Refresh SGC

Settings

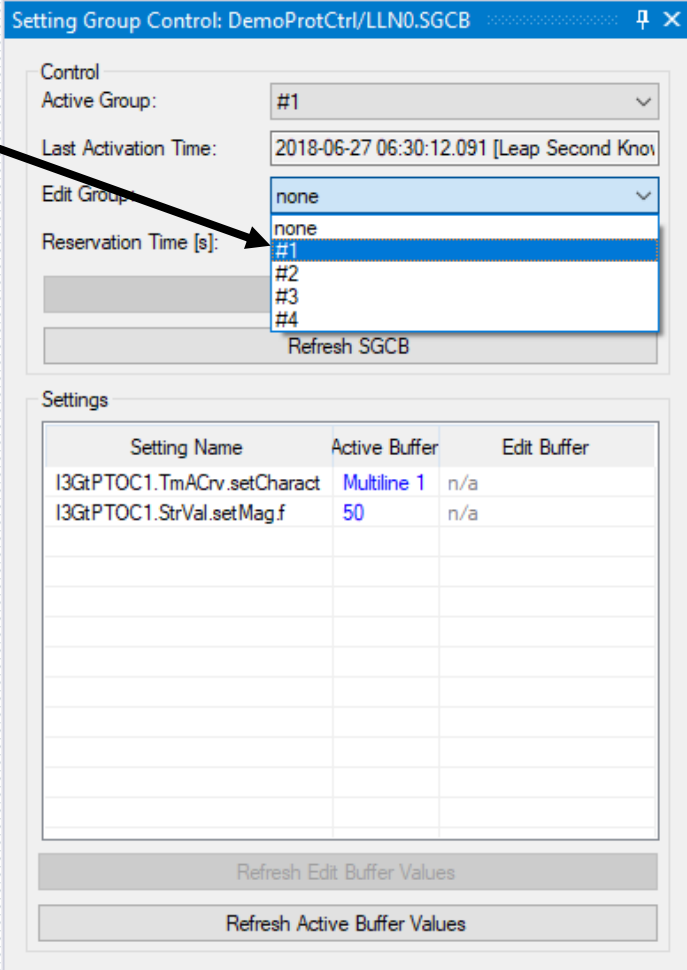
Setting Name	Active Buffer	Edit Buffer
I3GtPTOC1.TmACrv.setCharact	Multiline 1	n/a
I3GtPTOC1.StrVal.setMag.f	50	n/a

Refresh Edit Buffer Values

Refresh Active Buffer Values

# Selection of the setting group for editing

Selection of the setting group for editing is made from the drop-down list with assigned numbers of all groups implemented in the device.  
(none – denotes that none of the setting groups shall be available for editing).



Setting Group Control: DemoProtCtrl/LLN0.SGCB

Control

Active Group: #1

Last Activation Time: 2018-06-27 06:30:12.091 [Leap Second Know]

Edit Group: none

Reservation Time [s]:

Refresh SGCB

Settings

Setting Name	Active Buffer	Edit Buffer
I3GtPTOC1.TmACrv.setCharact	Multiline 1	n/a
I3GtPTOC1.StrVal.setMag.f	50	n/a

Refresh Edit Buffer Values

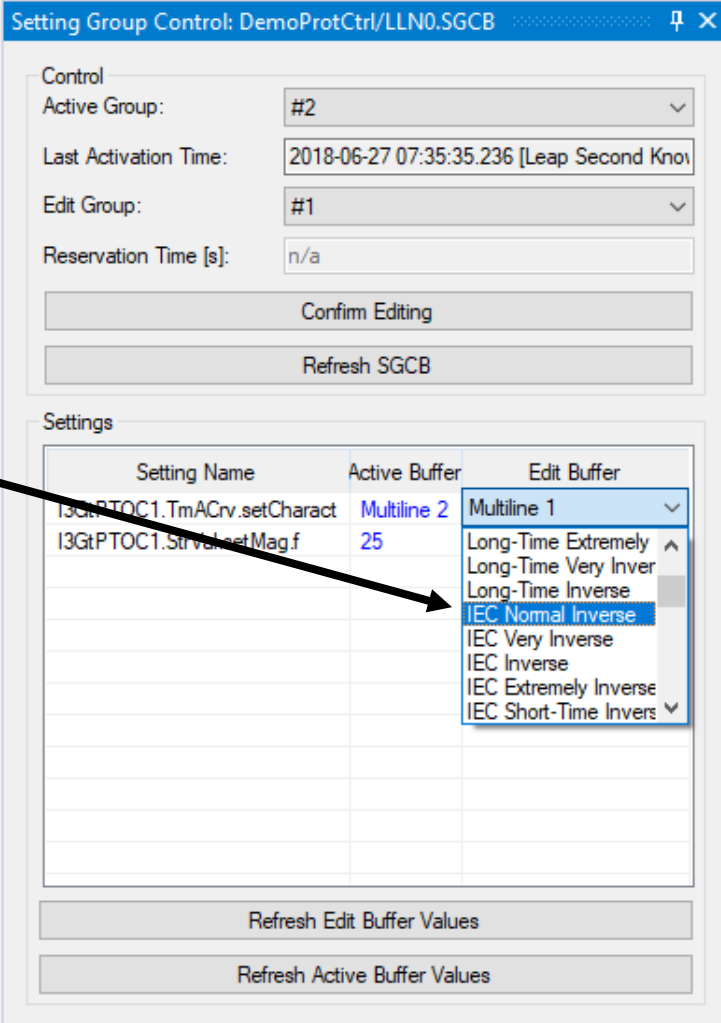
Refresh Active Buffer Values

# Change of setting values in the group selected for editing

Setting values from the group selected for editing are presented in the list below (**Edit Buffer** column shows attributes of FC=SE) – there is no need to search this information in the data model.

For settings of enum type a new value can be selected from a drop-down list.

New values are checked for being accepted by the server device.

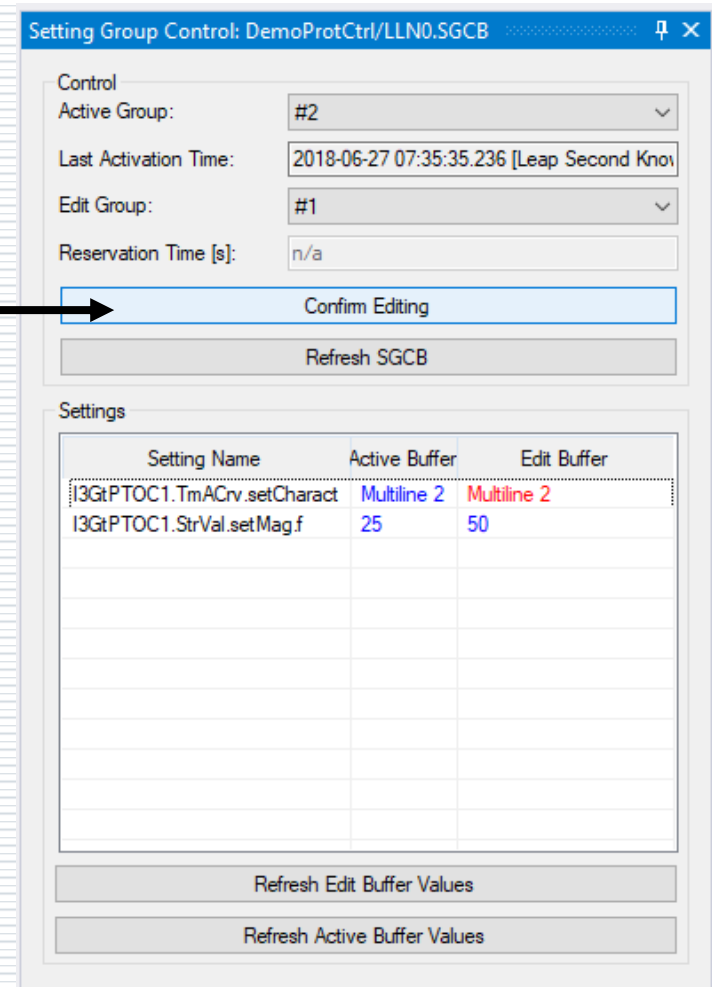


The screenshot shows a software window titled "Setting Group Control: DemoProtCtrl/LLN0.SGCB". It contains several input fields and buttons. The "Active Group" is set to "#2", "Last Activation Time" is "2018-06-27 07:35:35.236 [Leap Second Know]", "Edit Group" is "#1", and "Reservation Time [s]" is "n/a". There are "Confirm Editing" and "Refresh SGCB" buttons. Below these is a "Settings" table with three columns: "Setting Name", "Active Buffer", and "Edit Buffer". The table has two rows of data. The first row's "Edit Buffer" dropdown is open, showing a list of options including "Multiline 1", "Long-Time Extremely", "Long-Time Very Inver", "Long-Time Inverse", "IEC Normal Inverse", "IEC Very Inverse", "IEC Inverse", "IEC Extremely Inverse", and "IEC Short-Time Invers". An arrow points from the text "For settings of enum type a new value can be selected from a drop-down list." to this dropdown menu.

Setting Name	Active Buffer	Edit Buffer
I3GtPTOC1.TmACrv.setCharact	Multiline 2	Multiline 1
I3GtPTOC1.StrVal.setMag.f	25	Long-Time Extremely

# Confirmation of new setting values from the edited group

Newly introduced setting values are temporarily memorized in the server device (if correct), but their assignment to the group selected for editing must be still confirmed by pressing the command button **Confirm Editing**. Only after that the edited setting group will acquire the new values.



The screenshot shows a software window titled "Setting Group Control: DemoProtCtrl/LLN0.SGCB". It contains several fields and buttons. The "Active Group" is set to "#2", "Last Activation Time" is "2018-06-27 07:35:35.236 [Leap Second Know]", "Edit Group" is set to "#1", and "Reservation Time [s]" is "n/a". Below these fields are two buttons: "Confirm Editing" (highlighted with a blue border and an arrow pointing to it from the text on the left) and "Refresh SGCB". Below the buttons is a table titled "Settings" with three columns: "Setting Name", "Active Buffer", and "Edit Buffer". The table contains two rows of data. At the bottom of the window are two more buttons: "Refresh Edit Buffer Values" and "Refresh Active Buffer Values".

Setting Name	Active Buffer	Edit Buffer
I3GtPTOC1.TmACrv.setCharact	Multiline 2	Multiline 2
I3GtPTOC1.StrVal.setMag.f	25	50

# Log view

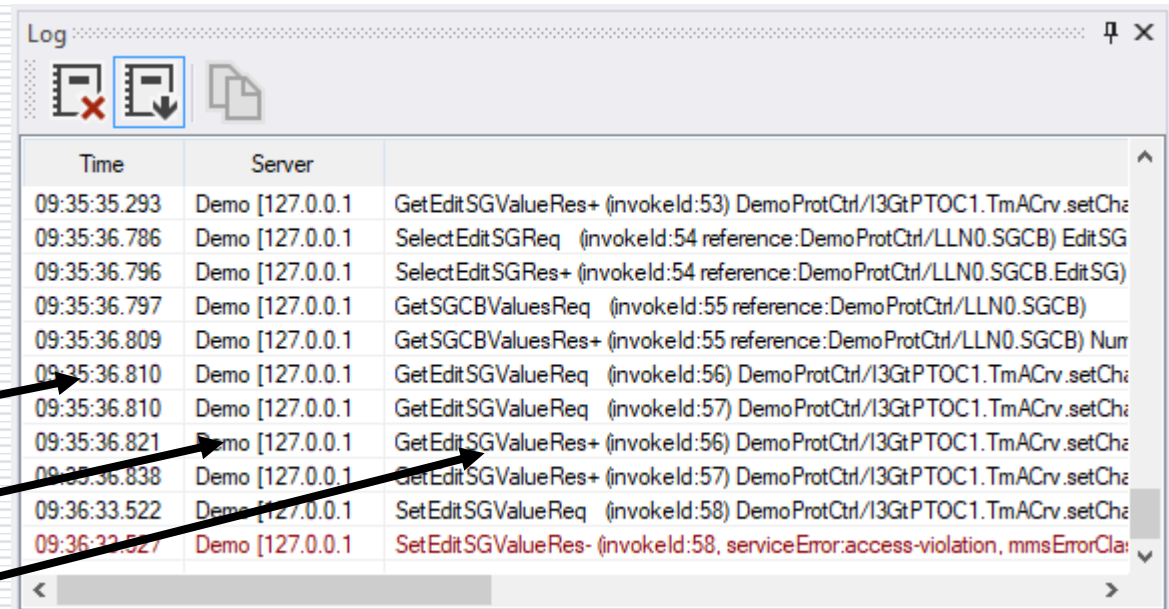
The tool provides a chronological view of operations (commands, responses and events) occurring during the interactions with server devices.

Each message in the log is described by:

**Time** – timestamp of the occurrence,

**Server** – device concerned,

**Message** – description of the operation.

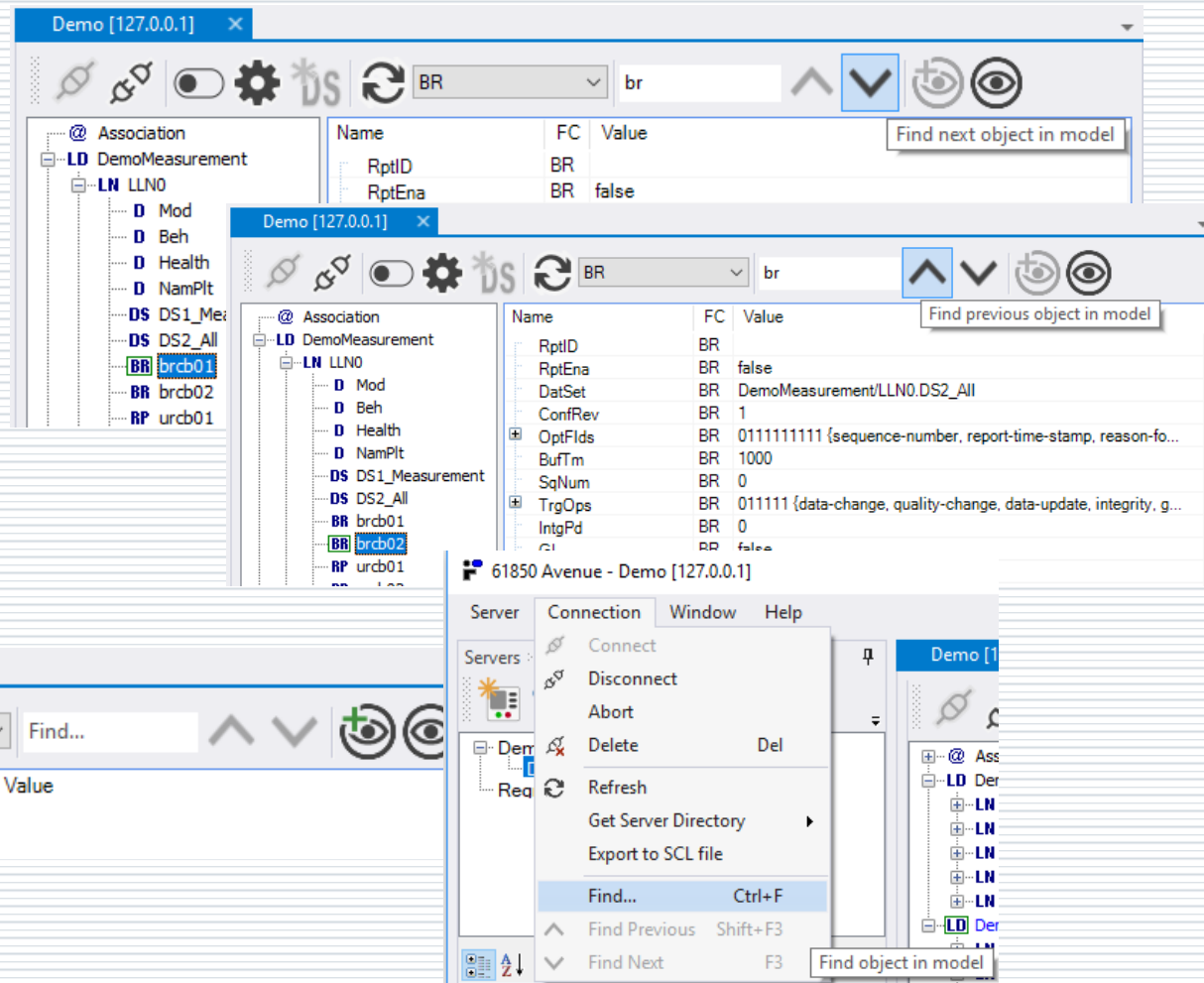


Time	Server	
09:35:35.293	Demo [127.0.0.1	GetEditSGValueRes+ (invokeld:53) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:35:36.786	Demo [127.0.0.1	SelectEditSGReq (invokeld:54 reference:DemoProtCtrl/LLN0.SGCB) EditSG
09:35:36.796	Demo [127.0.0.1	SelectEditSGRes+ (invokeld:54 reference:DemoProtCtrl/LLN0.SGCB.EditSG)
09:35:36.797	Demo [127.0.0.1	GetSGCBValuesReq (invokeld:55 reference:DemoProtCtrl/LLN0.SGCB)
09:35:36.809	Demo [127.0.0.1	GetSGCBValuesRes+ (invokeld:55 reference:DemoProtCtrl/LLN0.SGCB) Num
09:35:36.810	Demo [127.0.0.1	GetEditSGValueReq (invokeld:56) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:35:36.810	Demo [127.0.0.1	GetEditSGValueReq (invokeld:57) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:35:36.821	Demo [127.0.0.1	GetEditSGValueRes+ (invokeld:56) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:35:36.838	Demo [127.0.0.1	GetEditSGValueRes+ (invokeld:57) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:36:33.522	Demo [127.0.0.1	SetEditSGValueReq (invokeld:58) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:36:33.527	Demo [127.0.0.1	SetEditSGValueRes- (invokeld:58, serviceError:access-violation, mmsErrorCla

# Finding objects


The search function allows users to enter any string of characters, and then search for matching objects in the data model. The function will highlight all objects in the model with names containing the search text.


The user can start searching for objects using the keyboard shortcut **Ctrl + F**.

