

61850 Avenue 2.1

Substation Communication Tool

User guide

Prepared by Wojciech E. Kozlowski
Version: April 2021

We reserve all rights in this document and in the information contained therein. Reproduction, use or disclosure to third parties without express authority is strictly forbidden.

If this document has accidentally or illegally come into your possession, please prevent it from being used and inform INFO TECH using contact references given at www.infotech.pl

© Copyright INFO TECH sp.j. 2021

Contents

□	Information on the product and supplier	3
□	Installation procedure	9
□	61850 Avenue - IEC 61850 client	14
■	Connection with server device and data model browsing	16
■	Import of SCL file and connection with server device	20
■	Reporting function	26
■	Control services	33
■	Creating dynamic datasets	37
■	Activation and editing of setting groups	39
■	Log view	46
■	Generation of ICD/CID file	50
□	61850 Relay Simulator	52
□	GOOSE toolset: GOOSE Sender and GOOSE Receiver	57
■	Publishing GOOSE messages	59
■	Subscribing GOOSE messages	63
■	R-GOOSE	68
□	Sampled Values toolset: SAV Sender and SAV Receiver	70
■	Transmission of Sampled Values	72
■	Reception and processing of Sampled Values	76
■	R-SV	83
□	File Transfer Tool	84
□	61850 ICD Editor	89
□	Supplier contact information	93

INFO TECH sp.j.

- ❑ 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 December 2020, the licensed INFO TECH software is the basis for implementing IEC 61850 interfaces in the products of about 45 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

Other known products from this area:

- ❑ **ProtAn** – protocol analyzer for serial asynchronous communication (RS-232, RS-485)
- ❑ **ProtAn for Ethernet** – protocol analyzer for Ethernet networks
- ❑ **ProTester** – simulation tools for master and slave stations of protocols operating on serial and TCP/IP based networks
- ❑ **IEC 61850 Software Library (source code)**
- ❑ **61850 SCL Runner** – simulator of IEC 61850 server devices based on their description in SCL files

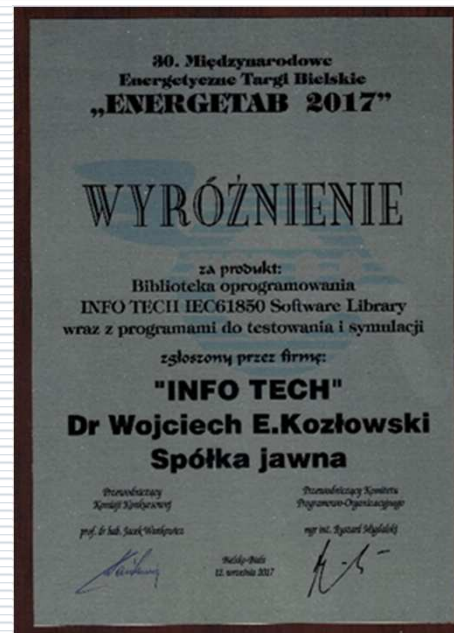
61850 Avenue toolset

- ❑ **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 the server program **61850 Relay Simulator**)
- ❑ Updates and functional extensions in the following years
- ❑ **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
- ❑ Added support of **Edition 2.1** in the release of January 2021

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

- ❑ 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

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.

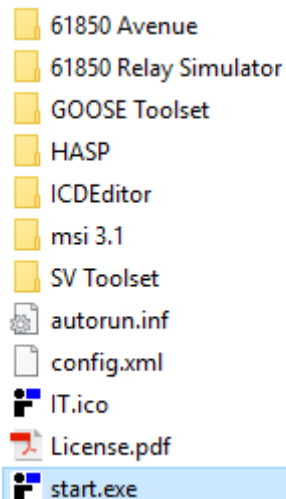
We recommend
MS Windows 10.



To install the software

From the supplied CD: possible start in autorun mode.

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



License

- ☐ **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

- ❑ **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**)



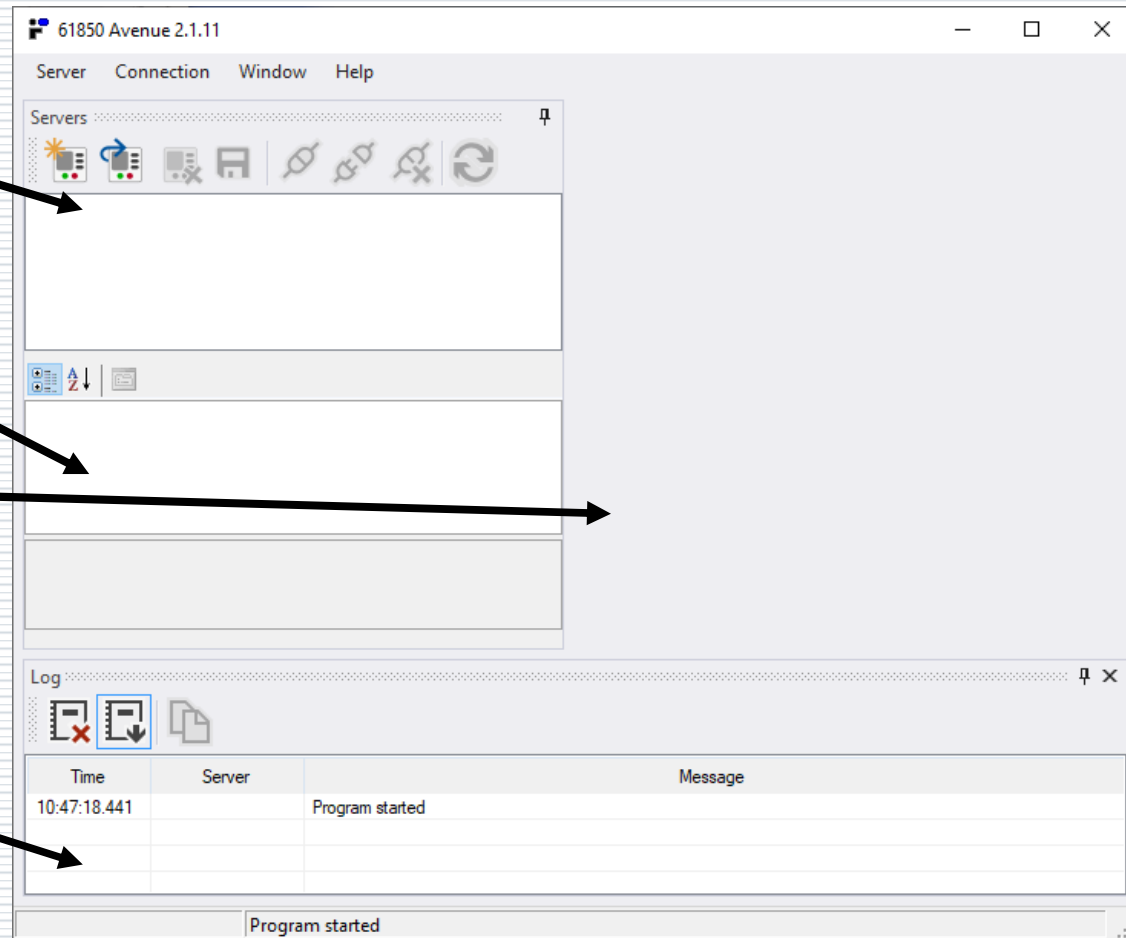
Initial view after the first start-up of 61850 Avenue client

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

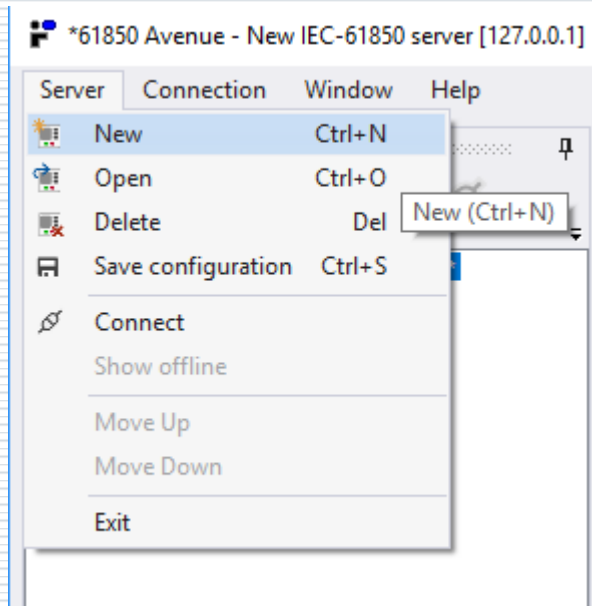
Properties – window with the list of connection parameters of the selected server (connection parameters can be saved in the configuration file).

Main operation view – for folders with server data models.