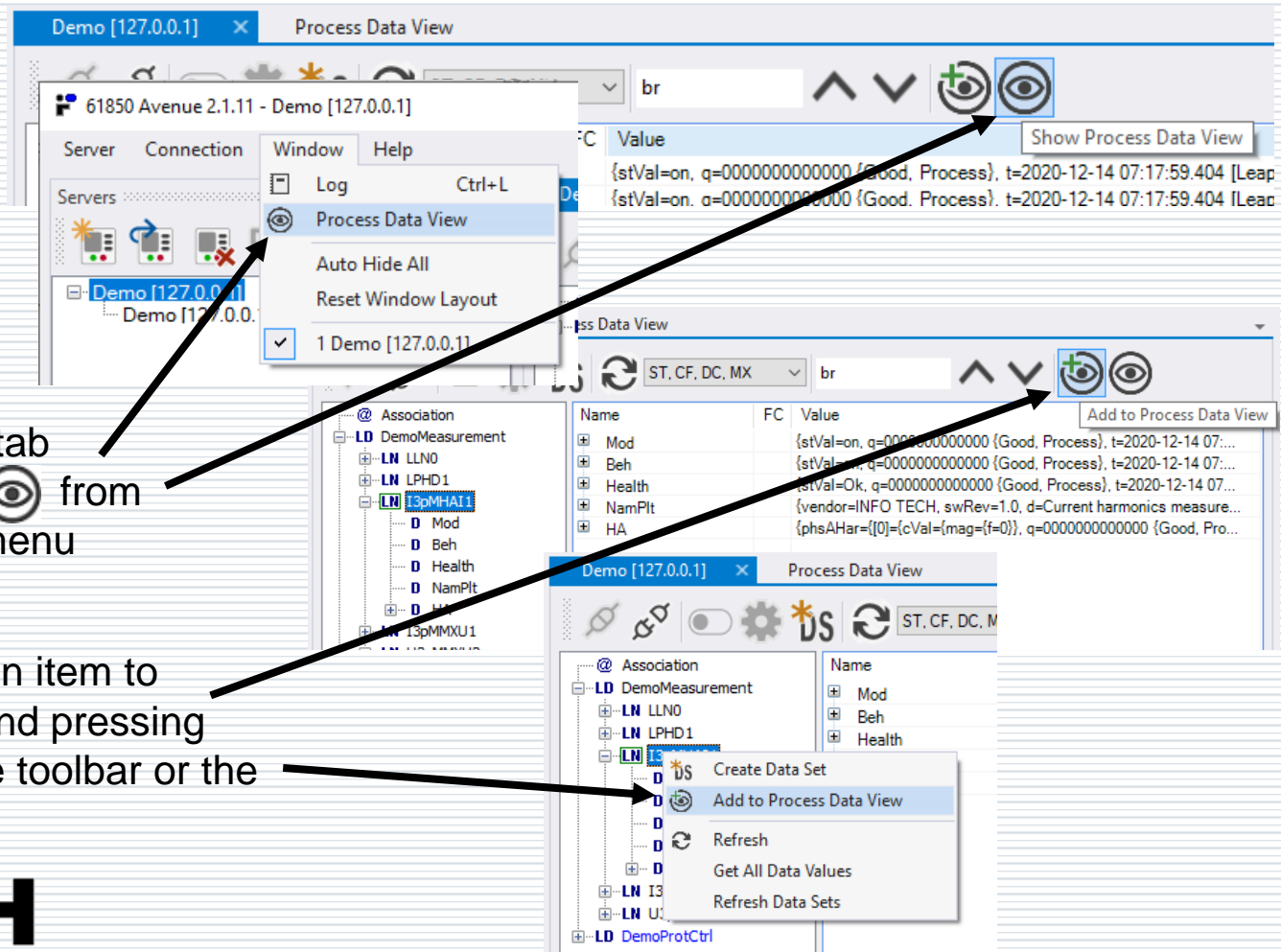


# Process Data View - adding objects

Process Data View (PDV) is a common view to monitor selected items from different IEDs.


PDV is a separate tab opened by button  from the toolbar or the menu *Window*


The user can add an item to PDV by selecting and pressing button  from the toolbar or the context menu.





# Process Data View (PDV) - toolbar

PDV toolbar is composed of the following elements:

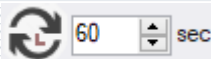
Confirming update of all items by button 

Removing item(s) from PDV by button 






Refreshing selected items by button 

Copying selection by button 

Data polling settings



The user can configure PDV presentation scope (right click on the table header) by showing / hiding columns of specific data attributes.

Process Data View x Demo [127.0.0.1]								
     10 sec								
Location	Function	Object name	Value	Quality	Timestamp	FC	Reference	
DemoMeasurement	I3pMHA11	HA.phsBHar(14)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsBHar(...)	
DemoMeasurement	I3pMHA11	HA.phsBHar(15)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsBHar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(0)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(1)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(2)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(3)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(4)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(5)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(6)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(7)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(8)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(9)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(10)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(11)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(12)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(13)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(14)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMHA11	HA.phsChar(15)	0	00000000000000 {Good, Process}	1970-01-01 00:00:...	MX	DemoMeasurement/I3pMHA11.HA.phsChar(...)	
DemoMeasurement	I3pMMXU1	Mod - Mode	on	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Mod.stVal	
DemoMeasurement	I3pMMXU1	Beh - Behaviour	on	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Beh.stVal	
DemoMeasurement	I3pMMXU1	Health - Health	Ok	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Health.stVal	
DemoMeasurement	I3pMMXU1	A.phsA - Phase A current	0 A	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsA.cVal...	
DemoMeasurement	I3pMMXU1	A.phsB - Phase B current	0 A	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsB.cVal...	
DemoMeasurement	I3pMMXU1	A.phsC - Phase C current	0 A	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsC.cVal...	
DemoMeasurement	LPHD1	PhyHealth - OK	Ok	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsC.cVal...	
DemoMeasurement	LPHD1	Proxy - Indicates if this LN is a proxy	false	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsC.cVal...	
DemoMeasurement	U3pMMXU2	Mod - Mode	on	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Beh.stVal	
DemoMeasurement	U3pMMXU2	Beh - Behaviour	on	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Beh.stVal	
DemoMeasurement	U3pMMXU2	Health - Health	Ok	00000000000000 {Good, Process}	2023-03-06 11:54:...	ST	DemoMeasurement/I3pMMXU1.Health.stVal	
DemoMeasurement	U3pMMXU2	PhV.phsA - Phase A voltage	15000 V	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsA.cVal...	
DemoMeasurement	U3pMMXU2	PhV.phsB - Phase B voltage	15000 V	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsB.cVal...	
DemoMeasurement	U3pMMXU2	PhV.phsC - Phase C voltage	15000 V	00000000000000 {Good, Process}	2023-03-06 11:54:...	MX	DemoMeasurement/I3pMMXU1.A.phsC.cVal...	

# Process Data View (PDV) – data polling

After adding items to PDV, the user can enable (or disable) cyclic data polling by clicking



Enabled data polling.

The configurable parameters for cyclic polling of PDV items are:

- Polling cycle  sec (default value is 60 seconds).
- Number of items in one request. Configurable in the Options view (Help -> Options):

PDV items count limit per poll:

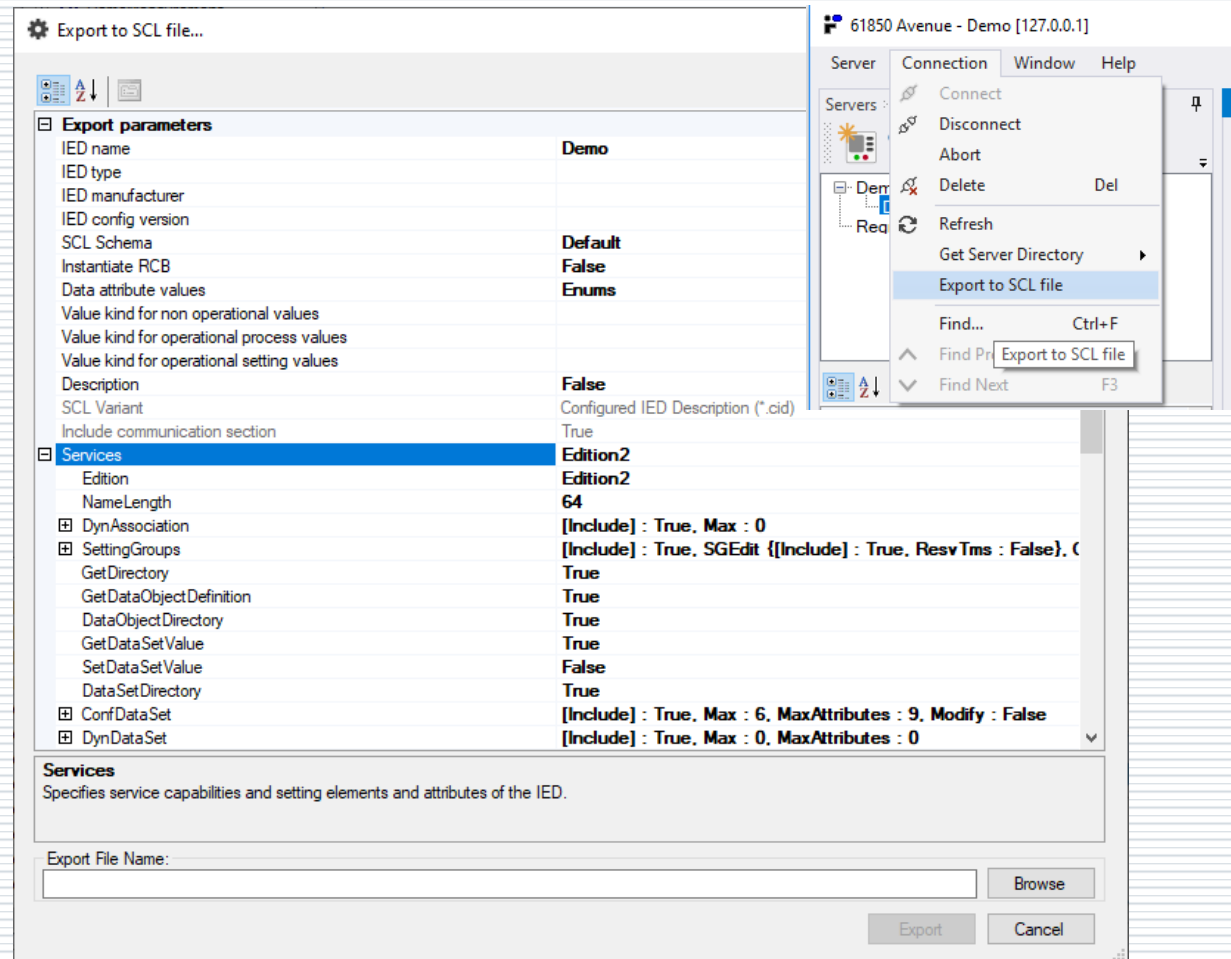
Process Data View Demo [127.0.0.1]									
60 sec									
Location	Location	Object name	Value	Quality	Timestamp	Received	FC	Reference	
DemoMeasurement	LN0	Mod - Mode	on	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(LN0.Mod.stVal	
DemoMeasurement	LN0	Beh - Behaviour	on	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(LN0.Beh.stVal	
DemoMeasurement	LN0	Health - OK	Ok	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(LN0.Health.stVal	
DemoMeasurement	13pMHA11	Mod - Mode	on	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(13pMHA11.Mod.stVal	
DemoMeasurement	13pMHA11	Beh - Behaviour	on	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(13pMHA11.Beh.stVal	
DemoMeasurement	13pMHA11	Health - Health	Ok	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	ST	DemoMeasurement(13pMHA11.Health.stVal	
DemoMeasurement	13pMHA11	HA.phsAHar(0)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(0).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(1)	100	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(1).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(2)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(2).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(3)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(3).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(4)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(4).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(5)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(5).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(6)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(6).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(7)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(7).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(8)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(8).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(9)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(9).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(10)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(10).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(11)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:1...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(11).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(12)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(12).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(13)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(13).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(14)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(14).c...	
DemoMeasurement	13pMHA11	HA.phsAHar(15)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsAHar(15).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(0)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(0).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(1)	100	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(1).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(2)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(2).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(3)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(3).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(4)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(4).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(5)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(5).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(6)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(6).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(7)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(7).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(8)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(8).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(9)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(9).c...	
DemoMeasurement	13pMHA11	HA.phsBHar(10)	0	00000000000000 (Good, Process)	2023-03-06 11:54:...	13:20:2...	MX	DemoMeasurement(13pMHA11.HA.phsBHar(10).c...	

The PDV items highlighted with blue font are the ones that have been refreshed but not yet viewed by the user. cycle. After viewing by the user, the refreshed item is set back to the default black font.

# Generation of ICD/CID file

Possible for a selected server device with explored data model. By invoking **Export to SCL file...** command.

The user can adjust the produced SCL file in the dialog of parameter selection.



# What else can be found in 61850 Avenue toolset ...

IEC 61850 Relay Simulator

GOOSE testing toolset

Sampled Values testing toolset

File transfer testing toolset

IEC 61850 ICD Editor



# 61850 Relay Simulator

Feeder bay model with circuit breaker and disconnecter.

Simple overcurrent protection relay with IEC61850 server interface (representative classes of LNs, fixed data model).

An excellent tool to help comprehending how a protection relay is seen in the IEC 61850 communication network.

Very easy to use for testing operations of the IEC 61850 client end.



# IEC 61850 Relay: Setup in the start view - edition

Standard edition to be applied can be selected by the user (1, 2 or 2.1).

Other connection parameters:

- Optional RCB attributes can be included.
- Service tracking configuration can be added.
- OSI addresses can be optionally checked.
- MMS communication on port 102 or optionally secure communication using TLS on port 3782 and optionally ACSE authentication.

Connection on the selected interface or on all interfaces can be accepted.

Select server parameters

IED name: Demo

Edition: 2Amd1: IEC 61850-7-4:2007B

Service tracking configuration

DpcTrk	Not assigned
UrcbTrk	Not assigned
BrcbTrk	Not assigned
GocbTrk	Not assigned
SgcbTrk	Not assigned

Root path:

Interface: VMware Network Adapter VMnet8 MAC: 00:50:56:C0:00:C

☒ MMS server on all available interfaces Port: 102

VMware Virtual Ethernet Adapter for VMnet8  
IP: 192.168.72.1  
IP6: FE80:0000:0000:0000:0A28:19D9:AB4E:F2B5

☐ Check OSI addresses

☐ Use TLS

☐ Use ACSE authentication

# IEC 61850 Relay: Setup in the start view – TLS & ACSE

When using TLS and ACSE:

- the port number must be set to 3782,
- the certificate and private key of the server must be provided,
- the certificate of Certificate Authority, Certificate Revocation List and the certificate of the client must be provided,
- optionally, the allowed IP addresses of the client can be defined.

The screenshot shows a configuration window for the IEC 61850 Relay. At the top, there is a checkbox labeled "MMS server on all available interfaces" which is checked. To its right is a "Port" field containing the value "3782". Below this, a text box displays network information: "VMware Virtual Ethernet Adapter for VMnet8", "IP: 192.168.72.1", and "IP6: FE80:0000:0000:0000:0A28:19D9:AB4E:F2B5". Further down, there are three checkboxes: "Check OSI addresses" (unchecked), "Use TLS" (checked), and "Use ACSE authentication" (checked). Below these are two sections for cybersecurity configuration. The "Server cybersecurity configuration" section has fields for "Certificate" and "Private key", each with a folder icon and a radio button. The "Client cybersecurity configuration" section has fields for "CA file", "CRL file", and "Certificate", each with a folder icon and a radio button. There is also a large text area for "Allowed IPs" with a green plus icon and a radio button. At the bottom, there are "OK" and "Cancel" buttons.

☒ MMS server on all available interfaces      Port: 3782


VMware Virtual Ethernet Adapter for VMnet8  
IP: 192.168.72.1  
IP6: FE80:0000:0000:0000:0A28:19D9:AB4E:F2B5


☐ Check OSI addresses

☒ Use TLS


☒ Use ACSE authentication


Server cybersecurity configuration


Certificate:   ☐


Private key:   ☐

Client cybersecurity configuration

CA file:   ☐

CRL file:   ☐

Certificate:   ☐

Allowed IPs:   ☐

OK      Cancel

# IEC 61850 Relay: Outgoing feeder bay simulator

Feeder bay model with circuit breaker and disconnecter.

Simple overcurrent protection relay with IEC61850 server interface (representative classes of LNs, fixed data model).

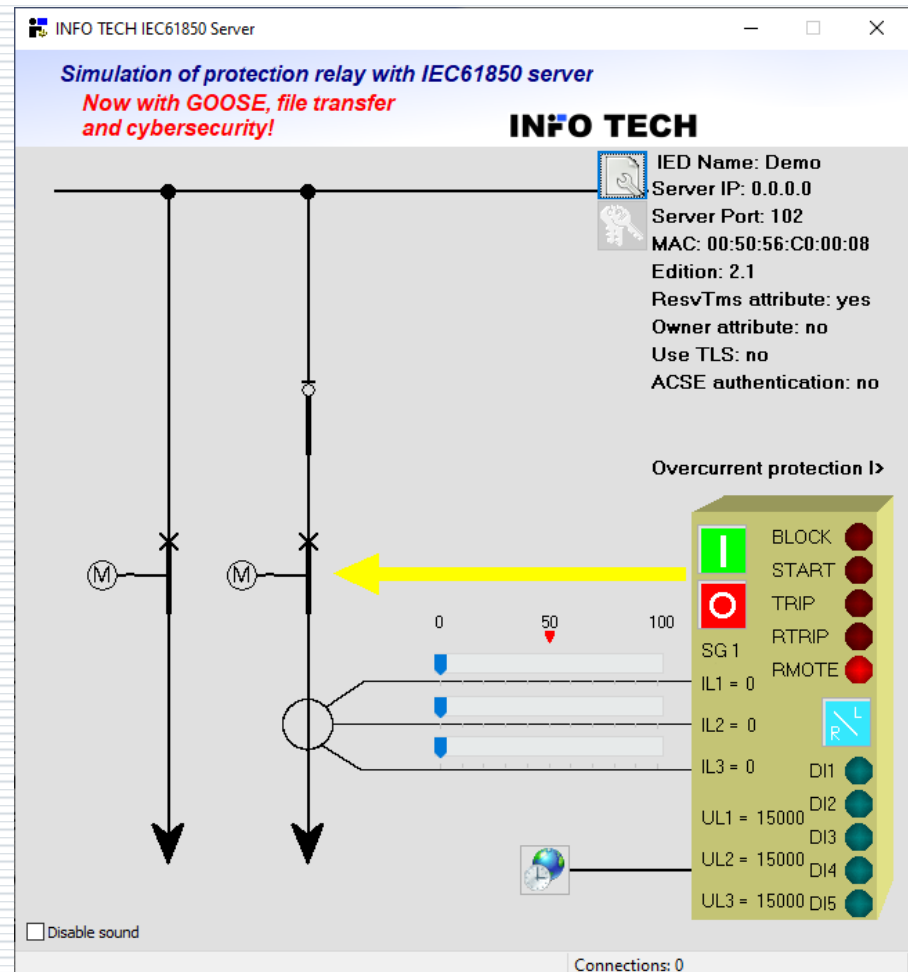
Local and remote monitoring.

Local and remote control (DO-es control model) with hardwired interlocking.

Additional line with circuit breaker for demonstration of an alternative control model (SBO-es).

Simulation of CB motor failure.

Client of time server.