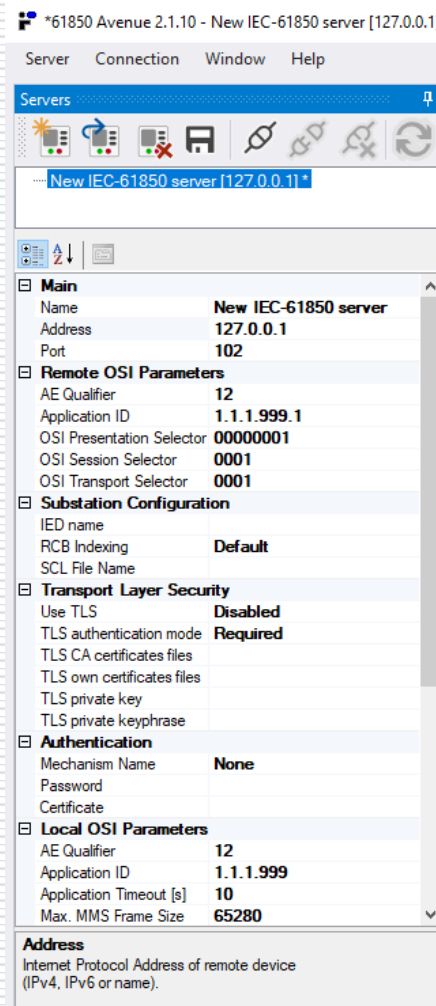
Log view – chronological view of operations (commands, responses and events) occurring during the interactions with server devices.



Connection to a new server device with data model browsing



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



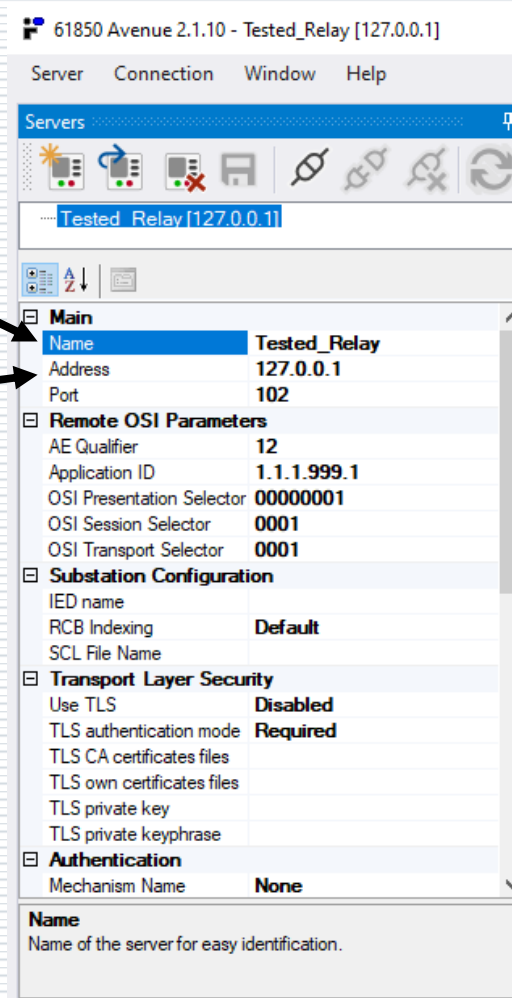
A new server IED with the name **New IEC-61850 server** and IP address **[127.0.0.1]** will appear in **Properties** window.



* **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**.



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

Connection to a server with the use of Transport Layer Security (TLS)

The use of TLS can be enabled by setting to **Enabled** the parameter **Use TLS** in section **Transport Layer Security** of Server Communication Profile.

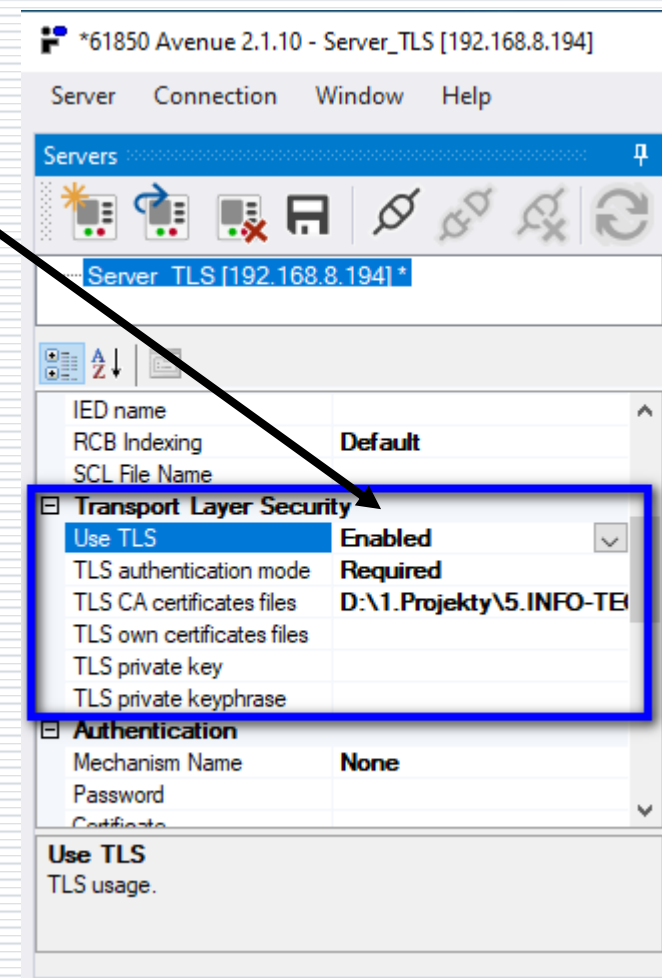
The following parameters can be also configured:
TLS authentication mode – selection between **Required** authentication with TLS CA certificate or **Optional**

TLS CA certificates files - path to TLS CA certificate (necessary if TLS authentication mode is set to Required)

TLS own certificates files - path to Client TLS certificate

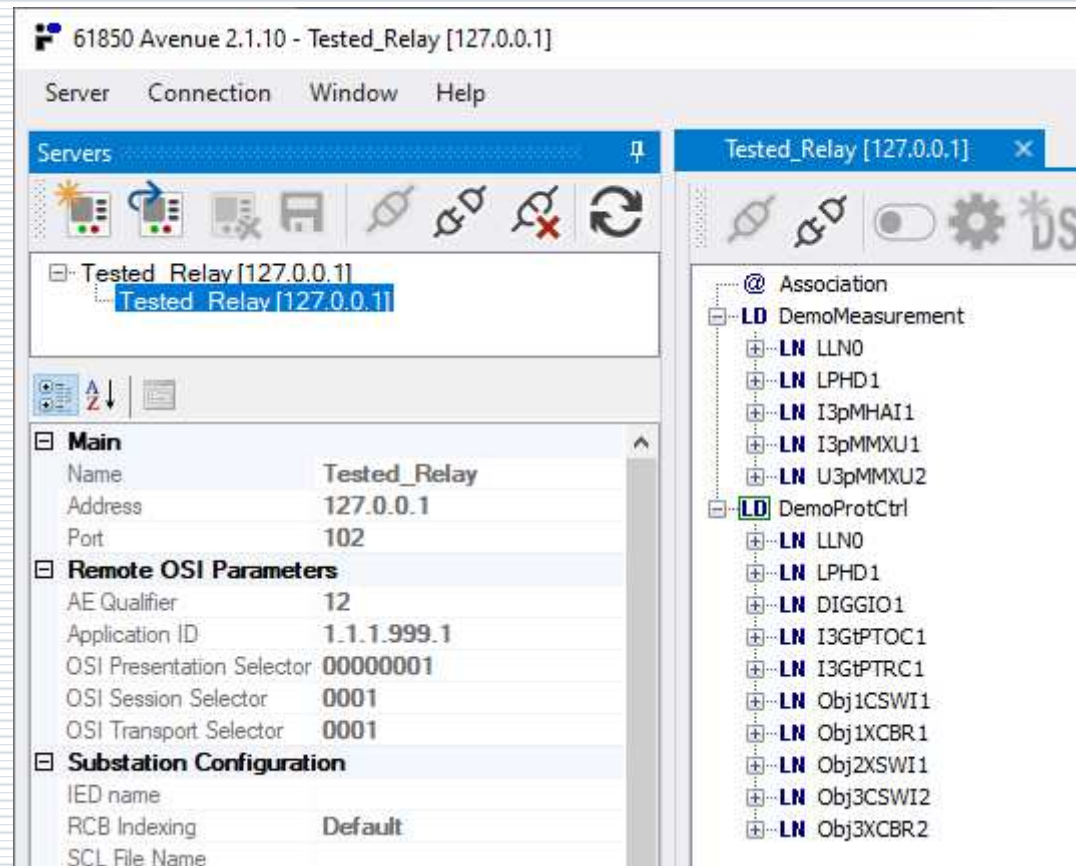
TLS private key - path to TLS private key

TLS private keyphrase - password of TLS private key (if set)