# IEC 61850 Relay: options for Ed.1, Ed.2 and Ed.2.1

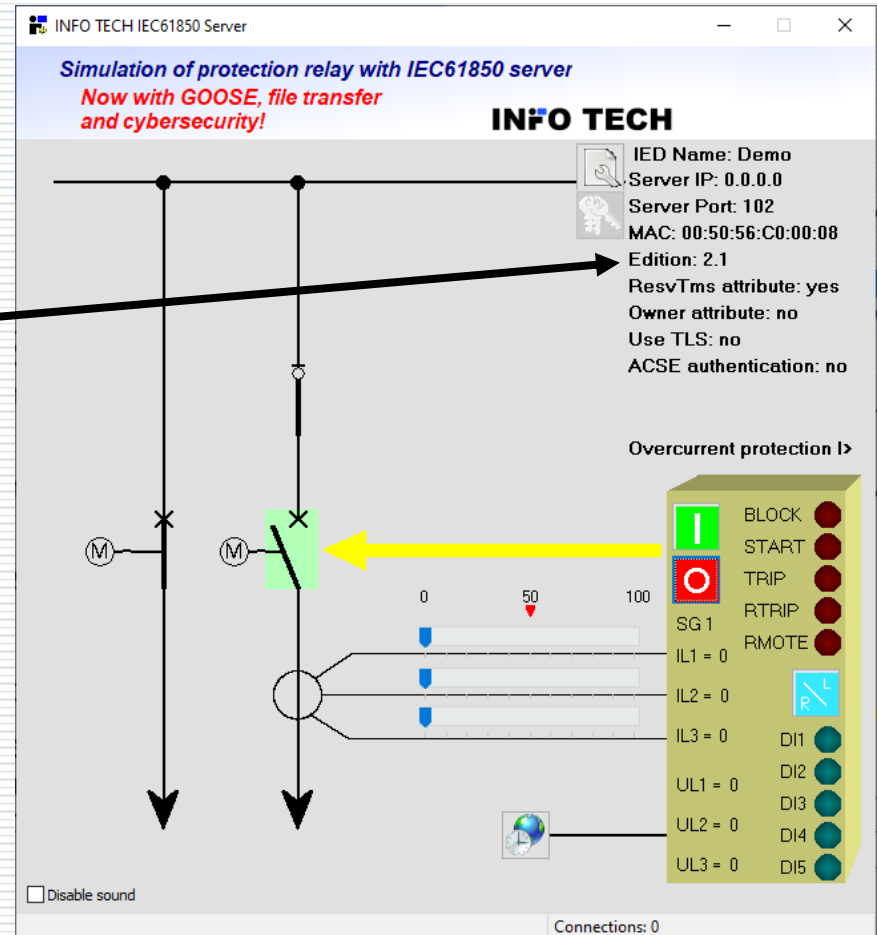
Three options of the simulator program execution are available:

- Conformant with IEC 61850 Ed.1
- Conformant with IEC 61850 Ed.2
- Conformant with IEC 61850 Ed.2.1

(with different ICD files).

Note:

Remember that on the same PC you can run only one instance of the simulator program at a time.

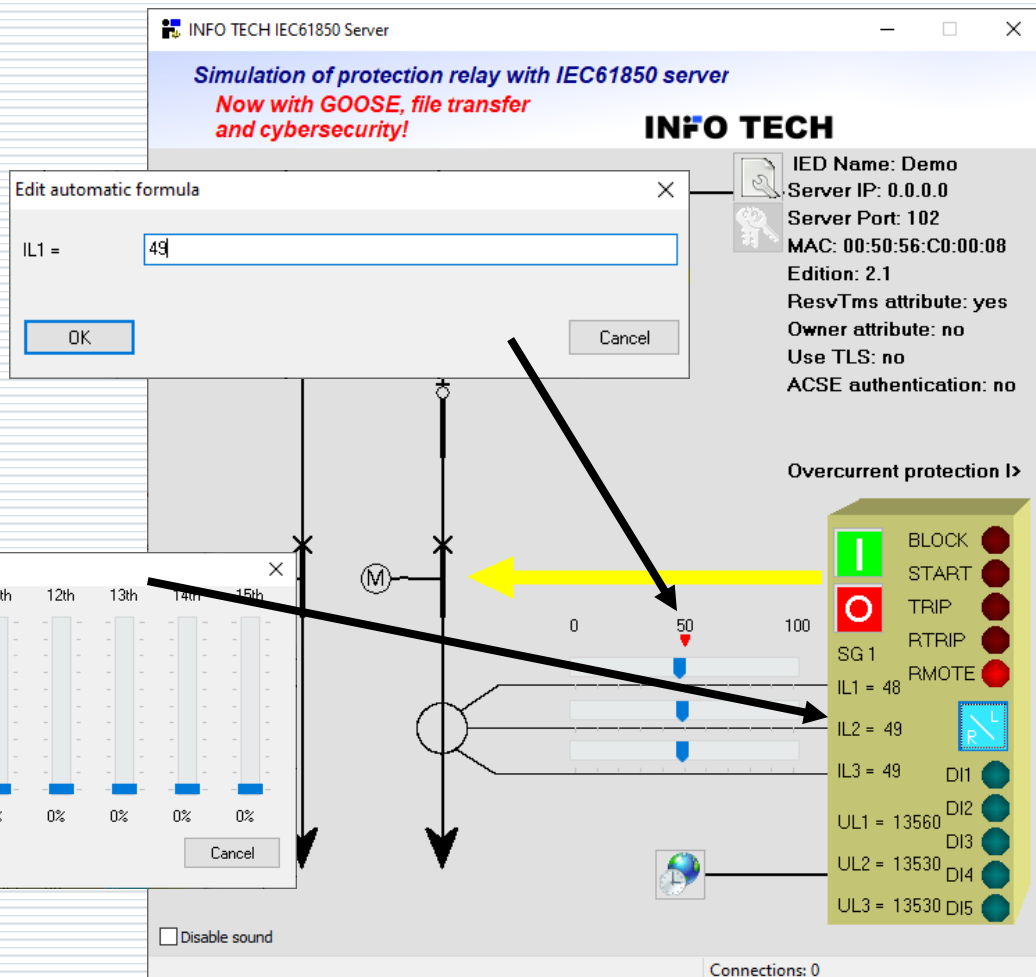
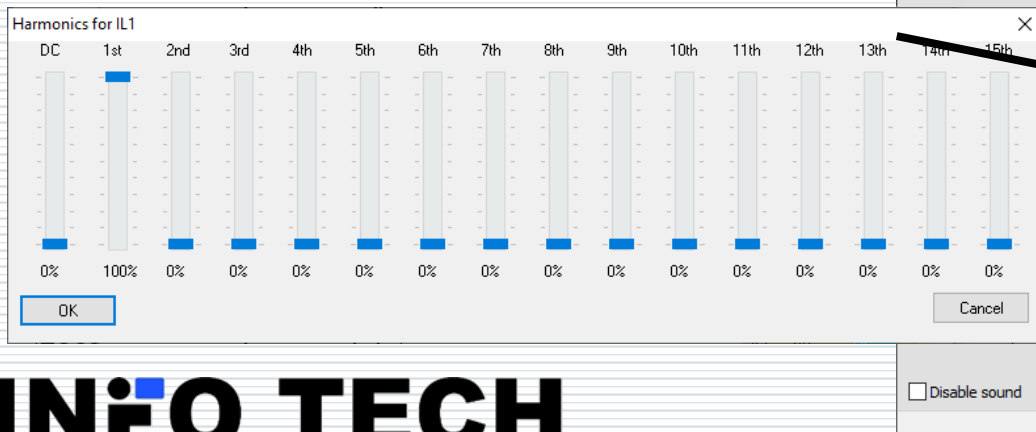


# IEC 61850 Relay: simulation of analog signals

Current level can be driven for each phase (manually or by formula, e.g. time dependent) – menu on its scroll bar.

Possibility to simulate harmonic distortion – click on signal name.

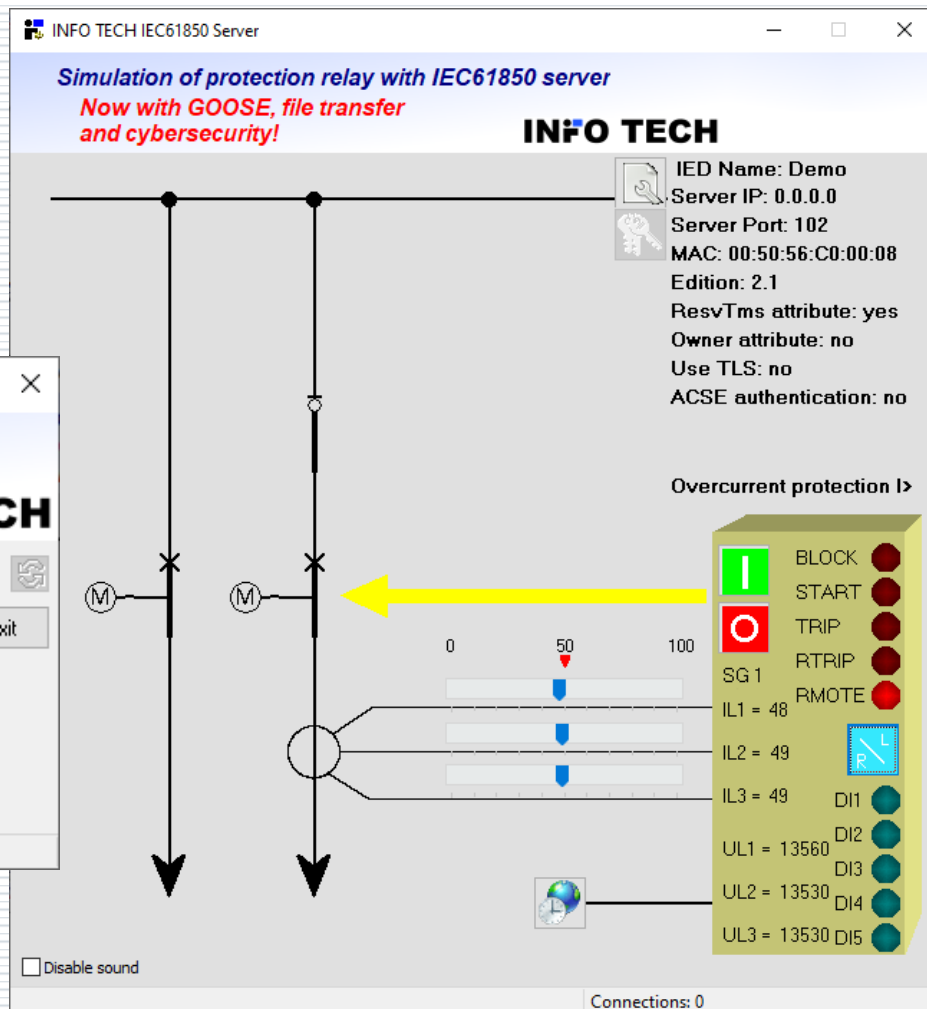
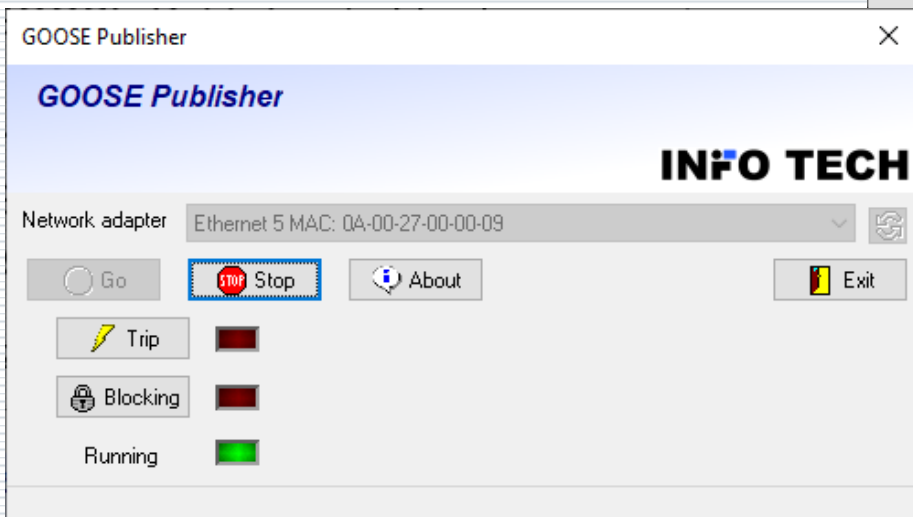
Overcurrent protection with inverse time characteristics.



# IEC 61850 Relay: GOOSE communication

GOOSE Publisher function (in a separate program): publishing status changes.

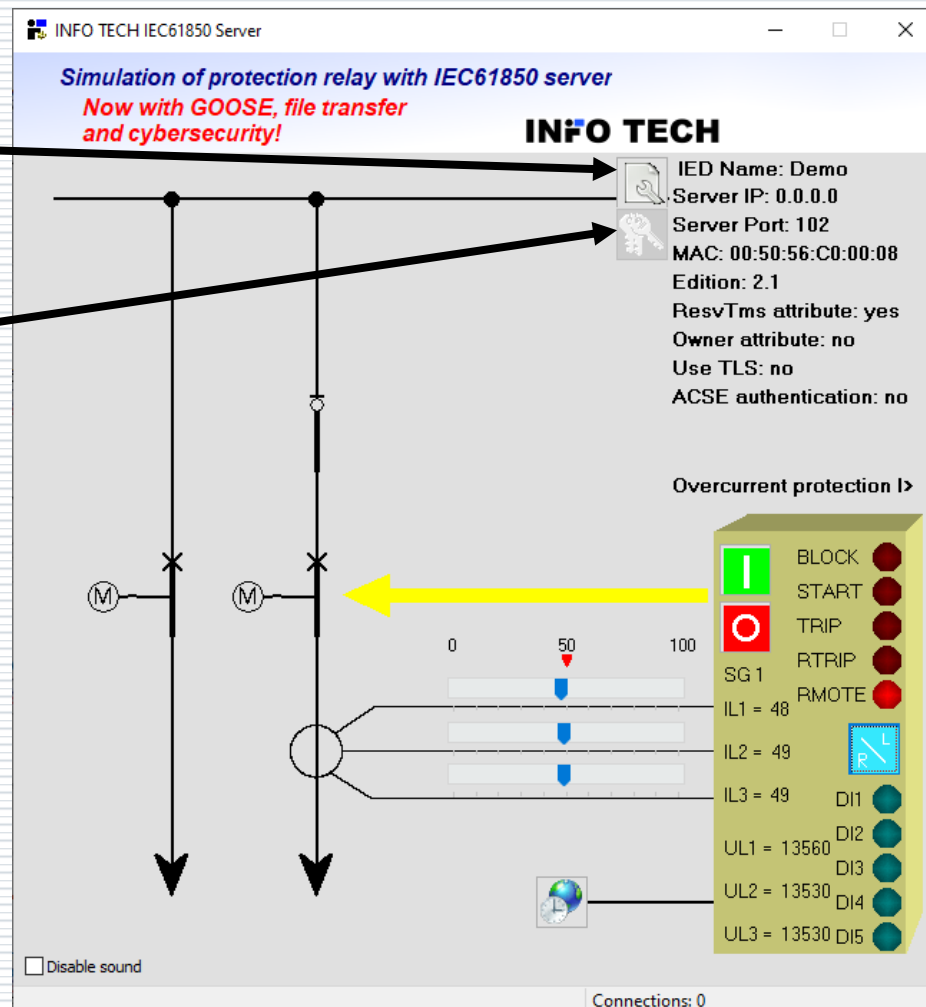
GOOSE Subscriber function: enables **remote tripping** and **remote protection blocking** from another application.



# IEC 61850 Relay: Export of configuration files

Export of ICD file.

If TLS and/or ACSE used:  
Export of secrets (file with  
certificates and keys)



# GOOSE Toolset

---



# GOOSE toolset: GOOSE Sender – configurable publisher

The program operating as GOOSE Publisher with configurable transmission parameters of GOOSE messages, including the possibility of creating a dataset with data values driven manually by the user or by calculation formulas.

Press **GO** button to start publishing and **STOP** button to terminate.

Note: The program by default sets the GOOSE message **Simulation** bit (Ed.2) / **Test** bit (Ed.1) to TRUE to avoid unwanted consequences of transmitting GOOSE messages. It is the user's responsibility to change this bit value.

GOOSE Sender

File Edit Transmission Help

Network adapter: Ethernet 5 MAC: 0A-00-27-00-00-09

Type: Not routable

Ethernet

Source: 0A:00:27:00:00:09 Own

Destination: 01:0C:CD:01:00:20 M-cast

VLAN

Priority: 4

☒ VLAN header CFI: Eth ID: 0 H

IP

Address: 239.1.1.35 M-cast

Class of traffic: 32

GOOSE

Edition: 1

App ID: 20 H

Fixed: FALSE

DSRef: LLN0\$DS4

CBRef: LLN0\$gcb1

GID: EM20

Time: 2023-03-08 08:18:43.335

TTL: 0

StNum: 0

SqNum: 0

CfgRev: 20

NComm: FALSE

Test: TRUE

Data items

Idx	Type	Value	Formula	Data reference
0	BOOL	FALSE		
1	STRUCT	5 element(s)		
1.0	BOOL	FALSE		
1.1	QUALITY	00000000000000		
1.2	TIME	2023-03-08 08:18:49.749		
2	INT	0		

Remember to select the correct Ethernet adapter from the list of **Network adapter** parameter.

# GOOSE Sender – data values defined by formulas

if	Conditional result: if argument 1 evaluates to true (is not 0) result is equal to argument 2 otherwise result is equal to argument 3
intpower	IntPower raises argument 1 to the power specified by argument 2 (both arguments are treated as integers)
ln	Natural logarithm ( $\ln(e) = 1$ ) of the argument
log10	Logarithm of base 10 of the argument
logN	Logarithm base N of X
max	Maximum of 2 arguments
min	Minimum of 2 arguments
pi	The ratio of a circle's circumference to its diameter. Pi is approximated as 3.1415926535897932385
pow	Power raises argument 1 (base) to power given by argument 2 (exponent). For fractional exponents or exponents greater than 2147483647, base must be greater than 0
radtodeg	Converts angles measured in radians to degrees
randG	Produces random numbers with Gaussian distribution parametrized by argument 2 (standard deviation) about the argument 1 (mean).
random	Produces random number within the range $0 \leq X < 1$
round	Rounds a real-type value to an integer-type value
sin	Sine of the argument
sinh	Hyperbolic sine of the argument
sqr	Square of the argument
sqrt	Square root of the argument
tan	Tangent of X
tanh	Hyperbolic tangent of X
trunc	Truncates a real-type value to an integer-type value (value of X rounded toward zero)

Symbol Explanation	
!	Factorial i.e. $5!$ gives $1*2*3*4*5 = 120$
%	Percentage i.e. 10% gives 0.1
-	Negate i.e. -10 gives -10 and --10 gives 10
+	Positive value i.e. +10 gives 10
^	Power i.e. $3^2$ gives 9
*	Multiplication i.e. $2*2$ gives 4
/	Division i.e. $4/2$ gives 2
div	Integer division (result and operands are treated as integers)
mod	Remainder i.e. $3 \bmod 2$ gives 1 (result and operands are treated as integers)
+	Sum i.e. $2+2$ gives 4
-	Subtract i.e. $4-2$ gives 2
-	Subtract i.e. $4-2$ gives 2
-	Subtract i.e. $4-2$ gives 2
<	Less than i.e. $3 < 2$ gives 0 (false)
<=	Less than or equal to i.e. $1 \leq 2$ gives 1 (true)
>=	Greater than or equal to i.e. $4 \geq 2$ gives 1 (true)
>	Greater than i.e. $4 > 2$ gives 1 (true)
=	Equal to i.e. $4 = 2$ gives 0 (false)
<>	Not equal to i.e. $4 \neq 2$ gives 1 (true)
not	Logical negation i.e. not 0 gives 1 and not 1 gives 0
or	Bitwise or i.e. 1 or 4 gives 5
and	Bitwise and i.e. 3 and 6 gives 2
xor	Bitwise xor i.e. 7 xor 5 gives 2

When defining formulas for calculating data values and their changes it is possible to use various operators, functions and variable T representing time counter (in seconds) from the publisher function start, e.g.:

T mod 2	- sequence false, true, false ... (1 s interval)
$30 + 10 * \sin(2 * T)$	- sin wave with average value 30
if(T mod 2, 10, -10)	- square wave -10,10,-10 ...

# GOOSE Sender – configuration based on imported SCL file

It is possible to configure GOOSE Publisher function by the definition of GoCB object included in the imported SCL file. Transmission parameters and the dataset will be configured as specified in the chosen control block of the selected device.

The screenshot displays the GOOSE Sender application window. The 'Import' menu is highlighted, and an arrow points to the 'Available GOOSE streams' table. The 'GOOSE' configuration panel on the right shows settings for Edition 1, App ID 2, Fixed FALSE, DSRRef LLN0\$DS4, CBRRef LLN0\$gcb1, GID G2, and Time 2023-03-08 08:02:55.610. The 'Data items' table at the bottom lists two streams: Index 1, IED Demo, Type Not routable, Destination Address 01-0C-CD-01-00-00, App ID 0001, Conf Rev 1, GOOSE ID G1, and GCB Reference DemoProtCtrl/LLN0\$GO\$gcb1; and Index 2, IED Demo, Type Not routable, Destination Address 01-0C-CD-01-00-01, App ID 0002, Conf Rev 1, GOOSE ID G2, and GCB Reference DemoProtCtrl/LLN0\$GO\$gcb2. The 'Dataset elements' list includes DemoProtCtrl/DIGGIO1.Ind1.stVal [ST], DemoProtCtrl/DIGGIO1.Ind2.stVal [ST], DemoProtCtrl/DIGGIO1.Ind3.stVal [ST], DemoProtCtrl/DIGGIO1.Ind4.stVal [ST], and DemoProtCtrl/DIGGIO1.Ind5.stVal [ST].

Idx	IED	Type	Destination Address	App ID	Conf Rev	GOOSE ID	GCB Reference
1	Demo	Not routable	01-0C-CD-01-00-00	0001	1	G1	DemoProtCtrl/LLN0\$GO\$gcb1
2	Demo	Not routable	01-0C-CD-01-00-01	0002	1	G2	DemoProtCtrl/LLN0\$GO\$gcb2

# GOOSE Sender – simulation of another device

In this way the program can simulate the transmission performed by another device. It allows to test how GOOSE messages will be received and processed by devices with GOOSE Subscriber function.

In case of such a configuration the dataset description table will also include Data reference information with names of dataset elements.

The screenshot shows the GOOSE Sender application window. The interface includes a menu bar (File, Edit, Transmission, Help) and a toolbar with various icons. The main configuration area is divided into several sections:

- Ethernet:** Type is set to "Not routable". Source MAC is "0A:00:27:00:00:09" (Own). Destination MAC is "01:0C:CD:01:00:01" (M-cast).
- VLAN:** VLAN header is checked. Priority is 4. CFI is Eth. ID is 0.
- IP:** Address is "239.1.1.35" (M-cast). Class of traffic is 32.
- GOOSE:** Edition is 1. App ID is 2. Fixed is FALSE. DSRef is "DemoProtCtrl/LLN0\$DS4\_GOOSE". CBRef is "DemoProtCtrl/LLN0\$GO\$gob2". GID is G2. Time is "2023-03-08 08:02:55.610". TTL is 4000. StNum is 1. SqNum is 113. CfgRev is 1. NComm is FALSE. Test is TRUE.

Below the configuration sections is a table titled "Data items":

Idx	Type	Value	Formula	Data reference
0	BOOL	FALSE		DemoProtCtrl/DIGGIO1.lnd1.stVal [ST]
1	BOOL	FALSE		DemoProtCtrl/DIGGIO1.lnd2.stVal [ST]
2	BOOL	FALSE		DemoProtCtrl/DIGGIO1.lnd3.stVal [ST]
3	BOOL	FALSE		DemoProtCtrl/DIGGIO1.lnd4.stVal [ST]
4	BOOL	FALSE		DemoProtCtrl/DIGGIO1.lnd5.stVal [ST]

# GOOSE Sender – dataset elements of both simple and structured types

The created or imported configuration of GOOSE Publisher function may include dataset containing elements of simple or structured types – both options are supported.

The screenshot shows the GOOSE Sender application window. The top menu bar includes File, Edit, Transmission, and Help. Below the menu is a toolbar with icons for file operations, status (GO, STOP), and network settings. The main configuration area is divided into several sections:

- Ethernet**: Type (Not routable), Source (0A:00:27:00:00:09), Destination (01:0C:CD:01:00:20), VLAN (checked), Priority (4), CFI (Eth), ID (0), IP Address (239.1.1.35), and Class of traffic (32).
- GOOSE**: Edition (1), App ID (20), Fixed (FALSE), DSRRef (EM20TCPLD0/LLN0\$DS3\_Goose), CBRRef (EM20TCPLD0/LLN0\$G0\$gcb1), GID (EM20), Time (2023-03-08 08:02:55.610), TTL (4000), StNum (1), SqNum (113), CtgRev (20), NComm (FALSE), and Test (TRUE).

Below the configuration area is a table titled "Data items" with columns: Idx, Type, Value, Formula, and Data reference.

Idx	Type	Value	Formula	Data reference
0	STRUCT	3 element(s)		EM20TCPLD0/GOOSE01GGIO65.Ind [ST]
0.0	BOOL	FALSE		EM20TCPLD0/GOOSE01GGIO65.Ind.stVal [ST]
0.1	QUALITY	000000000000		EM20TCPLD0/GOOSE01GGIO65.Ind.q [ST]
0.2	TIME	2023-03-08 09:17:08.328		EM20TCPLD0/GOOSE01GGIO65.Ind.t [ST]
1	STRUCT	3 element(s)		EM20TCPLD0/GOOSE02GGIO66.Ind [ST]
1.0	BOOL	TRUE		EM20TCPLD0/GOOSE02GGIO66.Ind.stVal [ST]
1.1	QUALITY	000000000000		EM20TCPLD0/GOOSE02GGIO66.Ind.q [ST]
1.2	TIME	2023-03-08 09:17:08.329		EM20TCPLD0/GOOSE02GGIO66.Ind.t [ST]
2	STRUCT	3 element(s)		EM20TCPLD0/GOOSE03GGIO67.Ind [ST]
2.0	BOOL	TRUE		EM20TCPLD0/GOOSE03GGIO67.Ind.stVal [ST]
2.1	QUALITY	000000000000		EM20TCPLD0/GOOSE03GGIO67.Ind.q [ST]
2.2	TIME	2023-03-08 09:17:08.330		EM20TCPLD0/GOOSE03GGIO67.Ind.t [ST]
3	STRUCT	3 element(s)		EM20TCPLD0/GOOSE04GGIO68.Ind [ST]
3.0	BOOL	TRUE		EM20TCPLD0/GOOSE04GGIO68.Ind.stVal [ST]
3.1	QUALITY	000000000000		EM20TCPLD0/GOOSE04GGIO68.Ind.q [ST]
3.2	TIME	2023-03-08 09:17:08.331		EM20TCPLD0/GOOSE04GGIO68.Ind.t [ST]
4	STRUCT	3 element(s)		EM20TCPLD0/GOOSE05GGIO69.Ind [ST]

# GOOSE toolset: GOOSE Receiver – configurable subscriber

Configurable GOOSE  
Subscriber function: reception  
parameters can be set  
manually or from the message  
stream detected in the  
network and subscribed.

Press **GO** button to start the  
message reception and **STOP**  
button to terminate.

GOOSE Receiver

File Transmission Data Help

GO STOP

Network adapter: Ethernet 5 MAC: 0A-00-27-00-00-09

**Type** Not routable

**Ethernet**

Source 0A:00:27:00:00:09

Destination 01:0C:CD:01:00:01 M-cast

**VLAN**

☒ VLAN header

Priority 4

CFI Eth

ID 0 H

**IP**

Destination 239.1.1.35 M-cast

Source 0.0.0.0

IGMP 0.0.0.0

**GOOSE**

App ID 2 H

TTL 4000

DSRef DemoProtCtrl/LLN0\$DS4\_GOOSE

CBRef DemoProtCtrl/LLN0\$GO\$gcb2

GID G2

Time 2023-03-08 08:23:37.707

StNum 1

SqNum 18

CfgRev 1

NComm FALSE

Test TRUE

Status OK

**Statistics**

Frames 6

Accepted 6

Errors 0

Clear

**Data items**

Idx	Type	Value	Data reference
0	BOOL	FALSE	
1	BOOL	FALSE	
2	BOOL	FALSE	
3	BOOL	FALSE	
4	BOOL	FALSE	

# GOOSE Receiver – monitoring the selected message stream

The selected GOOSE message stream can be monitored to test the performance of transmitting device (e.g. detect data changes, interruptions of transmissions, etc.).

Viewing message streams present in the networks allows also to recognize configuration errors, e.g. the same APPID or GOOSE ID values set to different publishers.

GOOSE Receiver

File Transmission Data Help

Network adapter: Ethernet MAC: 98-29-A6-87-39-76

**GOOSE**

Type: Not routable

Ethernet

Source: 98:29:A6:87:39:76

Destination: 01:0C:CD:01:00:01

VLAN

☒ VLAN header

Priority: 4

CFI: Eth

ID: 0

IP

Address: 239.1.1.35

App ID: 2

TTL: 4000

DSRef: DemoProtCtrl/LLN0\$DS4\_GOOSE

CBRRef: DemoProtCtrl/LLN0\$GO\$gcb2

GID: G2

Time: 2020-06-05 12:26:52.849

StNum: 2

SqNum: 24

CfgRev: 1

NComm: FALSE

Test: TRUE

Status:

**Data items**

Idx	Type	Value	Data reference
0	BOOL	FALSE	DemoProtCtrl/DIGGIO1.Ind1.stVal [ST]
1	INT	0	DemoProtCtrl/DIGGIO1.Ind2.stVal [ST]
2	FLOAT	1.65699994	DemoProtCtrl/DIGGIO1.Ind3.stVal [ST]
3	BOOL	FALSE	DemoProtCtrl/DIGGIO1.Ind4.stVal [ST]
4	BOOL	FALSE	DemoProtCtrl/DIGGIO1.Ind5.stVal [ST]

A sequence of received GOOSE messages can be traced in the invoked **Parser** window.

# GOOSE Receiver – detecting errors in configuration of message streams

The view of GOOSE message streams indicates conflicts in the system configuration:

**Error:** streams of different publishers have the same parameter values of Destination MAC, App ID and GOOSE ID

**Warning:** streams of different publishers have the same parameter values of Destination MAC and App ID.

[illegible]

Streams with conflicts are marked with colored background:

**Red** – error, **Dark red** – error and conflict with the stream selected for monitoring, **Yellow** – warning, **Dark yellow** – warning and conflict with the stream selected for monitoring, No color – no conflict.

# GOOSE Receiver – configuration from imported SCL file

GOOSE Subscriber function can be also configured by the definition of GoCB object included in the imported SCL file. In this way it is possible to test message transmissions from each of the publishers present in the described system.

The screenshot displays the 'GOOSE Receiver' application window. The 'Import' menu is open, showing options for 'Ethernet', 'VLAN', and 'IP'. The 'Ethernet' section is active, showing source and destination MAC addresses, a priority of 4, and a checked 'VLAN header' option. The 'GOOSE' section on the right shows configuration for App ID 2, TTL 4000, DSRef, CBRef, GID, and Time. Below the configuration panels, a table titled 'Available GOOSE streams' lists two streams. The 'Data reference' section on the right lists dataset elements for the selected stream.

Idx	IED	Type	Dest...	App ID	Con...	GOOSE ID	GCB Reference
1	Demo	Not routable	01-0C...	0001	1	G1	DemoProtCtrl/LLN0\$GO\$gcb1
2	Demo	Not routable	01-0C...	0002	1	G2	DemoProtCtrl/LLN0\$GO\$gcb2

Dataset elements
DemoProtCtrl/DIGGIO1.Ind1.stVal [ST]
DemoProtCtrl/DIGGIO1.Ind2.stVal [ST]
DemoProtCtrl/DIGGIO1.Ind3.stVal [ST]
DemoProtCtrl/DIGGIO1.Ind4.stVal [ST]
DemoProtCtrl/DIGGIO1.Ind5.stVal [ST]

# GOOSE Receiver – dataset elements of both simple and structured types

GOOSE Subscriber function supports reception of messages with dataset containing elements of simple or structured types.

The screenshot shows the GOOSE Receiver application window. It has a menu bar (File, Transmission, Data, Help) and a toolbar with icons for file operations, GO/STOP, search, and help. The main configuration area is divided into several sections:

- Network adapter:** Ethernet MAC: 98-29-A6-87-39-76
- Type:** Not routable
- Ethernet:**
  - Source: 98 : 29 : A6 : 87 : 39 : 76 (Own)
  - Destination: 01 : 0C : CD : 01 : 00 : 01 (M-cast)
- VLAN:**
  - Priority: 4
  - ☒ VLAN header
  - CFI: Eth
  - ID: 0 (H)
- IP:**
  - Address: 239 . 1 . 1 . 35 (M-cast)
- GOOSE:**
  - App ID: 2 (H)
  - TTL: 4000
  - DSRef: DemoProtCtrl/LLN0\$DS4\_GOOSE
  - CBRef: DemoProtCtrl/LLN0\$GO\$gcb2
  - GID: G2
  - Time: 2020-06-05 12:26:52.849
  - StNum: 2
  - SqNum: 137
  - CfgRev: 1
  - NComm: FALSE
  - Test: TRUE
  - Status:

Below the configuration is a **Data items** table:

Idx	Type	Value	Data reference
0	BOOL	FALSE	
1	INT	0	
2	FLOAT	1.6569999945	
3	BOOL	FALSE	
4	BOOL	FALSE	

# GOOSE Sender and GOOSE Receiver support also routable messages

The **Type** of packet to be sent or to be received can be configured:

**Not routable** – GOOSE message as Ethernet frame

**Routable** – sent over IP between IEDs, data part of GOOSE frame routed using IP packets and UDP protocol, locally forwarded by receiving IED as Ethernet GOOSE frame

**Routable tunneled** – sent between routers of two subsystems, GOOSE frame routed using IP packets and UDP protocol, locally forwarded by router as Ethernet GOOSE frame

The screenshot shows a configuration window with the following fields:

Type	Not routable
Ethernet	Not routable
Source	Routable
Destination	01 : 0C : CD : 01 : 00 : 01
	M-cast

The screenshot shows a configuration window with the following fields:

IP	
Address	239 . 1 . 1 . 35
	M-cast
Class of traffic	32

For routable GOOSE the multicast destination IP address and class of traffic must be also configured.

# Routable GOOSE: differences between types of routing

---

By using routable GOOSE (R-GOOSE) it is possible to transfer critical messages between different LANs of a wide area automation system.

An IP packet with **routable tunneled R-GOOSE** message contains an original destination MAC address and VLAN header – this information is then retained by the receiving router when forwarding R-GOOSE message as Ethernet GOOSE message to the local network.

An IP packet with **routable R-GOOSE** message comes without its original destination MAC address and VLAN header. This information will be set by the receiving router based on the internal setup before forwarding R-GOOSE message as Ethernet GOOSE message to the local network.

# Sampled Values Toolset

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# SV toolset: SAV Sender – working area

Sender working area shows properties of the currently sent Sampled Values stream. This area is divided into several groups:

**Ethernet header** showing source and destination MAC address of the message

**VLAN header** showing VLAN part of the message (if present)

**Sampled Values header** used to set Sampled Values header part of the message

**Signal sampling properties** showing all options of the sampling rate and ASDU packing in accordance with the IEC 61869-9

**Signal quality bits** allowing to set quality bits for each sampled signal

**Signal values** allowing to set amplitude and phase of each simulated signal

The screenshot shows the 'Sampled Values Sender' application window. It features a menu bar (File, Transmission, Help), a toolbar with icons for file operations and status (GO, STOP, INFO), and a network adapter selection dropdown set to 'Ethernet MAC: 98-29-A6-87-39-76'.

The main configuration area is divided into several sections:

- Type:** Set to 'Routable'.
- Ethernet:** Source MAC '98 : 29 : A6 : 87 : 39 : 76' (Own), Destination MAC '01 : 0C : CD : 04 : 00 : 00' (M-cast).
- VLAN:** Priority '4', CFI 'Eth', ID '0' (H).
- IP:** Address '239 . 1 . 1 . 35' (M-cast), Class of traffic '32'.
- Sampled Values Header:** App ID '4000' (H), Simulation 'TRUE' (green), Config Rev '1', SvID 'INFOTECHMU01'.
- Signal values:** Frequency '50.00' Hz, Nominal frequency '50 Hz'. It lists signals I1, I2, I3, Io, U1, U2, U3, Uo with their respective Amplitude [A] or [V] and Phase [deg] settings.
- Signal sampling:** Variant 'F4000S1', Samples/Cycle '80', Synchronized 'No'. A note specifies 'F4000S114U4 For use on 50Hz system backward compatible with 9-2LE guideline: 4000Hz sampling rate, 1 ASDU per frame'.
- Signal quality:** A table of quality bits for each signal (I1, I2, I3, Io, U1, U2, U3, Uo) with checkboxes for various error conditions like Invalid/Good, Questionable, Overflow, etc.

Annotations with arrows point from the text on the left to the corresponding sections in the software interface:

- From 'Ethernet header' to the Ethernet MAC address fields.
- From 'VLAN header' to the VLAN configuration fields.
- From 'Sampled Values header' to the App ID, Simulation, and Config Rev fields.
- From 'Signal sampling properties' to the Signal sampling section.
- From 'Signal quality bits' to the Signal quality table.
- From 'Signal values' to the Signal values section.