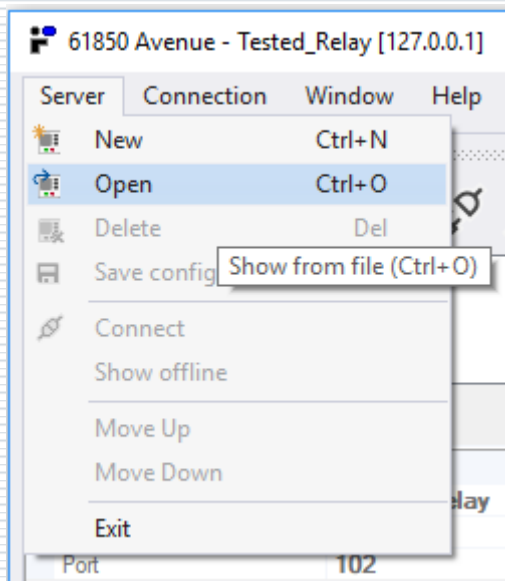


Server device data model displayed after connecting and browsing

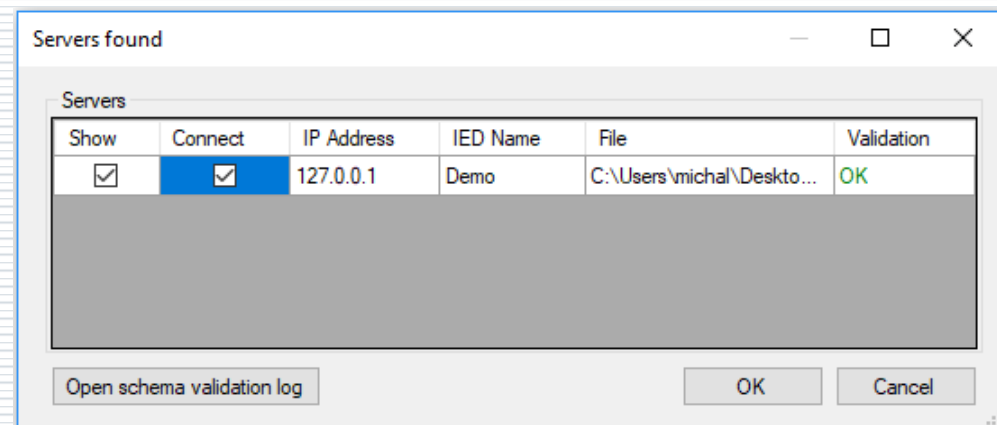
Fast exploration of the server device data model.



Connection to a new server device using its SCL description file



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



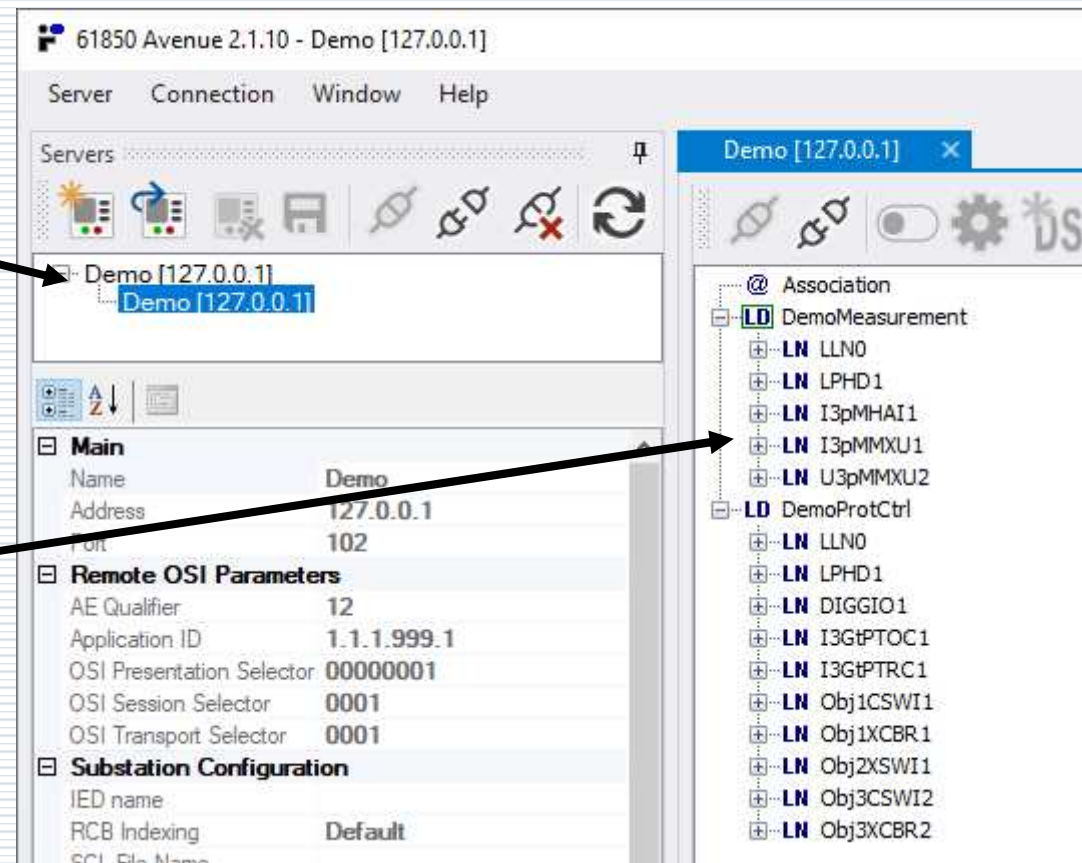
After selecting the file set check boxes:

- **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 shows the 61850 Avenue 2.1.10 software interface. The main window displays a tree view of the device structure under 'Demo [127.0.0.1]'. The tree view includes the following objects:

- LD DemoMeasurement
- LD DemoProtCtrl
 - LN LLNO
 - D Mod
 - D Beh
 - D Health
 - D NamPlt
 - D Loc
 - DS DS1_Disconnector
 - DS DS2_Protection
 - DS DS3_GOOSE
 - DS DS4_GOOSE
 - BR brcb01
 - BR brcb02
 - RP urcb01
 - RP urcb02
 - GO gcb1
 - GO gcb2
 - SG SGCB
 - LN LPHD1

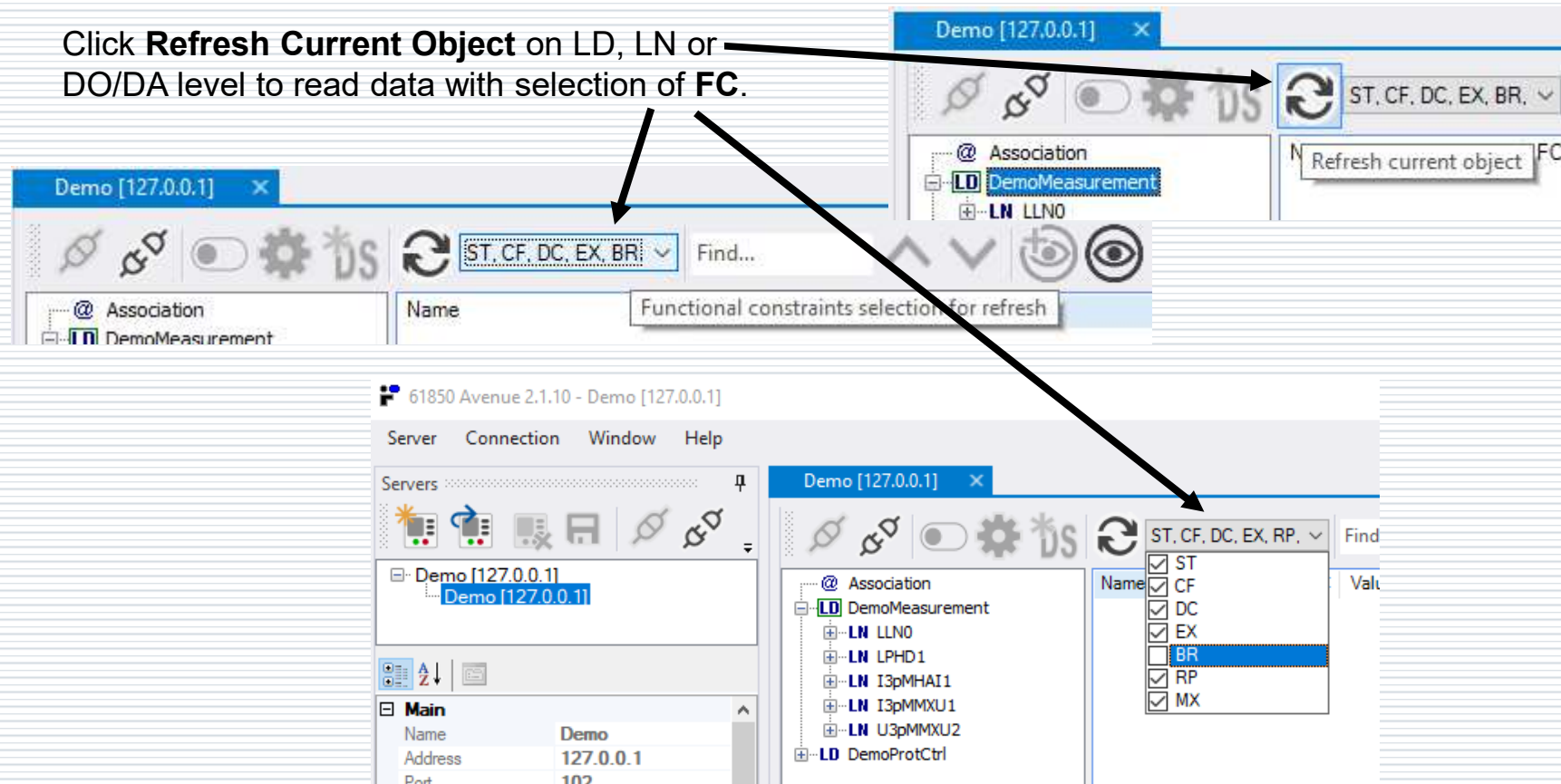
A callout box highlights the 'Connect' icon in the top toolbar. Another callout points to the 'DS DS3_GOOSE' object in the tree view, indicating off-line model browsing is possible.

Name	FC	Value
DemoProtCtrl/Ob...	ST	{stVal=1
DemoProtCtrl/Ob...	ST	{stVal=1
DemoProtCtrl/LL...	ST	{stVal=fr
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

Off-line model
browsing possible.

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.

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 61850 Avenue 2.1.10 software interface, which allows for multiple simultaneous connections to different servers. The interface is divided into several panes:

- Top Pane:** Shows the title bar "61850 Avenue 2.1.10 - Demo [127.0.0.1]" and a menu bar with "Server", "Connection", "Window", and "Help". Below the menu is a "Servers" list with icons for adding, removing, and connecting to servers. The list includes "Demo [127.0.0.1]" and "RegrTestEd2 [192.168.11.158]".
- Left Pane:** Displays a tree view for the selected server "Demo [127.0.0.1]". The tree structure includes:
 - Association
 - LD DemoMeasurement
 - LN LLNO
 - LN LPHD1
 - LN I3pMHAI1
 - LN I3pMMXU1
 - D Mod
 - D Beh
 - D Health
 - D NamPlt
 - D A
 - D phsA
 - D phsB
 - D phsC
 - LD DemoProtCtrl
 - LN LLNO
 - LN LPHD1
 - LN DIGGIO1
 - LN I3GPTOC1

- Right Pane:** Displays a tree view for the selected server "RegrTestEd2 [192.168.11.158]". The tree structure includes:
- Association
 - LD RegrTestEd2Application
 - LD RegrTestEd2MU01
 - LD RegrTestEd2Measurement
 - LD RegrTestEd2ProtCtrl
- Bottom Pane:** Contains a "Sequence Number" field, a "Data Set" dropdown, and a "Data Reference" table. The table has columns for "#", "Sequence Number", and "Data Set".

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 reporting parameters.

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

<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

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.

Demo [127.0.0.1]: DemoProtCtrl/LLN0.brcb01

Report Identifier:

Data Set Reference: DemoMeasurement/LLN0.DS2_All

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

- ☒ Sequence Number
- ☒ Report Time Stamp
- ☒ Reason For Inclusion
- ☒ Data Set Name
- ☒ Data Reference
- ☒ Buffer Overflow
- ☒ Entry Identifier
- ☒ Configuration Revision

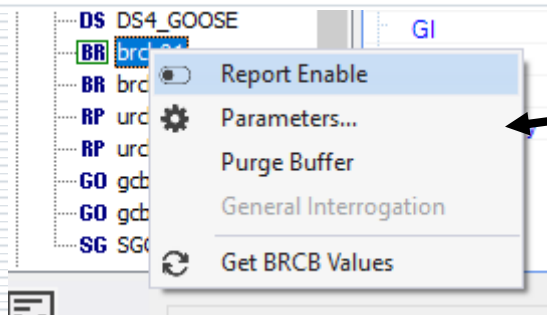
Trigger Options

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

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 shows a list of reports on the left and a detailed view of a selected report on the right.

#	Report ID	Reason code
0	DemoProtCtrl/LLN0\$BR\$brcb01	dchg
1	DemoProtCtrl/LLN0\$BR\$brcb01	dchg
2	DemoProtCtrl/LLN0\$BR\$brcb01	dchg
3	DemoProtCtrl/LLN0\$BR\$brcb01	dchg
4	DemoProtCtrl/LLN0\$BR\$brcb01	dchg
5	DemoProtCtrl/LLN0\$BR\$brcb01	dchg

Data Reference		FC	Value
DemoProtCtrl/Obj2XSW11.Pos		ST	Reason code: dchg
stVal		ST	01 {off}
q		ST	00000000000000 {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 INFO TECH software interface. The top window, titled 'Demo [127.0.0.1]', shows a tree view on the left with 'DemoMeasurement' expanded, revealing 'LN LLN0' and its sub-items. The main pane shows a table of report details for 'LN LLN0'. Below this, a 'List of reports' table is visible, showing columns for #, Report ID, SN, BOvf, and Den. A detailed view of a selected report is shown at the bottom right, displaying 'Data Reference', 'FC', and 'Value' for various parameters.

Name	FC	Value
RptID	BR	
RptEna	BR	true
DatSet	BR	DemoMeasurement/LLN0.DS1_Measurement
ConfRev	BR	1
OptFlds	BR	0111111111 {sequence-number, report-time-stamp, reason-for-inclusi...
BufTm	BR	1000
SqNum	BR	1
TrgOps	BR	011111 {data-change, quality-change, data-update, integrity, general-...
IntgPd	BR	0
GI	BR	false
PurgeBuf	BR	false
EntryID	BR	0000000000000001
TimeOfEntry	BR	2020-12-14 07:17:59.655

#	Report ID	SN	BOvf	Den
0	DemoMeasurement/LLN0\$BR\$brcb01	0	true	Den
1	DemoMeasurement/LLN0\$BR\$brcb01	1	false	Den
2	DemoMeasurement/LLN0\$BR\$brcb01	2	false	Den
3	DemoMeasurement/LLN0\$BR\$brcb01	3	false	Den
4	DemoMeasurement/LLN0\$BR\$brcb01	4	false	Den
5	DemoMeasurement/LLN0\$BR\$brcb01	5	false	Den

Data Reference	FC	Value
DemoMeasurement/I3pMHA11.HA	MX	Reason code: dupd
phsAHar.[0].cVal.mag.f	MX	0
phsAHar.[0].q	MX	0000000000000000 {...

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),

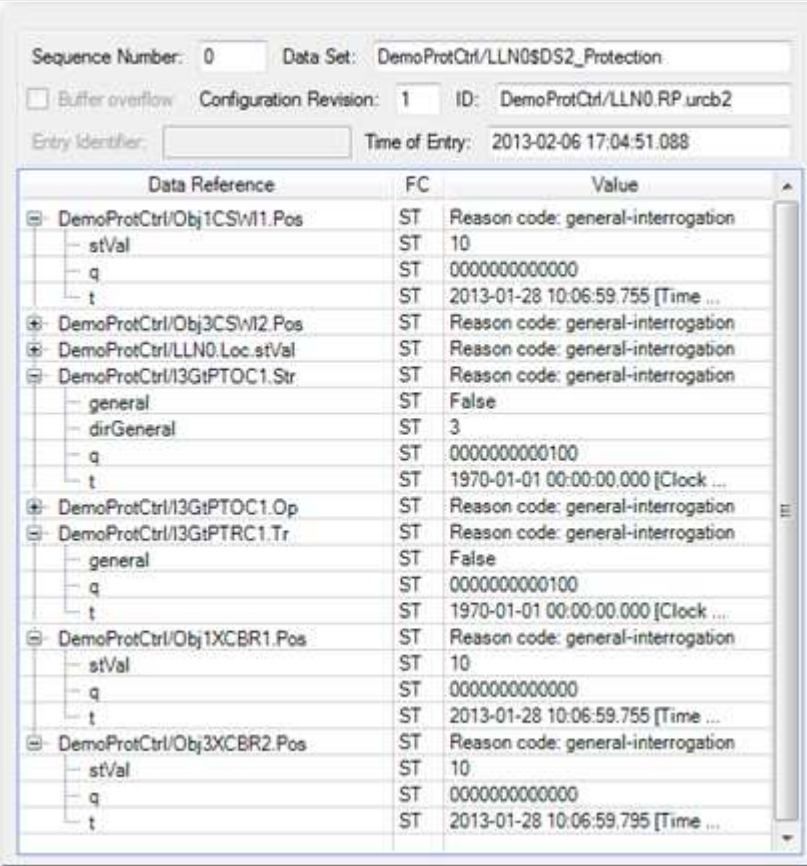
Configuration Revision – version of RCB configuration,

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.



Data Reference	FC	Value
⊖ DemoProtCtrl/Obj1CSW1.Pos	ST	Reason code: general-interrogation
stVal	ST	10
q	ST	000000000000
t	ST	2013-01-28 10:06:59.755 [Time ...
⊕ DemoProtCtrl/Obj3CSW12.Pos	ST	Reason code: general-interrogation
⊕ DemoProtCtrl/LLN0.Loc.stVal	ST	Reason code: general-interrogation
⊖ DemoProtCtrl/I3GtPTOC1.Str	ST	Reason code: general-interrogation
general	ST	False
dirGeneral	ST	3
q	ST	0000000000100
t	ST	1970-01-01 00:00:00.000 [Clock ...
⊕ DemoProtCtrl/I3GtPTOC1.Op	ST	Reason code: general-interrogation
⊖ DemoProtCtrl/I3GtPTRC1.Tr	ST	Reason code: general-interrogation
general	ST	False
q	ST	0000000000100
t	ST	1970-01-01 00:00:00.000 [Clock ...
⊖ DemoProtCtrl/Obj1XCBR1.Pos	ST	Reason code: general-interrogation
stVal	ST	10
q	ST	000000000000
t	ST	2013-01-28 10:06:59.755 [Time ...
⊖ DemoProtCtrl/Obj3XCBR2.Pos	ST	Reason code: general-interrogation
stVal	ST	10
q	ST	000000000000
t	ST	2013-01-28 10:06:59.795 [Time ...