# SV toolset: SAV Sender

## - simulator of Merging Unit

Configurable publisher of message stream with sampled values – Merging Unit simulator.

Define characteristics of sampled signals (amplitude, phase, frequency) manually or using calculation formulas. Simulate quality problems for the transmitted sampled values, if required.

Edit formula

Phs[I1] = [0,5]

OK Cancel

Press **GO** button to start publishing and **STOP** button to terminate.

Sampled Values Sender

File Transmission Help

Network adapter Ethernet MAC: 98-29-A6-87-39-76

Type Routable

Ethernet Source 98:29:A6:87:39:76 Own Destination 01:0C:CD:04:00:00 M-cast VLAN 4 CFI Eth ID 0 H

IP Address 239.1.1.35 M-cast Class of traffic 32

Sampled Values Header App ID 4000 H Simulation TRUE Config Rev 1 SvID INFOTECHMU01

Signal Values Frequency [Hz] 50.00 Nominal frequency 50 Hz Amplitude [A] Phase [deg] Amplitude [V] Phase [deg]

I1 100.00 f(x) 0.00 f(x) U1 1000.00 f(x) 0.00 f(x)

I2 100.00 f(x) 120.00 f(x) U2 1000.00 f(x) 120.00 f(x)

I3 100.00 f(x) -120.00 f(x) U3 1000.00 f(x) -120.00 f(x)

Io 0.00 f(x) 0.00 f(x) Uo 0.00 f(x) 0.00 f(x)

Sampled Values Quality

	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Questionable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bad Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oscillatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Old Data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inconsistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inaccurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Substituted/Process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator Blocked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Derived	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Include ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒

Signal sampling Variant F4000S1 Samples/Cycle 80 Synchronized No

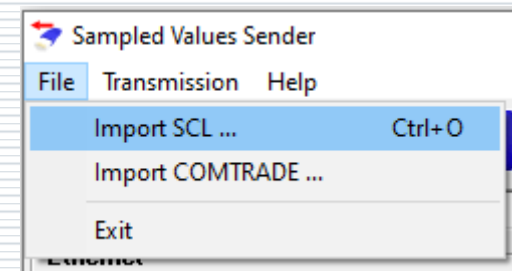
F4000S114U4  
For use on 50Hz system backward compatible with 9-2LE guideline: 4000Hz sampling rate, 1 ASDU per frame

# SV toolset: SAV Sender

## - configuration from files

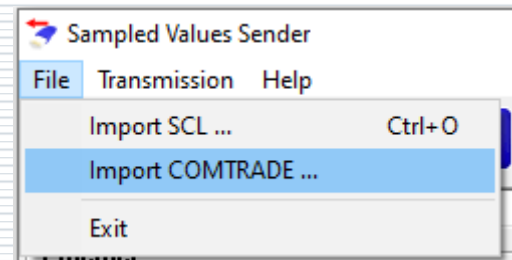
---

The transmission parameters of a Merging Unit to be simulated can be configured using an imported SCL file with the defined MSVCB object.



The sampled signals waveforms can be configured using a recording from an imported COMTRADE.

In this case it is necessary to assign channels from the COMTRADE file to the signals transmitted by SAV Sender.



# SV toolset: SAV Sender – COMTRADE channels selection

This window allows to select signals from an imported COMTRADE file and assign them to channels defined in the IEC 61850-9-2LE specification. Io and Uo signals can be artificially calculated from phase signals if needed (in such a case the DERIVED bit in quality attribute will be set for those signals). Not assigned channels will have values 0 and INVALID quality bit set.

It is possible to view selected signals by pressing **Preview** button. If the selection is acceptable, press **OK** button. Then invoke **Play COMTRADE** command from Transmission menu and the SAV stream will be sent to the network.

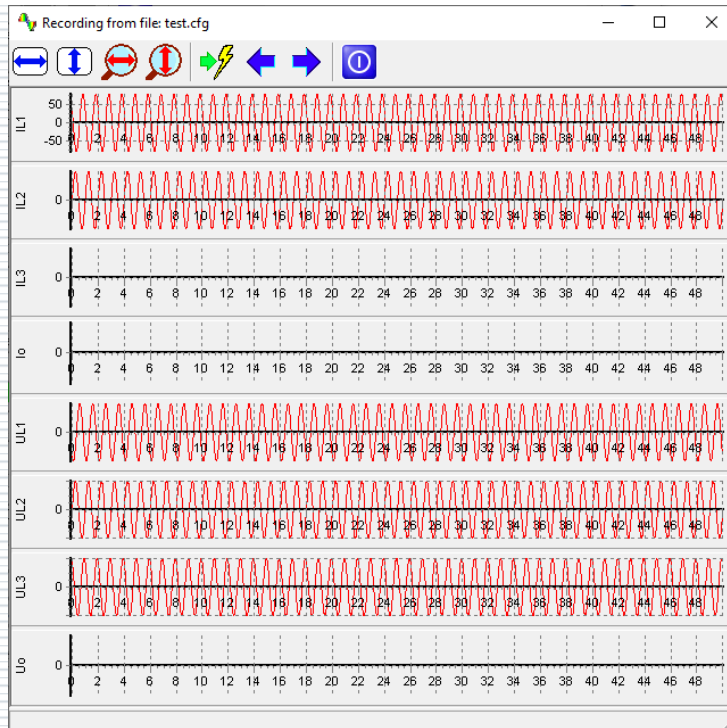
Signal	Channel in COMTRADE file
I1	IL1: L1 Current (A) [A]
I2	IL2: L2 Current (B) [A]
I3	IL3: L3 Current (C) [A]
Io	Not assigned
U1	UL1: L1 Voltage (A) [V]
U2	UL2: L2 Voltage (B) [V]
U3	UL3: L3 Voltage (C) [V]
Uo	Not assigned

☐ Calculate (next to Io)  
☐ Calculate (next to Uo)

OK      Preview      Cancel

# SV toolset: SAV Sender – COMTRADE recording preview

**Preview** button from channels selection window allows visualize selected signals from the imported COMTRADE file.



Shortcuts available in the viewer's toolbox are shown below



**Original width** - command rescales plot to fit horizontally complete waveform



**Original height** - command rescales plot to fit vertically complete waveform



**Magnify horizontally** - command magnifies plot horizontally



**Magnify vertically** - command magnifies plot vertically



**Go to trigger** - command moves plot to make trigger point visible on the screen



**Move left** - command moves plot one step left



**Move right** - command moves plot one step right



**Close** - command closes viewer window

# SV toolset: SAV Receiver - signal processing from received samples

Configurable sampled values subscriber: reception parameters can be set manually or defined using the selected SV message stream from the list of streams detected in the network.

Available SAV streams

Idx	Type	Source MAC	Destination ...	IP	App ID	Config Rev	SV ID	Mess...	Simul...
1	Not r...	98:29:A6:87...	01:0C:CD:04...	N/A	4000	1	INFOTECHM...	36448	FALSE

Press **GO** to start receiving and **STOP** to stop.

Subscribe Clear Close

Sampled Values Receiver

File Transmission Data Help

Start Stop Refresh adapters Detect streams

Network adapter Ethernet MAC: 98-29-A6-87-39-76

Communication status  
Status: OFF line  
Lost messages 0 Clear

Sampled Values Quality

	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Questionable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bad Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oscillatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Old Data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inconsistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inaccurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Substituted/Process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator Blocked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Derived	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IP Address 239 . 1 . 1 . 35 M-cast

Sampled Values PDU  
App ID 4000 H  
Config Rev 1  
SvID INFOTECHMU01  
Samples/cycle 80 Sample Count 3499  
APDUS 1 Synchronized No

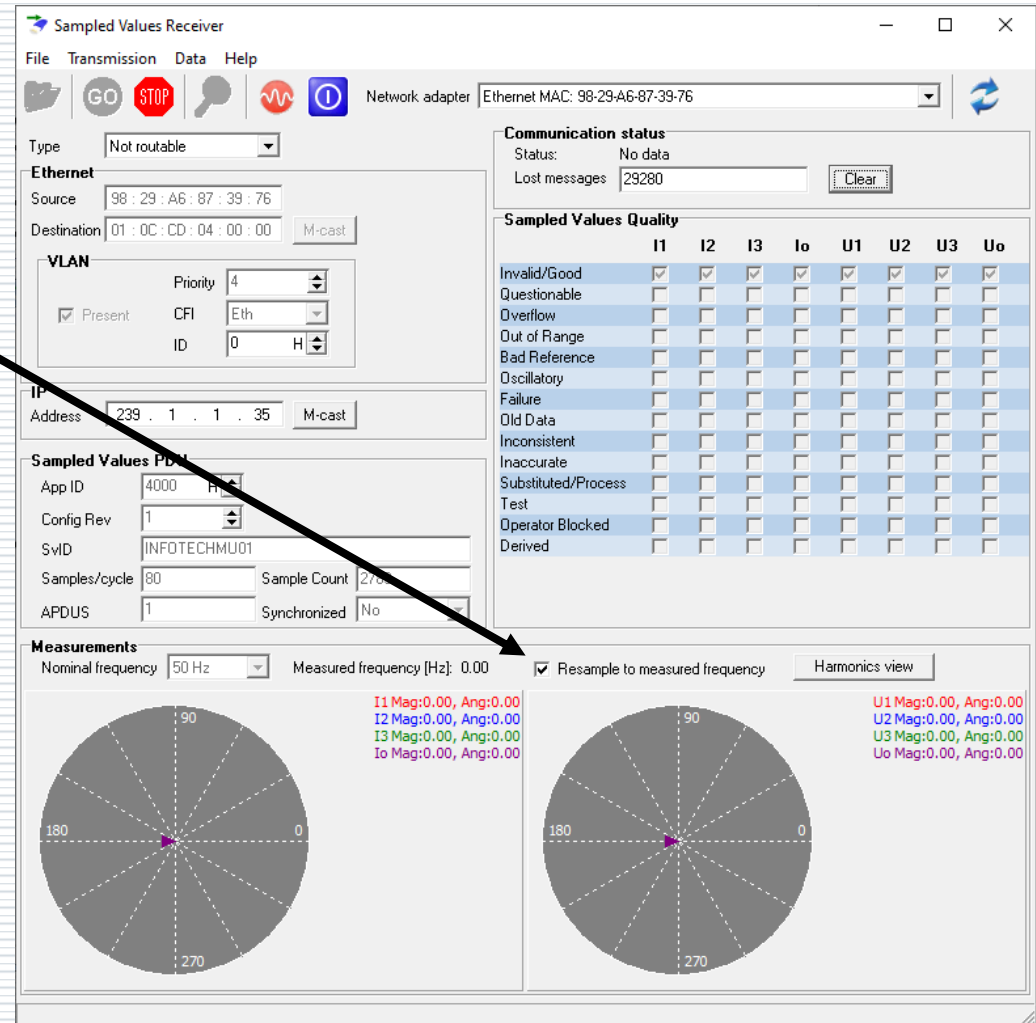
Measurements  
Nominal frequency 50 Hz Measured frequency [Hz]: 0.00 ☒ Resample to measured frequency Harmonics view

I1 Mag:0.00, Ang:0.00  
I2 Mag:0.00, Ang:0.00  
I3 Mag:0.00, Ang:0.00  
Io Mag:0.00, Ang:0.00  
U1 Mag:0.00, Ang:0.00  
U2 Mag:0.00, Ang:0.00  
U3 Mag:0.00, Ang:0.00  
Uo Mag:0.00, Ang:0.00

# SV toolset: SAV Receiver – computation of signal characteristics

Signal characteristics are computed in real-time based on the incoming sampled values message stream.

The computation may (optionally) apply resampling in case of detecting a deviation of the actual signal frequency from the nominal signal frequency specific for power systems.



# SV toolset: SAV Receiver - tracing SV message stream

SV messages are displayed in Parser window.

The screenshot displays the SAV Receiver application interface. The main window is titled "Sampled Values Receiver" and includes a menu bar with File, Transmission, Data, and Help. The "Data" menu is open, showing options for Parser window and Recorder. The "Parser window" is a separate window showing a list of SV messages. The "Communication status" section shows the status as "No data" and the number of lost messages as 14440. The "Sampled Values Quality" section displays a table of quality indicators for various channels (I1, I2, I3, Io, U1, U2, U3, Uo).

**Parser window**

```
VLAN Hdr ID:0 PRIO:4 CFI:0
SAV Hdr AppID:16384 PDUlen: 110
SAV PDU ASDUs:1
SAV ASDU 1 svID:INFOTECHMU01,smpCnt:2281,confRev:1,smpSynch:0
Frequency 50.00
I1:Amp: 77.00 Phase -86.00 Quality[Good.Process]
I2:Amp: 86.00 Phase 120.00 Quality[Good.Process]
I3:Amp: 0.00 Phase -99.00 Quality[Good.Process]
Io:Amp: 63.00 Phase 126.00 Quality[Good.Process]
U1:Amp: 930.00 Phase 0.00 Quality[Good.Process]
U2:Amp: 1000.00 Phase 120.00 Quality[Good.Process]
U3:Amp: 1000.00 Phase -120.00 Quality[Good.Process]
Uo:Amp: 0.00 Phase -99.00 Quality[Good.Process]

[2020.06.05 15:15:30.647931]
Ethernet Dst MAC:01-0C-CD-04-00-00 Src MAC:98-29-A6-87-39-76
VLAN Hdr ID:0 PRIO:4 CFI:0
SAV Hdr AppID:16384 PDUlen: 110
SAV PDU ASDUs:1
SAV ASDU 1 svID:INFOTECHMU01,smpCnt:2713,confRev:1,smpSynch:0
Frequency 50.00
I1:Amp: 77.00 Phase -86.00 Quality[Good.Process]
I2:Amp: 86.00 Phase 120.00 Quality[Good.Process]
I3:Amp: 0.00 Phase -99.00 Quality[Good.Process]
Io:Amp: 63.00 Phase 126.00 Quality[Good.Process]
U1:Amp: 930.00 Phase 0.00 Quality[Good.Process]
U2:Amp: 1000.00 Phase 120.00 Quality[Good.Process]
U3:Amp: 1000.00 Phase -120.00 Quality[Good.Process]
Uo:Amp: 0.00 Phase -99.00 Quality[Good.Process]
```

**Communication status**

Status: No data  
Lost messages: 14440

**Sampled Values Quality**

	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Questionable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bad Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oscillatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Old Data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inconsistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inaccurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Substituted/Process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator Blocked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Derived	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Sample Count: 2783  
Synchronized: No

Measured frequency [Hz]: 0.00 ☒ Resample to measured frequency ☐ Harmonics view

**Phasor Diagrams**

Left diagram (I1, I2, I3, Io):

- I1 Mag:0.00, Ang:0.00
- I2 Mag:0.00, Ang:0.00
- I3 Mag:0.00, Ang:0.00
- Io Mag:0.00, Ang:0.00

Right diagram (U1, U2, U3, Uo):

- U1 Mag:0.00, Ang:0.00
- U2 Mag:0.00, Ang:0.00
- U3 Mag:0.00, Ang:0.00
- Uo Mag:0.00, Ang:0.00

Show or hide parser window

# SAV Receiver – detecting errors in configuration of message stream

The view of SAV Receiver message streams indicates conflicts in the system configuration:

Stream viewer can also detect possible conflicts in process bus network. Application is using following rule to mark streams:

**Error state: two streams with different source MAC and the same Destination MAC, App ID and SV ID**

**Warning** state: two streams with different source MAC and the same Destination MAC and App ID

[illegible]

Streams with conflicts are marked with colored background:

Red – error, Yellow – warning, No color – no conflict, Lime - conflict warning with selected stream, Aqua - conflict error with selected stream

# SAV Receiver – importing streams definitions from SCL

Definitions of data sent over the network can be imported from standard SCL files. The program can use System Configuration Description files (SCD files) describing the whole substation system or files of selected IEDs like for example Configured IED Description (CID file). Selecting an appropriate stream and clicking at **Use** button will start reception of the stream according to its parameters defined in SCL file.

[illegible]

# SAV Receiver – recording samples in COMTRADE file

Received sequence of sampled values can be also recorded and saved in a COMTRADE format file (manual trigger or determined by condition formula).

The screenshot displays the SAV Receiver software interface, which is used for recording and analyzing sampled values. The interface is divided into several panels:

- Recorder Panel:** This panel allows users to configure recording parameters. It includes fields for Duration [ms] (set to 1000), Pretrigger time [%] (set to 50), and a Trigger condition field. Below these fields is a table showing the status of 8 recording slots. Slot #1 is 'Done' at 05.06.2020 16:50:26, while slots #2 through #8 are 'Empty'. Each slot has a 'Save', 'Clear', and 'View' button. A 'Manual trigger' button and a 'Clear all' button are also present.
- Sampled Values Receiver Panel:** This panel shows the network adapter (Ethernet MAC: 98-29-A6-87-39-76) and the communication status (Status: OFF line, Lost messages: 1461760). It also displays the sampled values quality, which is a table with columns for I1, I2, I3, Io, U1, U2, U3, and Uo. The quality table shows various error conditions like Invalid/Good, Questionable, Overflow, Out of Range, Bad Reference, Oscillatory, Failure, Old Data, Inconsistent, Inaccurate, Substituted/Process, Test, Operator Blocked, and Derived. The Sample Count is 3999, and the Synchronized status is 'No'.
- Sampled Values Quality Panel:** This panel displays the measured frequency (50.00 Hz) and a 'Resample to measured frequency' checkbox. It also shows a 'Harmonics view' with a circular plot of the measured frequency components. The plot shows the magnitude and angle of the fundamental and harmonic components for I1, I2, I3, Io, U1, U2, U3, and Uo.