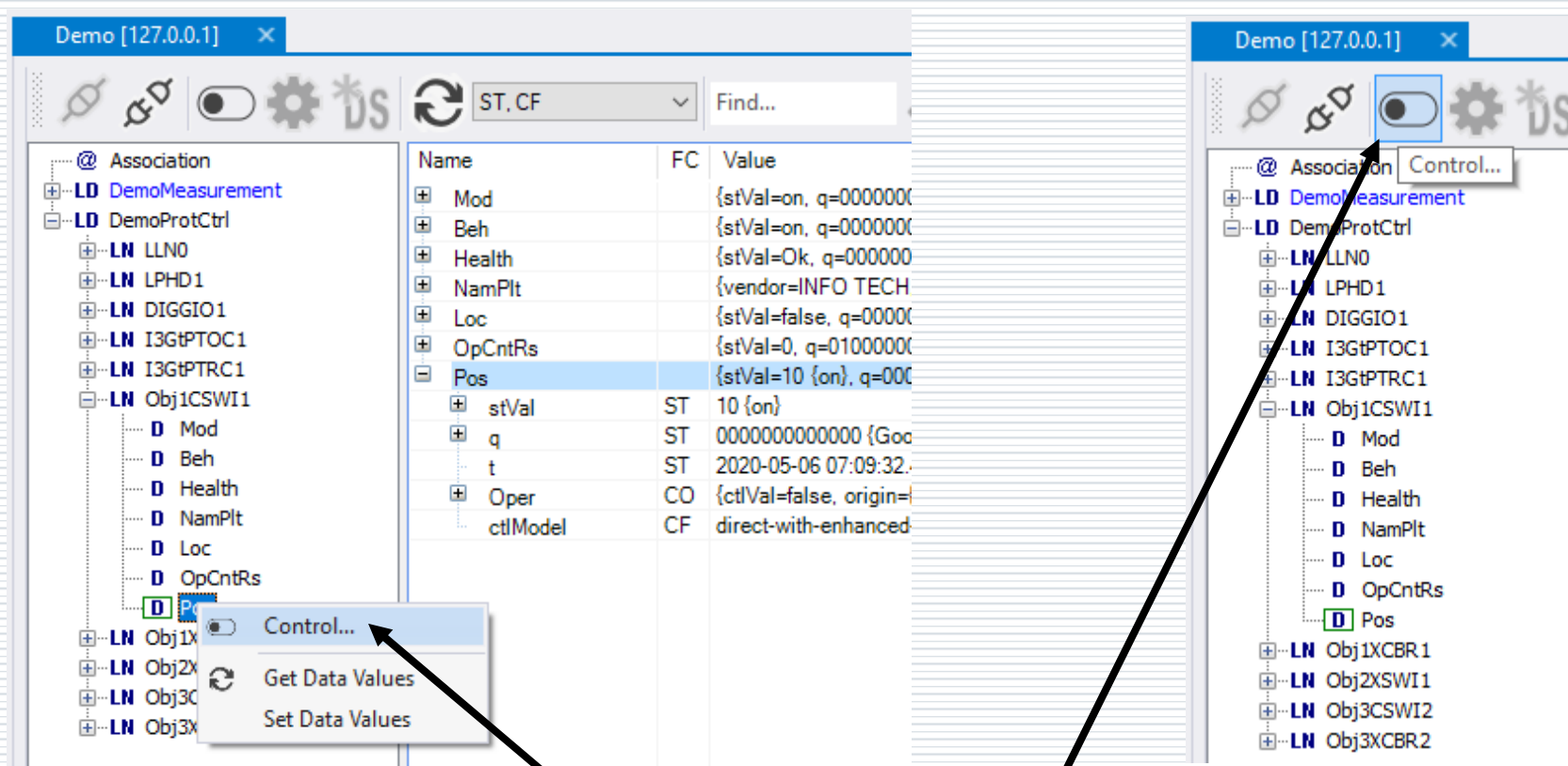
Data model view updates by reports

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 'Str' object is selected, and its details are shown in the main panel. The 'Str' object is highlighted in blue, and its value is also in blue font, indicating an update. The 'Str' object is a string type with a value of '2020-12-14 07:17:59.403 [Leap Second Known][Time Accuracy = 10 bits]'. The 'Str' object is also highlighted in blue in the tree view.

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], ctf...
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

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

Check

☐ Test

☐ 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 is divided into several sections:

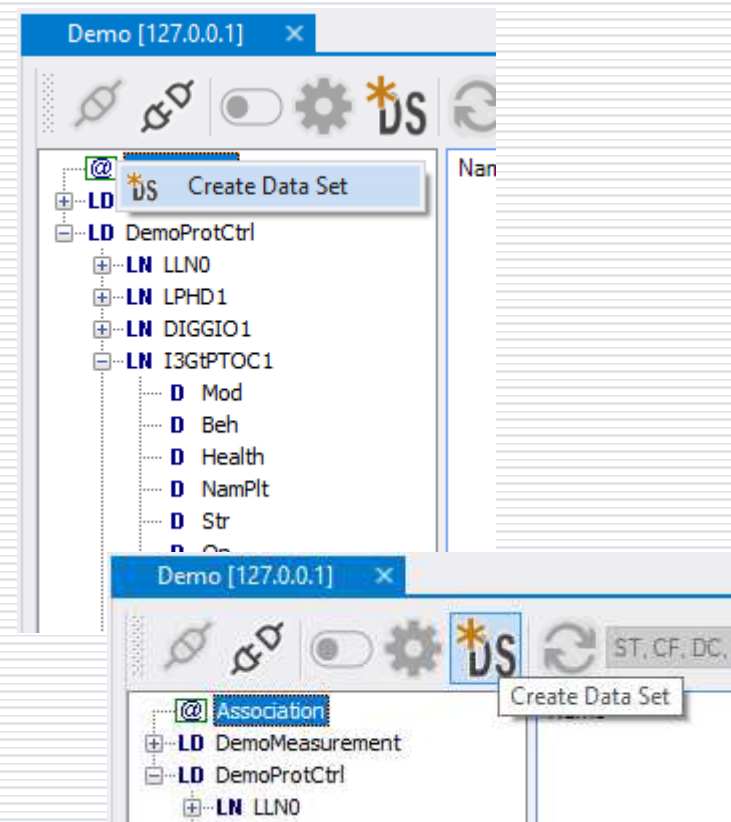
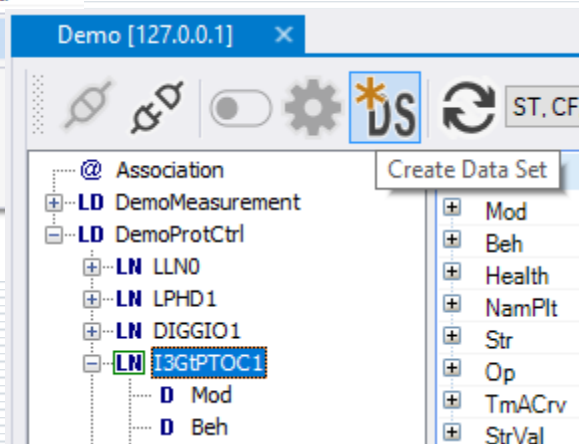
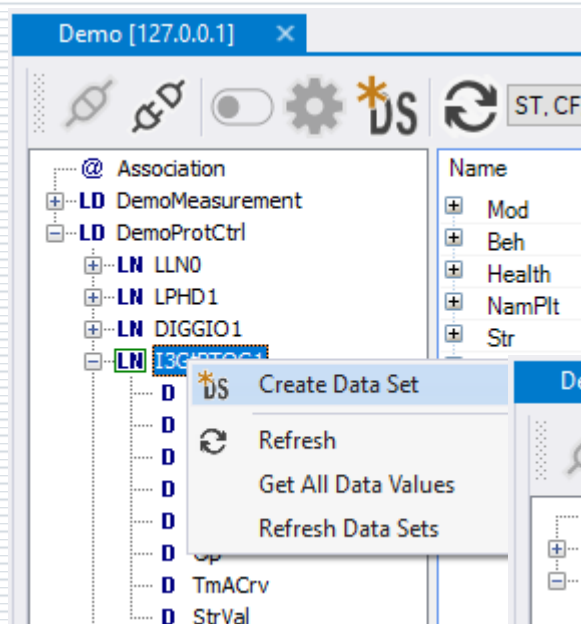
- Status Information:** Contains fields for Value (01 {off}), Control Number, Quality (000000000000 {Good, Process}), and Time Stamp (2018-03-26 13:14:14.016 [Leap Second Known][Time Accuracy = 10 bits]).
- Originator:** Contains fields for Category, Id, and a third empty field.
- Control:** Contains a Value dropdown (on {true}), Control Number (0), Time Stamp (2018-03-26 15:14:21), and a checkbox for "Use Current Time".
- Originator (Control):** Contains a Category dropdown (remote-control), Id (C0A80862), and a HEX dropdown.
- Check:** Contains checkboxes for Test, Synchrocheck, and Interlock Check.
- 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 Term.	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 shows the 'Demo [127.0.0.1]' window with a tree view on the left and a 'Create data set' dialog box on the right. The tree view shows a hierarchy of data elements under 'DemoProtCtrl'. The 'Create data set' dialog box has two main sections: 'Data Set Reference' and 'Data Set Members'.

Data Set Reference

Scope	Name
DemoProtCtrl/I3GtPTOC1	NewDataSet

Data Set Members

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

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 (**SGBC**), 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.

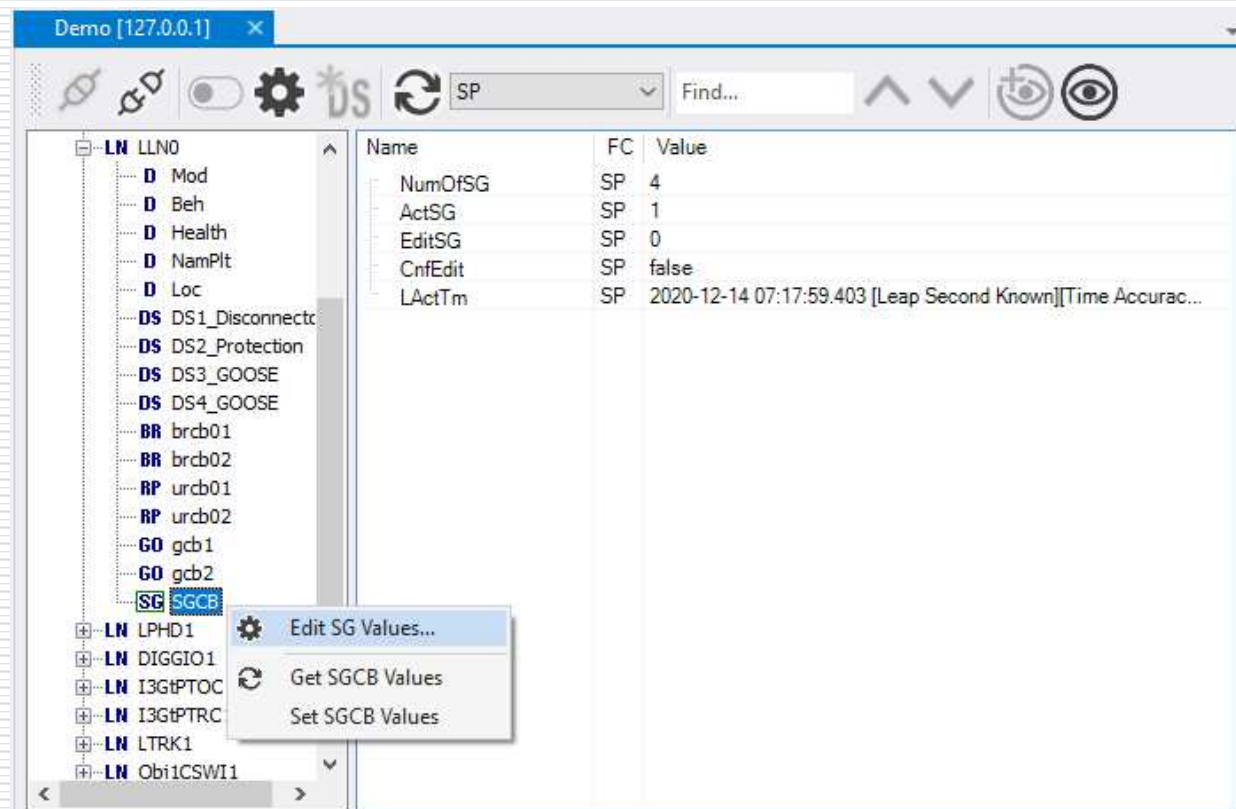
The screenshot shows the 'Demo [127.0.0.1]' application window. On the left is a tree view of the data model. Under 'LD DemoMeasurement', there is an 'LN LLN0' node which contains several sub-nodes including 'SG SGCB'. On the right is a table with three columns: 'Name', 'FC', and 'Value'.

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

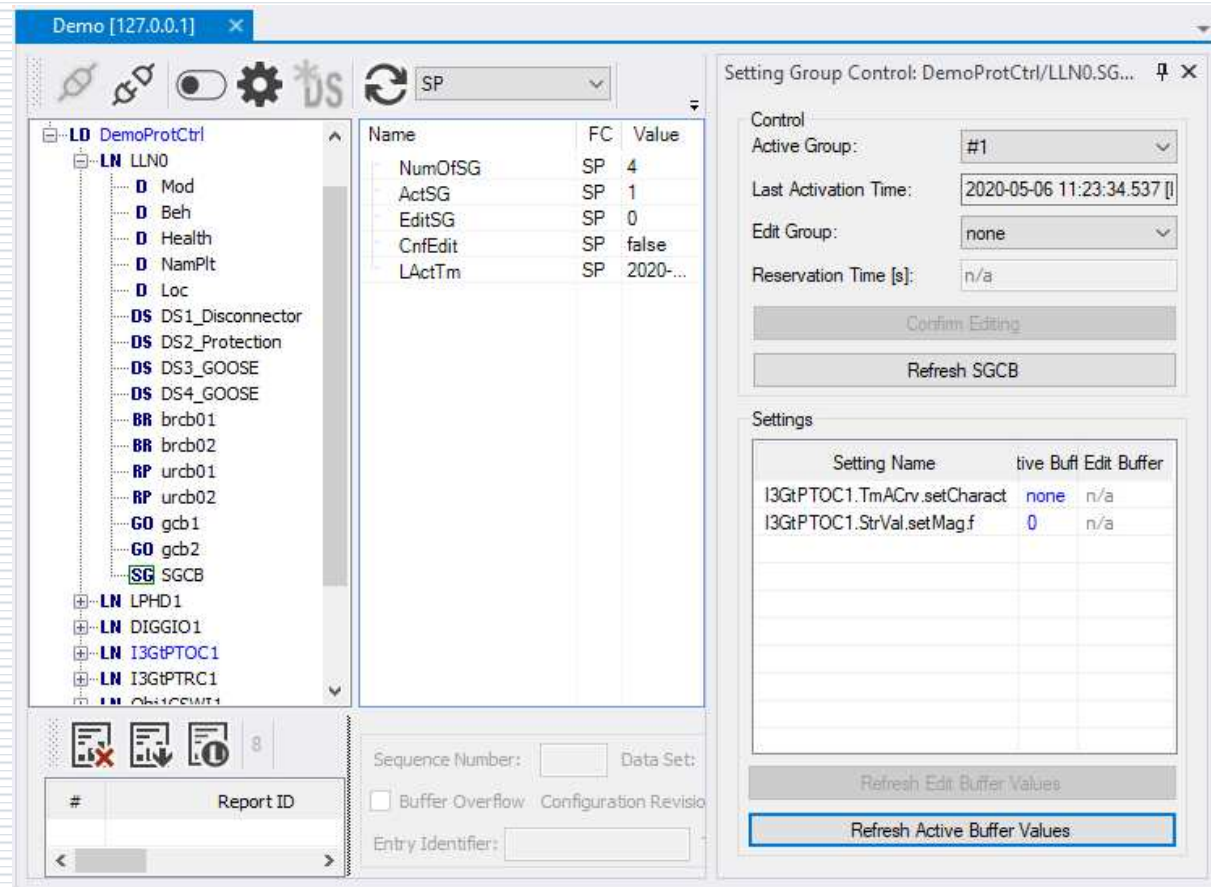
SGCB context menu allows to read all attribute values and to write attributes ActSG, EditSG, CnfSG, ResvTms. A new value should be set in **Value** field of the attribute and confirmed with a proper command.

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.