Slot	State	Trigger time	Progress	Save	Clear	View
#1	Done	05.06.2020 16:50:26	<div></div>	Save	Clear	View
#2	Waiting	-	<div></div>	Save	Clear	View
#3	Empty	-	<div></div>	Save	Clear	View
#4	Empty	-	<div></div>	Save	Clear	View
#5	Empty	-	<div></div>	Save	Clear	View
#6	Empty	-	<div></div>	Save	Clear	View
#7	Empty	-	<div></div>	Save	Clear	View
#8	Empty	-	<div></div>	Save	Clear	View

	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Questionable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overflow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Out of Range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bad Reference	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oscillatory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Failure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Old Data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inconsistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inaccurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Substituted/Process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Test	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Operator Blocked	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Derived	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Measured frequency [Hz]: 50.00 ☒ Resample to measured frequency ☐ Harmonics view

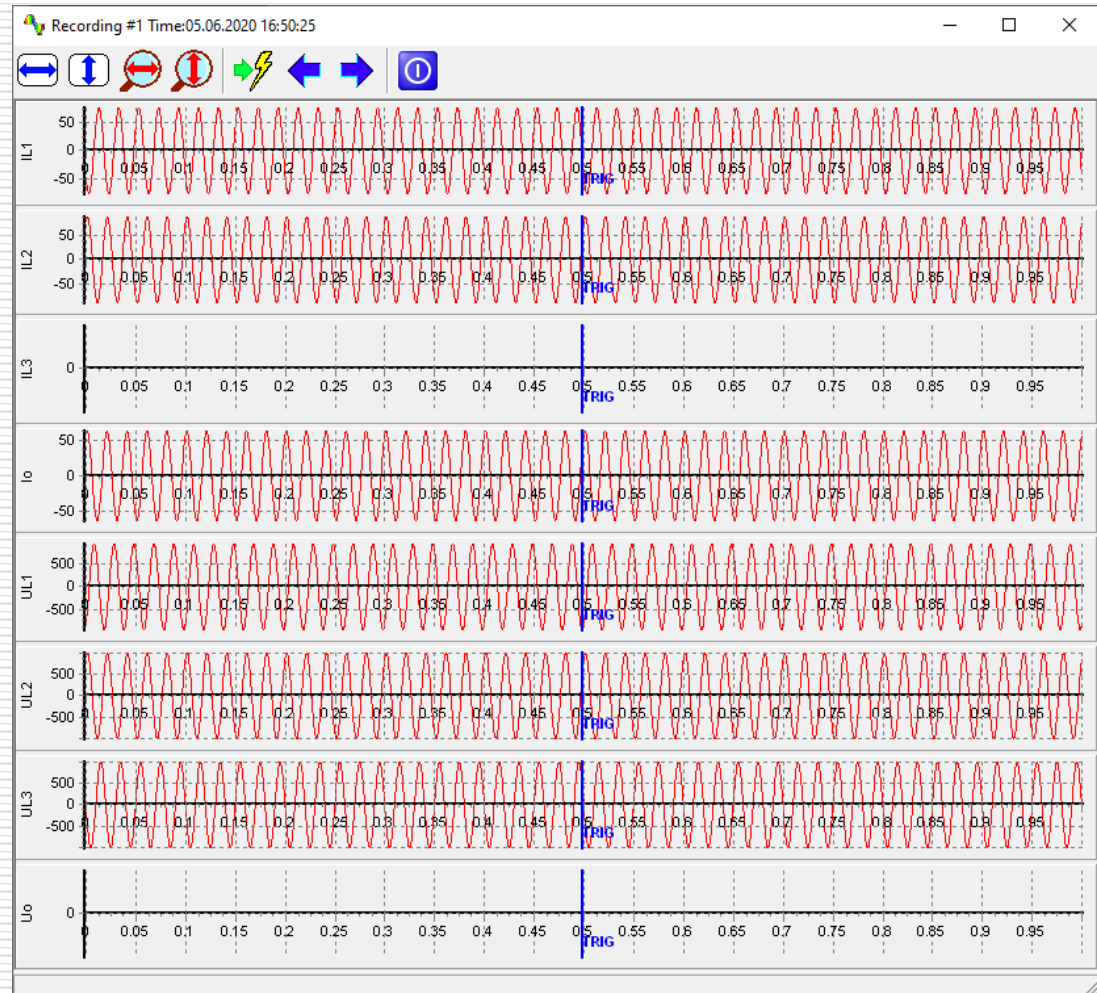
I1 Mag:77.00, Ang:-86.00  
I2 Mag:86.00, Ang:120.00  
I3 Mag:0.00, Ang:162.00  
Io Mag:63.00, Ang:126.00

U1 Mag:930.00, Ang:0.00  
U2 Mag:1000.00, Ang:120.00  
U3 Mag:1000.00, Ang:-120.00  
Uo Mag:0.00, Ang:162.00

# SV toolset: SAV Receiver

## – viewing recorded COMTRADE file

**View** button in **Recorder** window allows to examine the waveforms of the signals received and recorded.



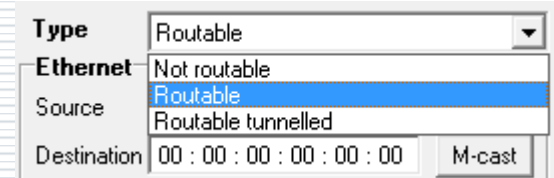
# SAV Sender and SAV Receiver support also routable messages

The **Type** of packet to be sent or to be received can be configured:

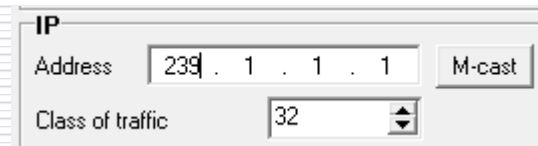
**Not routable** – SV message as Ethernet frame

**Routable** – sent over IP between IEDs, data part of SV frame routed using IP packets and UDP protocol, locally forwarded by receiving IED as Ethernet SV frame

**Routable tunneled** – sent between routers of two subsystems, SV frame routed using IP packets and UDP protocol, locally forwarded by router as Ethernet SV frame



A screenshot of a configuration window for packet types. It contains four rows: 'Type' with a dropdown menu set to 'Routable'; 'Ethernet' with a dropdown menu set to 'Routable' (highlighted in blue); 'Source' with a dropdown menu set to 'Routable tunneled'; and 'Destination' with a text field containing '00 : 00 : 00 : 00 : 00 : 00' and an 'M-cast' button to its right.



A screenshot of an 'IP' configuration window. It has two rows: 'Address' with a text field containing '239 . 1 . 1 . 1' and an 'M-cast' button to its right; and 'Class of traffic' with a dropdown menu set to '32'.

For routable GOOSE the multicast destination IP address and class of traffic must be also configured.

# File Transfer Tool

---



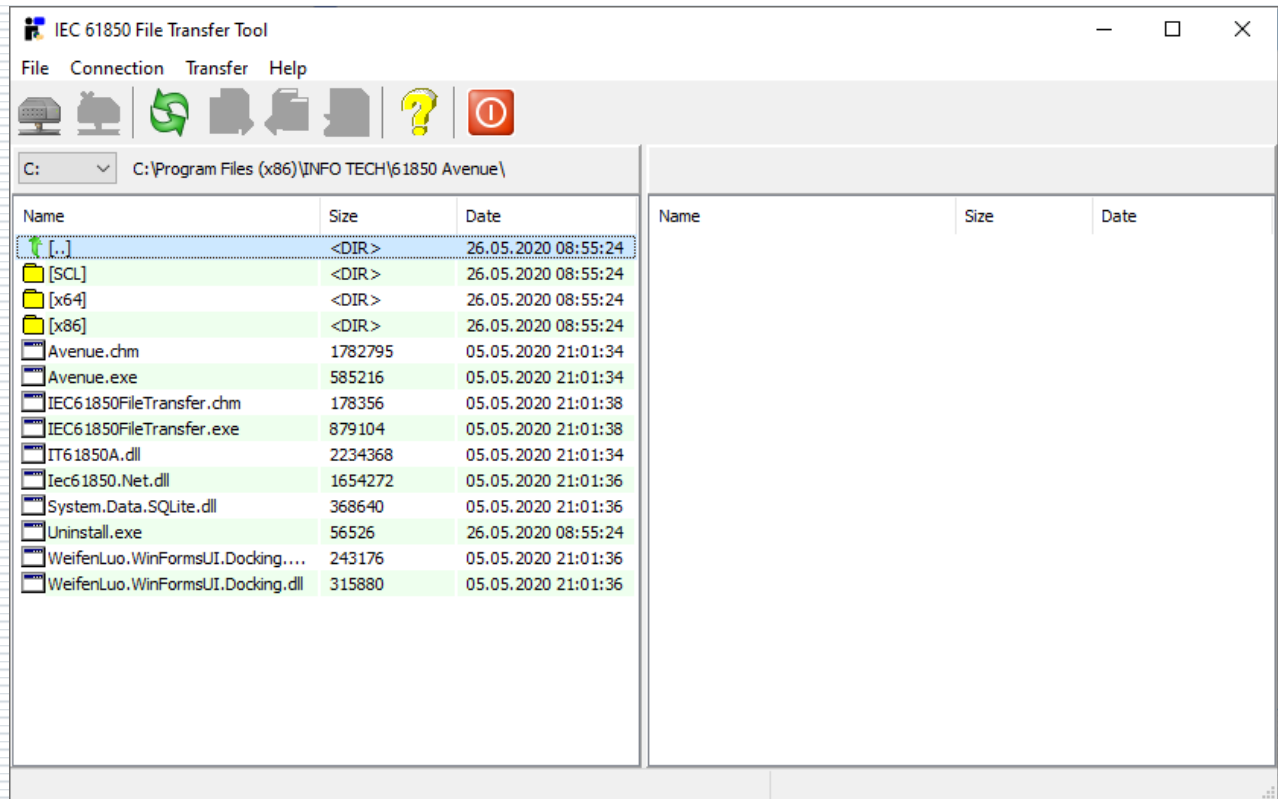
# File Transfer Tool – to test access to files in server devices

Initial view:

Left side: selected directory of the file system on PC.

Right side: file system of the server device.

The program operated as MMS protocol client using file services.

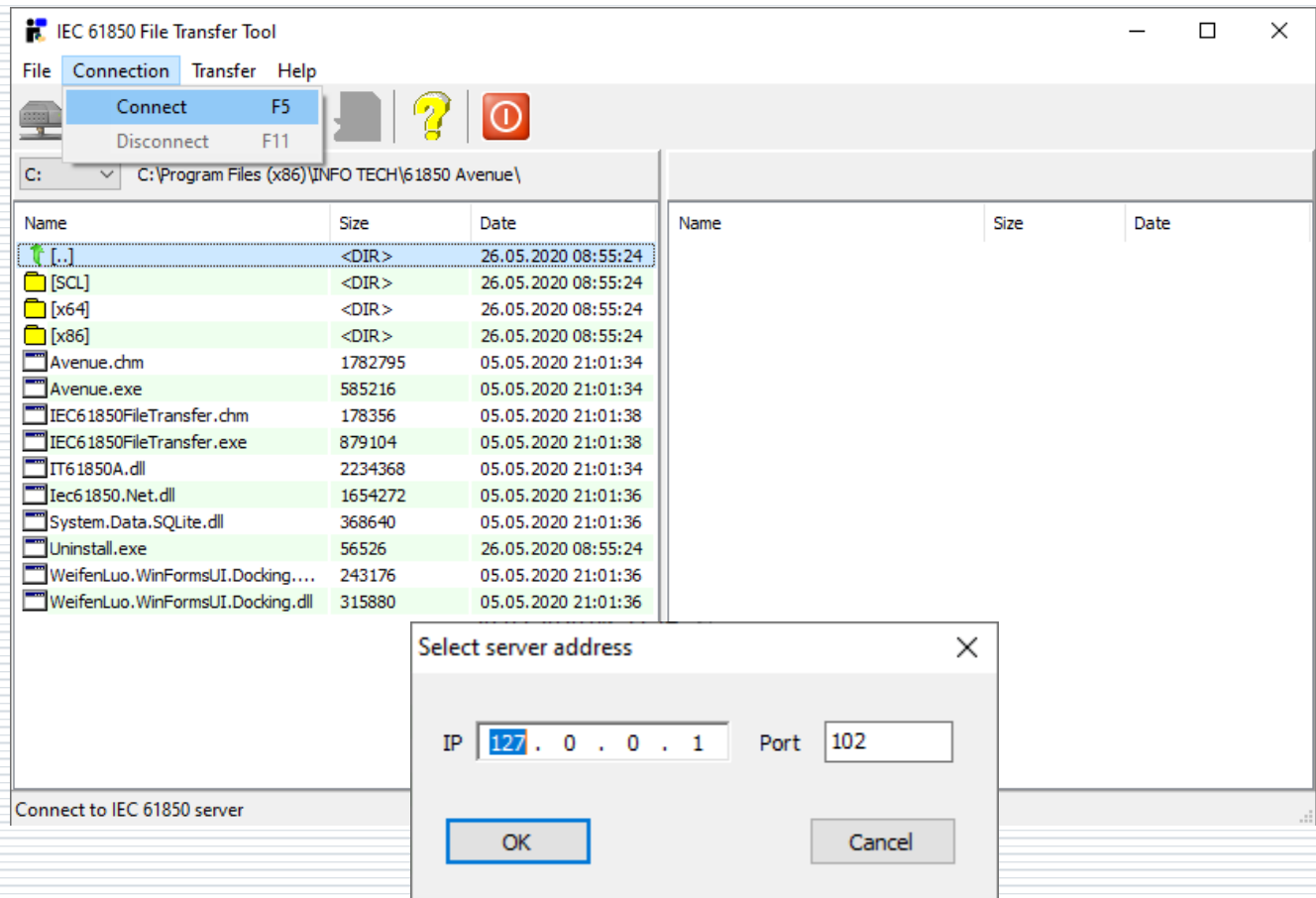


# File Transfer Tool – connection to server device as a file server

From **Connection** menu select **Connect** command.

Next, enter an IP address of the server device to connect to.

Port number 102 is default for MMS which is used for file transfer.

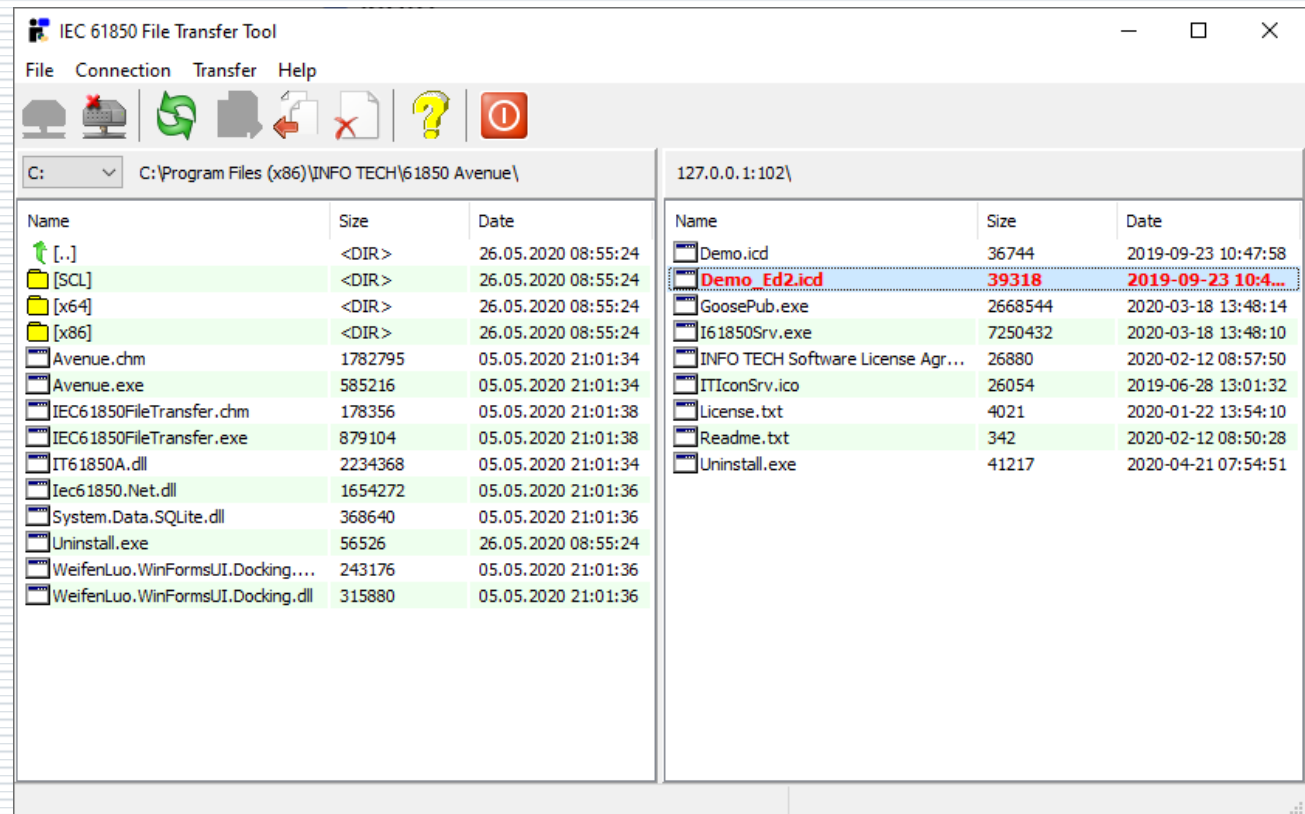


# File Transfer Tool – view of the file system in the server device

## Note:

IEC 61850 Edition 1 allows server devices to present their file system as hierarchical with subdirectories.

IEC 61850 Edition 2 requires server devices to present a flat file system (as specified in MMS protocol) and then the names of subdirectories (e.g. COMTRADE) shall be a part of the file name – as shown here.



# File Transfer Tool – file transfer operations

The set of supported operations is determined when establishing connection with the server device.

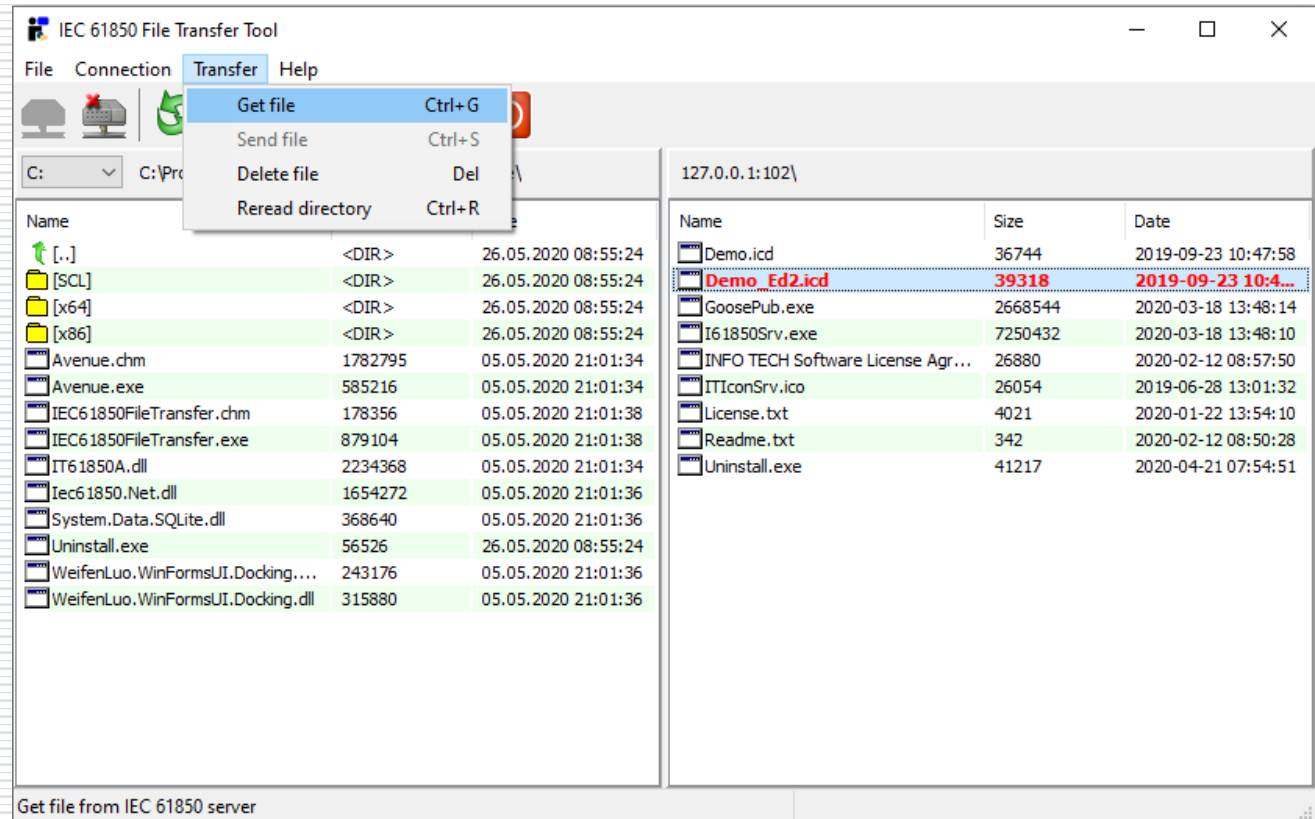
Possible operations in **Transfer** menu:

**Get file** – file reading from the server

**Send file** – file writing to the server

**Delete file** – file removal

**Reread directory** – refresh of the file list



# 61850 ICD Editor

A tool to create and modify SCL files.