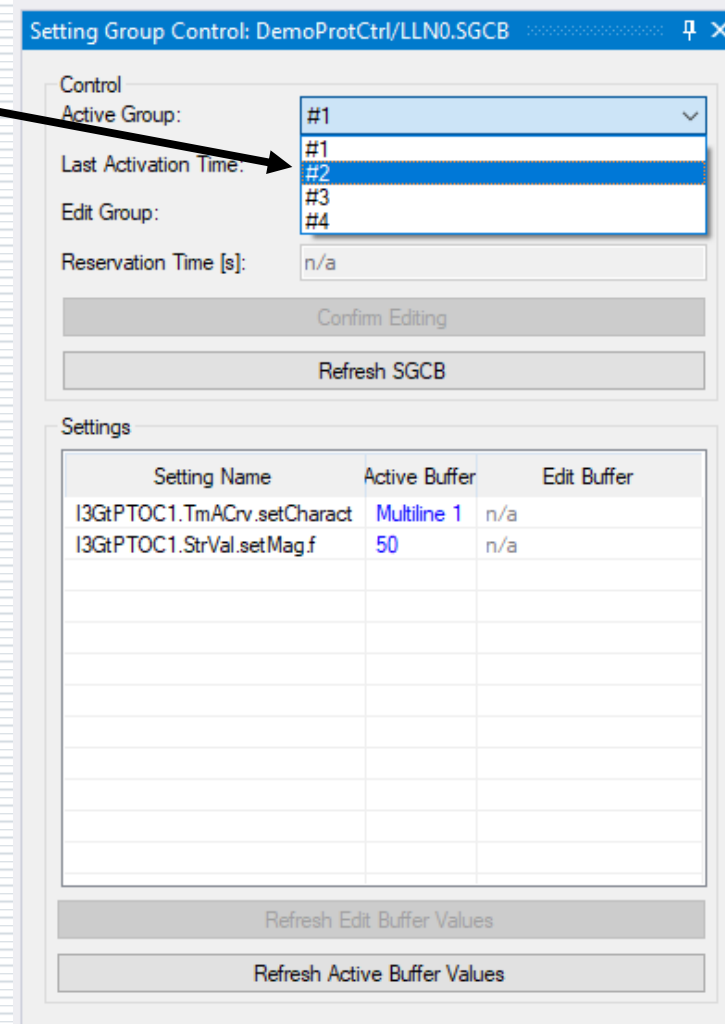


Change of the active setting group

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: #1

Edit Group: #2

Reservation Time [s]: n/a

Confirm Editing

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

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 Known]

Edit Group: none

Reservation Time [s]: #1

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.

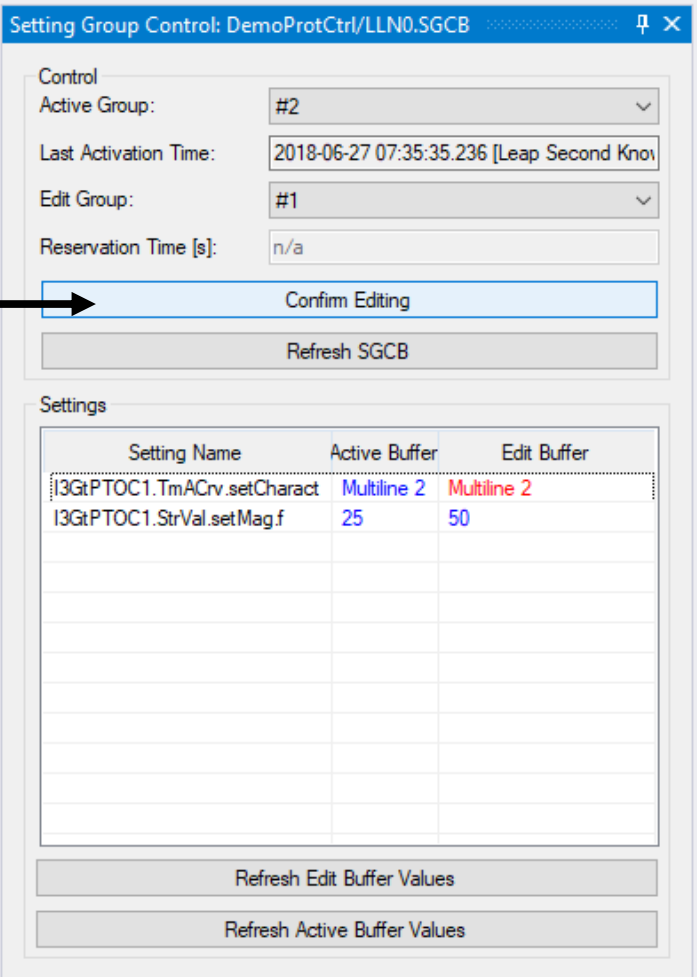
New values are checked for being accepted by the server device.

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" section with a table. The table has three columns: "Setting Name", "Active Buffer", and "Edit Buffer". Two rows are visible: "I3GtPTOC1.TmACrv.setCharact" with "Multiline 2" in the Active Buffer column, and "I3GtPTOC1.StrVal.setMag.f" with "25" in the Active Buffer column. The "Edit Buffer" column for the first row has a dropdown menu open, showing a list of options: "Multiline 1", "Long-Time Extremely", "Long-Time Very Inver", "Long-Time Inverse", "IEC Normal Inverse" (which is highlighted), "IEC Very Inverse", "IEC Inverse", "IEC Extremely Inverse", and "IEC Short-Time Invers". Below the table are "Refresh Edit Buffer Values" and "Refresh Active Buffer Values" buttons. An arrow points from the text "For settings of enum type a new value can be selected from a drop-down list." to the 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". At the bottom, there is a "Settings" section with a table showing two rows of data. Below the table 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

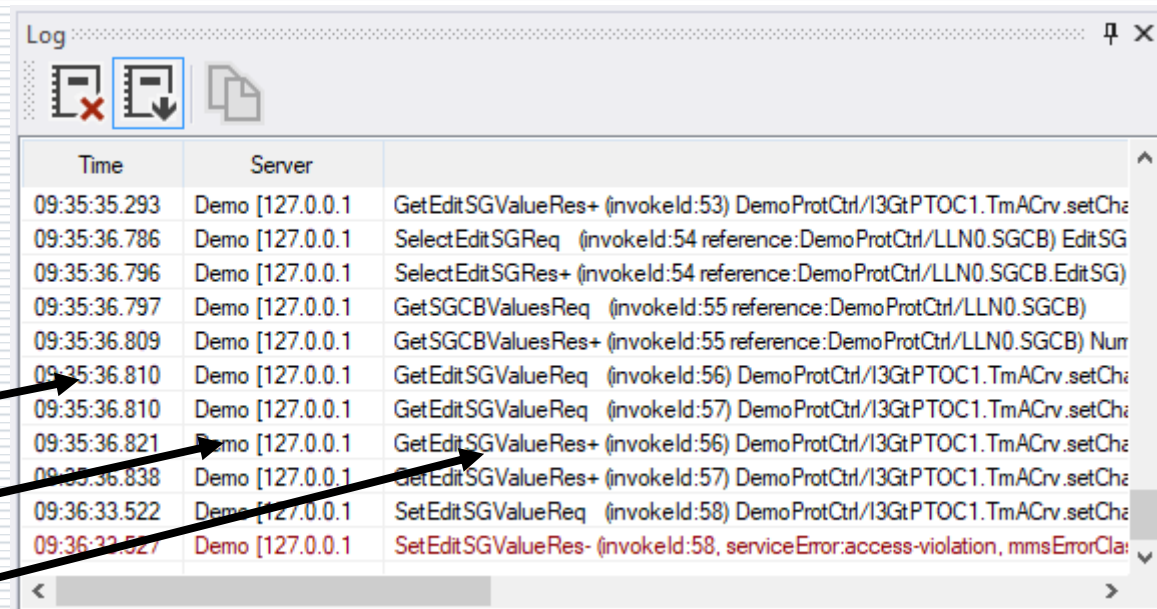
The tool provides a chronological view of operations (commands, responses and events) occurring during the interactions with server devices.

Each message in the log is described by:

Time – timestamp of the occurrence,

Server – device concerned,


Message – description of the operation.