# 61850 ICD Editor allows to build an ICD file of the server device

The screenshot displays the 61850 ICD Editor application with several open windows:

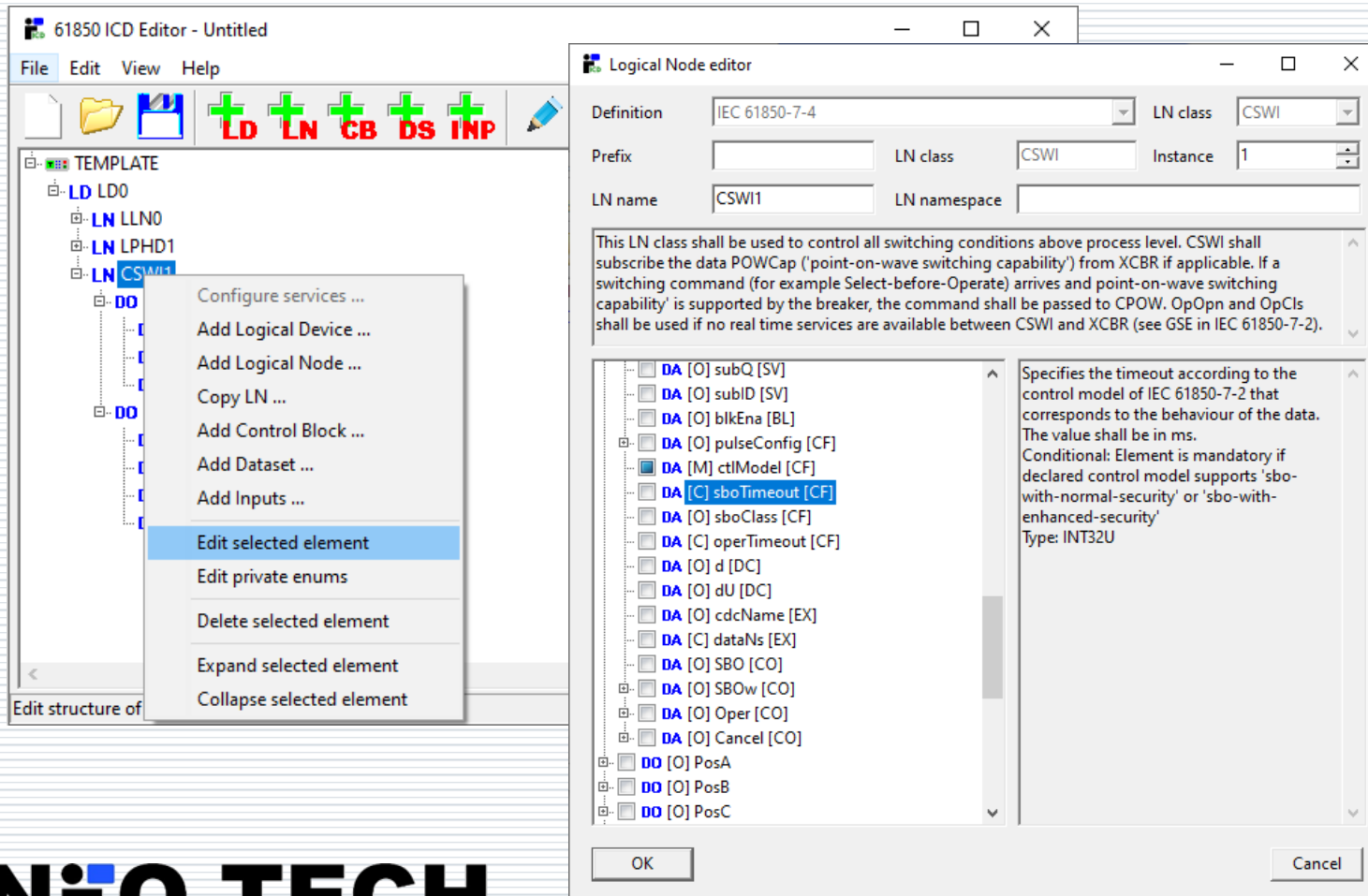
- 61850 ICD Editor - Untitled**: The main window with a menu bar (File, Edit, View, Help) and a toolbar. The left sidebar shows a project tree with nodes like LD0, LN LLN0, DO Beh, DA stVal [ST], DA q [ST], DA t [ST], LN LPHD1, DO PhyNam, DA vendor, DO PhyHealth, and DA stVal [ST].
- Create new Logical Device**: A dialog box for creating a new LD. Fields include Name (LD0), Type (IEC 61850-7-4), and Logical Device (IEC 61850-7-410). An OK button is at the bottom.
- Add new Logical Node**: A dialog box for adding a new LN. It shows a list of classes (XCBR, TVBR, TVTR, TWPH) and a list of LN names (XSXWI, YEFNC, YLTC, YPSH). A text box on the right explains that this LN is an example of a switch with short circuit breaking capability.
- Control Block Editor**: A dialog box for editing a control block. It shows a list of control block types (Unbuffered Report CB, Buffered Report CB) and a list of options (Sequence number, Time stamp, DataSet reference, Reason code, Data reference, Entry ID, Configuration revision, Buffer overflow). A text box on the right explains that this control block is indexed.

Annotations on the image:

- Add LD**: Points to the 'Create new Logical Device' dialog.
- Add LN with selection of optional DO and DA**: Points to the 'Add new Logical Node' dialog.
- Add RCB, GCB, SGCB, SVCB with attributes settings**: Points to the 'Control Block Editor' dialog.

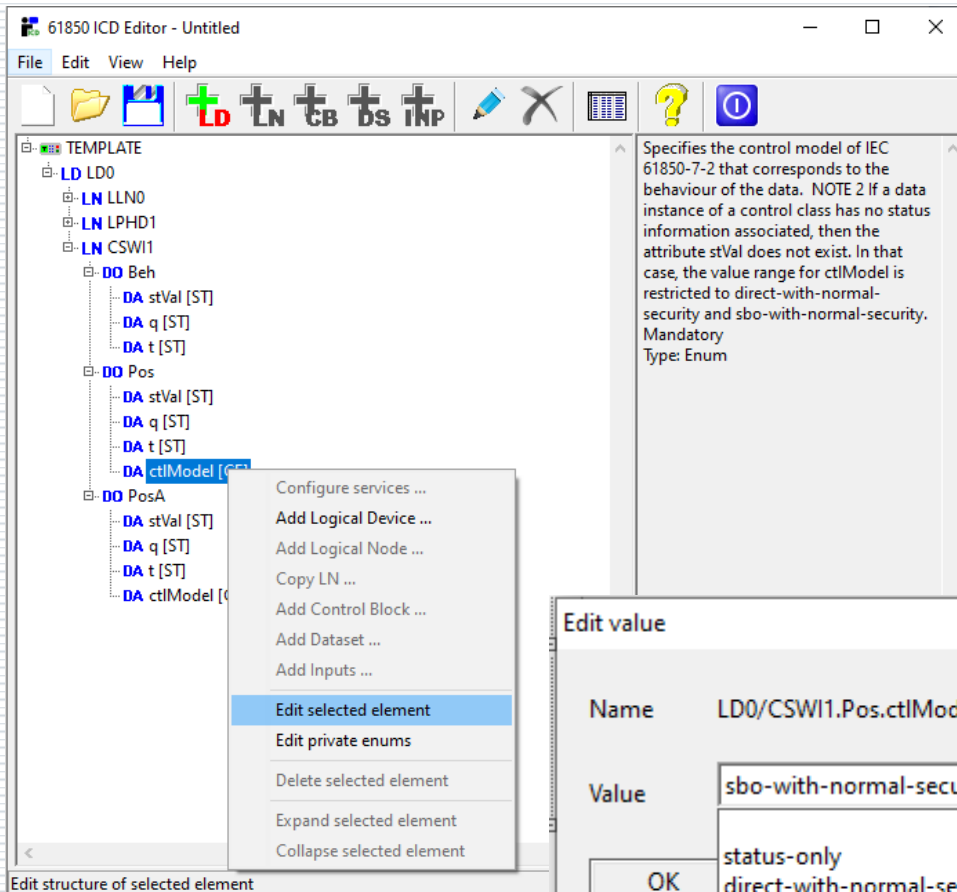
From scratch (new IED, new LD, new LN) or by modification of an existing file.

# 61850 ICD Editor - editing data model

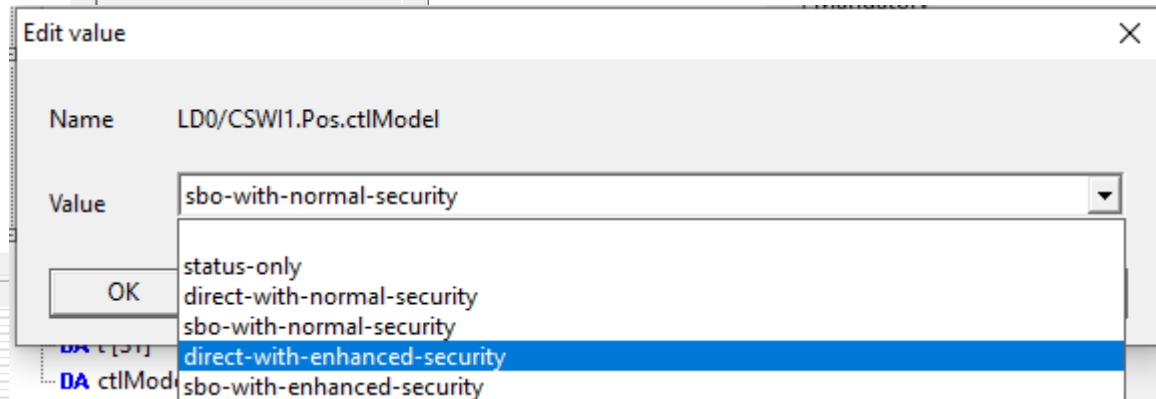


Any added LN can be later modified by adding/deleting optional DOs and DAs.

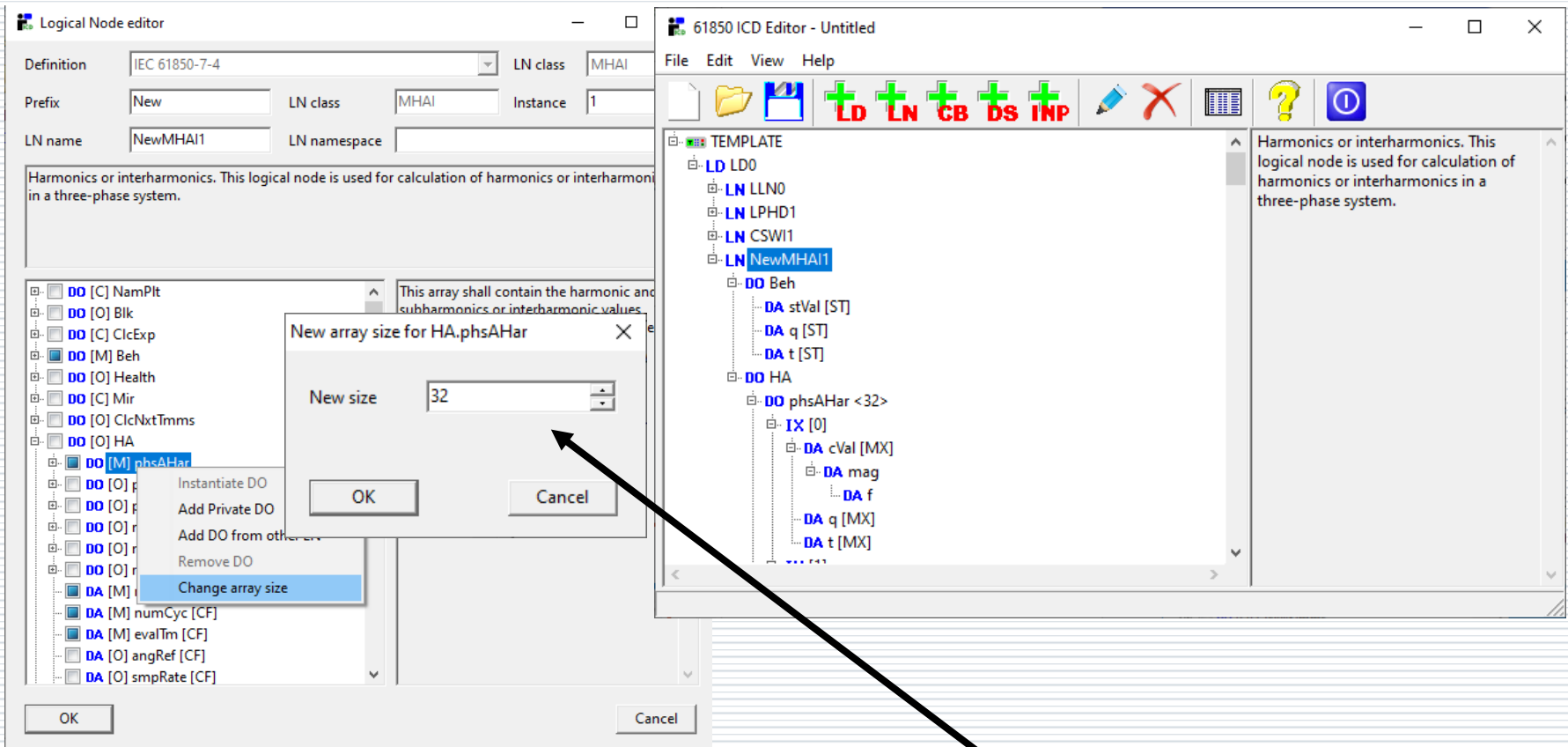
# 61850 ICD Editor - presetting DA values



Data attribute values can be preset if needed. Standard defined enums are supported.



# 61850 ICD Editor - LNs with DOs containing array types



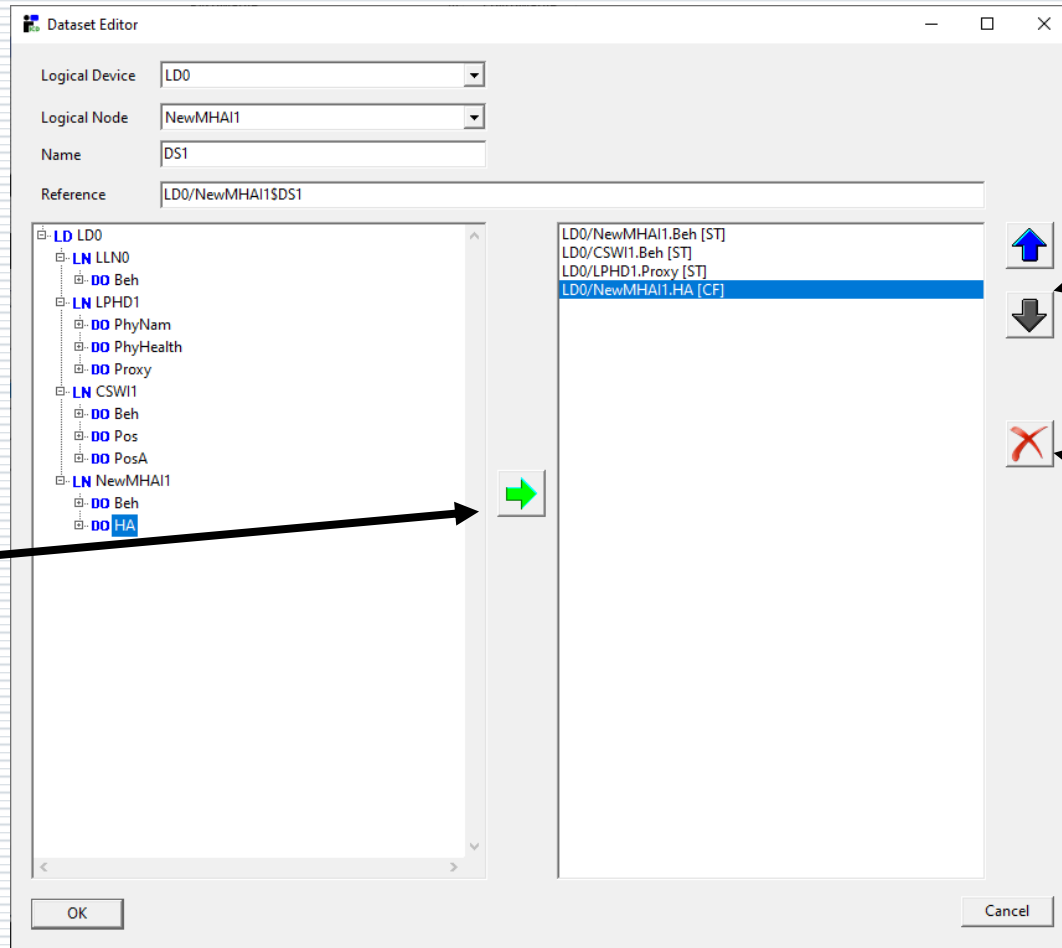
Array size can be set (default is 32).

# 61850 ICD Editor - Dataset creation by selection of elements from the data model

Any defined dataset can be later re-edited if needed.

Button for adding a selected element of data model to dataset.

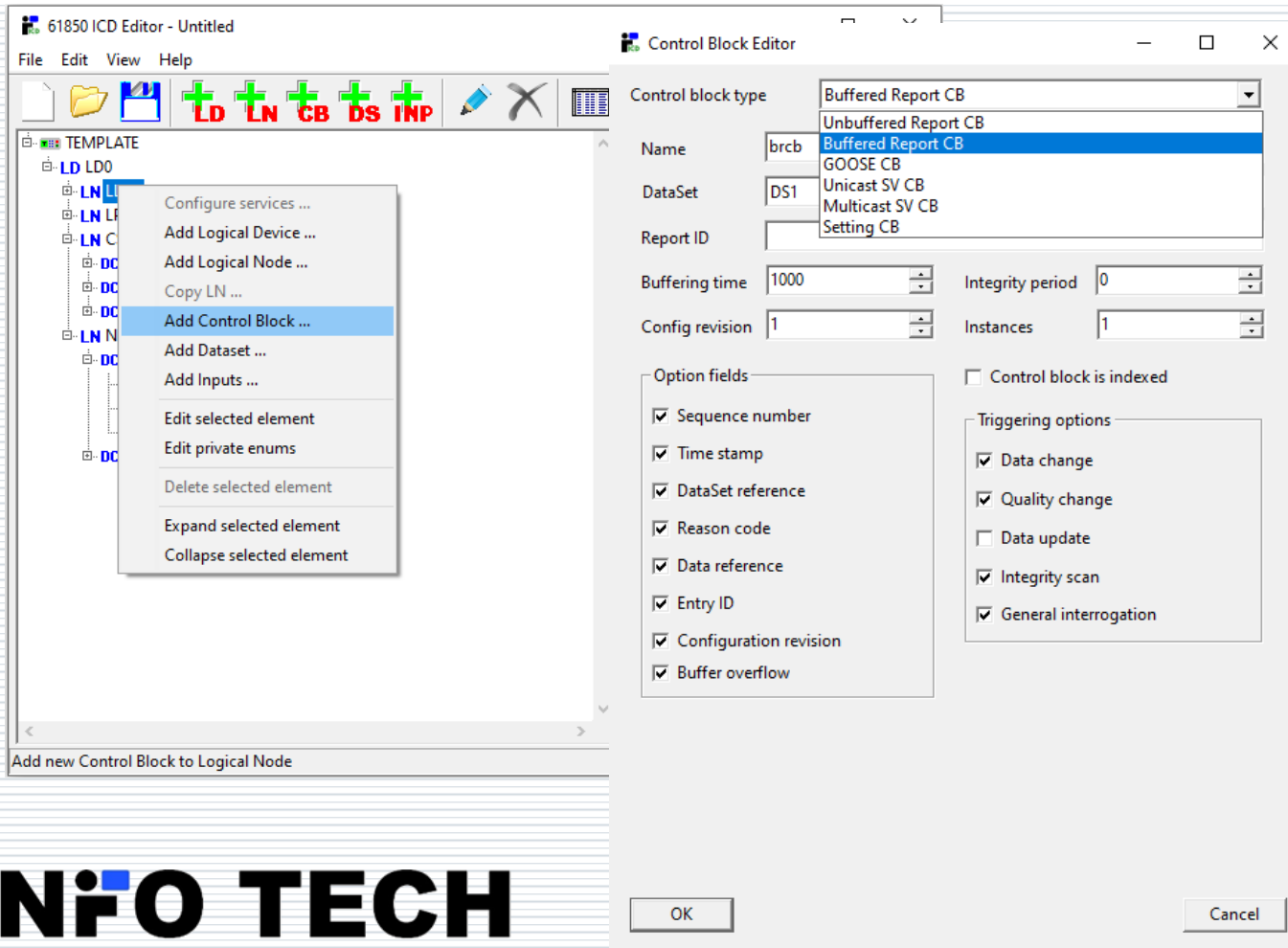
Note that in Ed.2.1 also indexed data can be elements of datasets.



Buttons for changing order of elements in dataset.

Button for removing element of dataset.

# 61850 ICD Editor - control blocks



URCB, BRCB, GoCB, USVCB, MSVCB and SGCB can be added to the data model and initially preset.

Any defined control block can be later re-edited if needed.

# 61850 ICD Editor - private Logical Nodes

Logical Node editor

Definition: IEC 61850-7-4 LN class: CSWI Prefix: LN class: CSWI Instance: 1 LN name: CSWI1 LN namespace:

This LN class shall be used to control all switching cond... subscribe the data POWCap ('point-on-wave switching... switching command (for example Select-before-Operat... capability' is supported by the breaker, the command s... shall be used if no real time services are available betw...

- DO [C] NamPlt
- DO [O] OpOpn
- DO [O] SelOpn
- DO [O] OpCls
- DO [O] SelCls
- DO [O] Loc
- DO [O] LocKey
- DO [O] Blk
- DO [O] ClcExp
- DO [M] **Instantiate DO**
- DO [O] **Add Private DO**
- DO [O] **Add DO from other LN**
- DO [M] Remove DO
- DO [O] Change array size
- DO [O] PosC
- DO [O] SwModKey
- DO [C] CmdBlk

OK

Add DO from other LN

Definition: IEC 61850-7-4 LN class: PTOC DO name: TmASt

Axis specification and points of the active curve defined v... or one of 'TmAChr'

OK

Add private data object

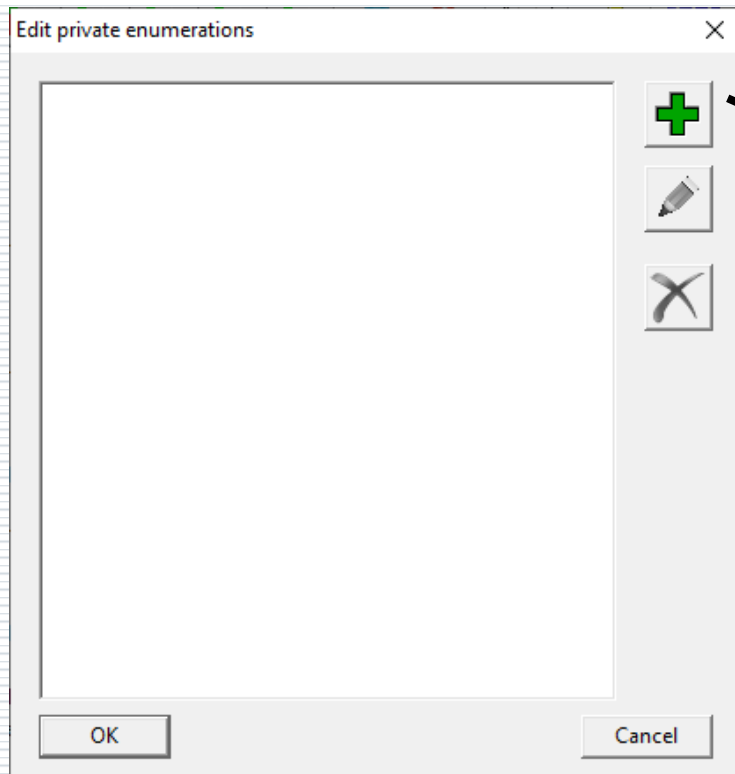
DO name: MyDO DO type: ACD Enumeration: Add Edit Data namespace: MyNameSpace

Directional protection activation information (ACD)

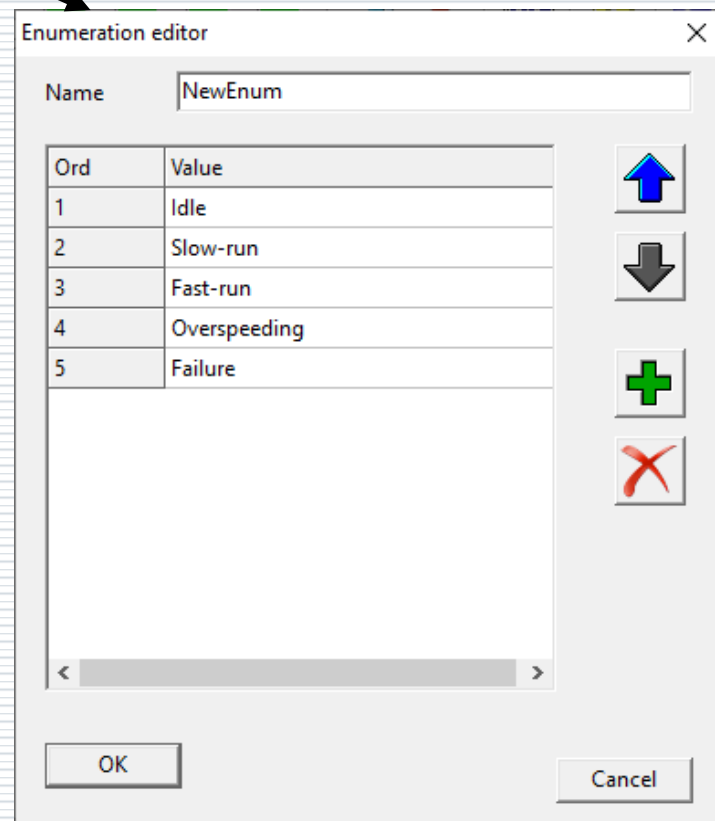
OK Cancel

Private LN class and instance can be defined with the use of DOs from other LN classes or using defined private DOs.

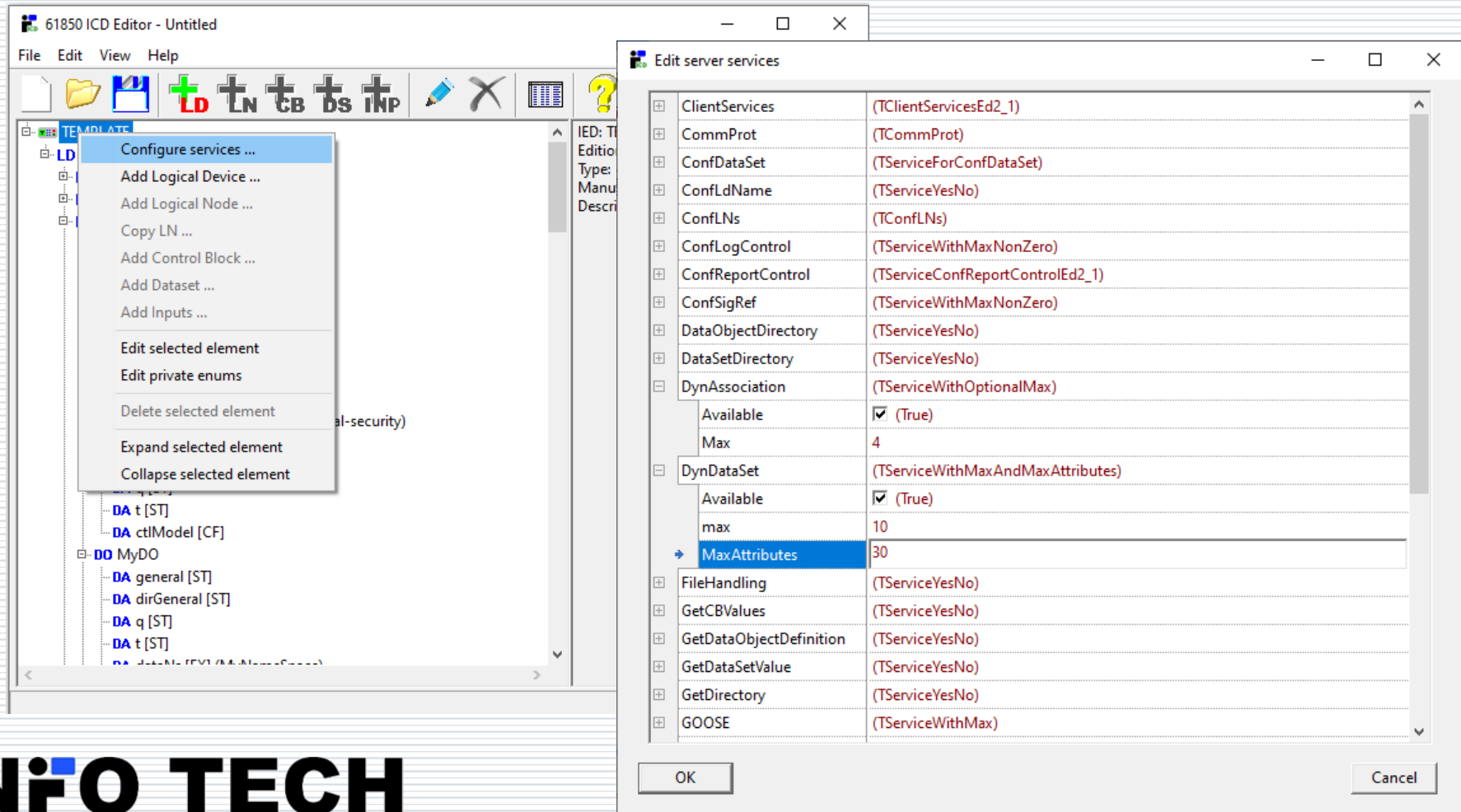
# 61850 ICD Editor – private enums



Definition of private enum type:  
Continuous range of integer values  
with assigned user-defined names.



# 61850 ICD Editor - data model parameters setup

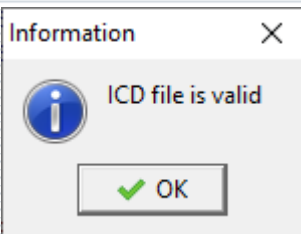


The screenshot shows the 61850 ICD Editor interface. The 'Edit server services' dialog box is open, displaying a list of services and their parameters. The 'MaxAttributes' parameter for the 'DynDataSet' service is highlighted and set to 30.

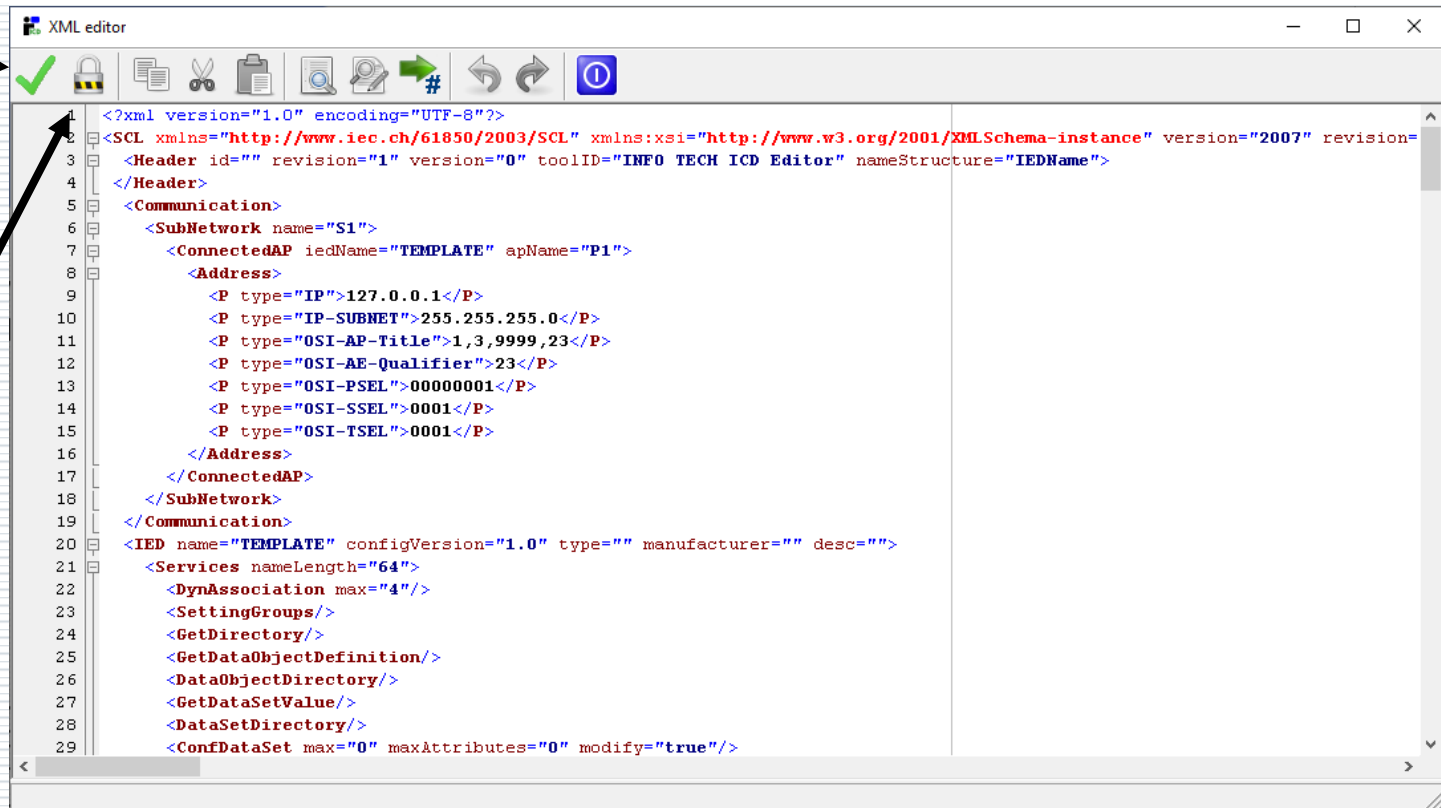
Service	Parameter	Value
ClientServices	(TClientServicesEd2_1)	
	Available	<input checked="" type="checkbox"/> (True)
CommProt	(TCommProt)	
	Max	4
ConfDataSet	(TServiceForConfDataSet)	
	Max	10
ConfLdName	(TServiceYesNo)	
	MaxAttributes	30
ConfLNs	(TConfLNs)	
	Max	10
ConfLogControl	(TServiceWithMaxNonZero)	
	Max	10
ConfReportControl	(TServiceConfReportControlEd2_1)	
	Max	10
ConfSigRef	(TServiceWithMaxNonZero)	
	Max	10
DataObjectDirectory	(TServiceYesNo)	
	Max	10
DataSetDirectory	(TServiceYesNo)	
	Max	10
DynAssociation	(TServiceWithOptionalMax)	
	Max	10
DynDataSet	(TServiceWithMaxAndMaxAttributes)	
	MaxAttributes	30
FileHandling	(TServiceYesNo)	
	Max	10
GetCBValues	(TServiceYesNo)	
	Max	10
GetDataObjectDefinition	(TServiceYesNo)	
	Max	10
GetDataSetValue	(TServiceYesNo)	
	Max	10
GetDirectory	(TServiceYesNo)	
	Max	10
GOOSE	(TServiceWithMax)	
	Max	10

# 61850 ICD Editor - XML Editor and ICD file validation

Validation  
check button



Unlock/lock  
button for  
manual  
editing.



# Possible applications of 61850 ICD Editor program

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- ❑ Creation and modification of ICD/CID file for the device under configuration.
- ❑ Processing of an ICD file into a CID file (addresses, datasets, parameters of control blocks).
- ❑ Creation and modification of ICD/CID file to be used for server device simulation (e.g. with the use of INFO TECH 61850 SCL Runner tool).
- ❑ Modification of ICD/CID file for the IEC 61850 client program (e.g. 61850 Avenue client), for example to enable execution of negative test cases on the server device.

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