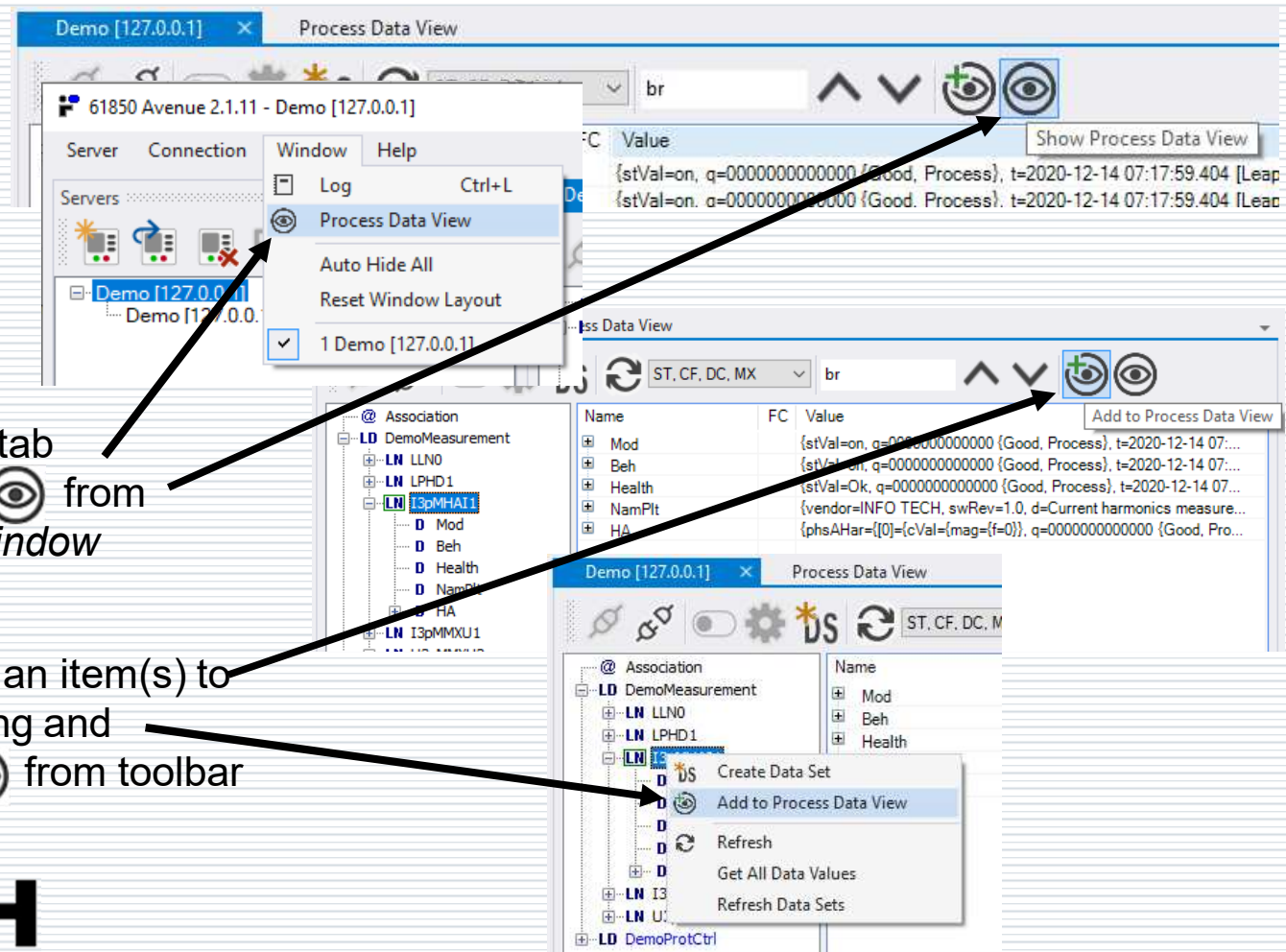
Time	Server	
09:35:35.293	Demo [127.0.0.1	GetEditSGValueRes+ (invokeld:53) DemoProtCtrl/I3GtPTOC1.TmACrv.setCha
09:35:36.786	Demo [127.0.0.1	SelectEditSGReq (invokeld:54 reference:DemoProtCtrl/LLN0.SGCB) EditSG
09:35:36.796	Demo [127.0.0.1	SelectEditSGRes+ (invokeld:54 reference:DemoProtCtrl/LLN0.SGCB.EditSG)
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

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 toolbar or menu *Window*


The users can add an item(s) to the PDV by selecting and pressing button  from toolbar or context menu.




Process Data View (PDV)

PDV toolbar is composed of the following elements:

Removing item(s) from PDV by button 

Confirming update of all items by button 

Refreshing selected items by button 

Copying selection by button 

The users can fully configure the PDV (right click on the table header) by showing / hiding columns with preferential data.

Demo [127.0.0.1] Process Data View

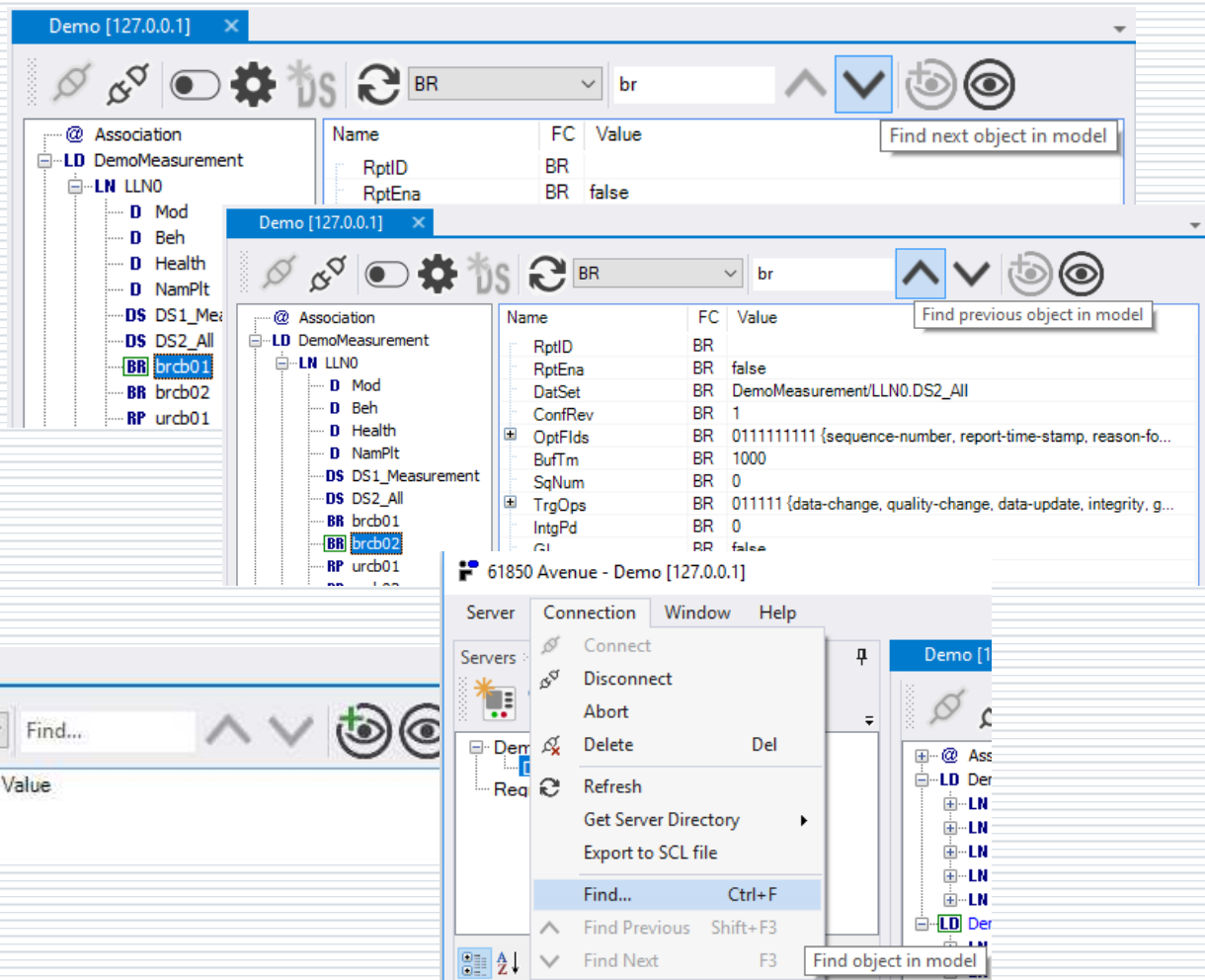
Location	Function	Object name	Value	Quality	Timestamp	Received	FC	Reference
DemoMeasurement	I3pMHAI1	Mod - Mode	on	0000000000...	2020-12-14 07:17:...	ST		DemoMeasurement/I3pMHAI1.Mod.stVal
DemoMeasurement	I3pMHAI1	Beh - Behaviour	on	0000000000...	2020-12-14 07:17:...	ST		DemoMeasurement/I3pMHAI1.Beh.stVal
DemoMeasurement	I3pMHAI1	Health - Health	Ok	0000000000...	2020-12-14 07:17:...	ST		DemoMeasurement/I3pMHAI1.Health.stVal
DemoMeasurement	I3pMHAI1	HA.phsAHar.[0]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[0]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[1]	100	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[1]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[2]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[2]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[3]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[3]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[4]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[4]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[5]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[5]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[6]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[6]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[7]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[7]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[8]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[8]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[9]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[9]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[10]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[10]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[11]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[11]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[12]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[12]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[13]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[13]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[14]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[14]
DemoMeasurement	I3pMHAI1	HA.phsAHar.[15]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsAHar.[15]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[0]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[0]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[1]	100	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[1]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[2]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[2]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[3]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[3]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[4]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[4]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[5]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[5]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[6]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[6]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[7]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[7]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[8]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[8]
DemoMeasurement	I3pMHAI1	HA.phsBHar.[9]	0	0000000000...	2020-12-14 08:09:...	MX		DemoMeasurement/I3pMHAI1.HA.phsBHar.[9]

Location	Function	Object name
DemoMeasurement	<input checked="" type="checkbox"/> Location	Mod - Mode
DemoMeasurement	<input checked="" type="checkbox"/> Function	Beh - Behaviour
DemoMeasurement	<input checked="" type="checkbox"/> Object name	Health - Health
DemoMeasurement	<input checked="" type="checkbox"/> Value	HA.phsAHar.[0]
DemoMeasurement	<input checked="" type="checkbox"/> Quality	HA.phsAHar.[1]
DemoMeasurement	<input checked="" type="checkbox"/> Timestamp	HA.phsAHar.[2]
DemoMeasurement	<input checked="" type="checkbox"/> Received	HA.phsAHar.[3]
DemoMeasurement	<input checked="" type="checkbox"/> FC	HA.phsAHar.[4]
DemoMeasurement	<input checked="" type="checkbox"/> Reference	HA.phsAHar.[5]
DemoMeasurement	<input checked="" type="checkbox"/>	HA.phsAHar.[6]
DemoMeasurement	<input checked="" type="checkbox"/>	HA.phsAHar.[7]
DemoMeasurement	<input checked="" type="checkbox"/>	HA.phsAHar.[8]

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.

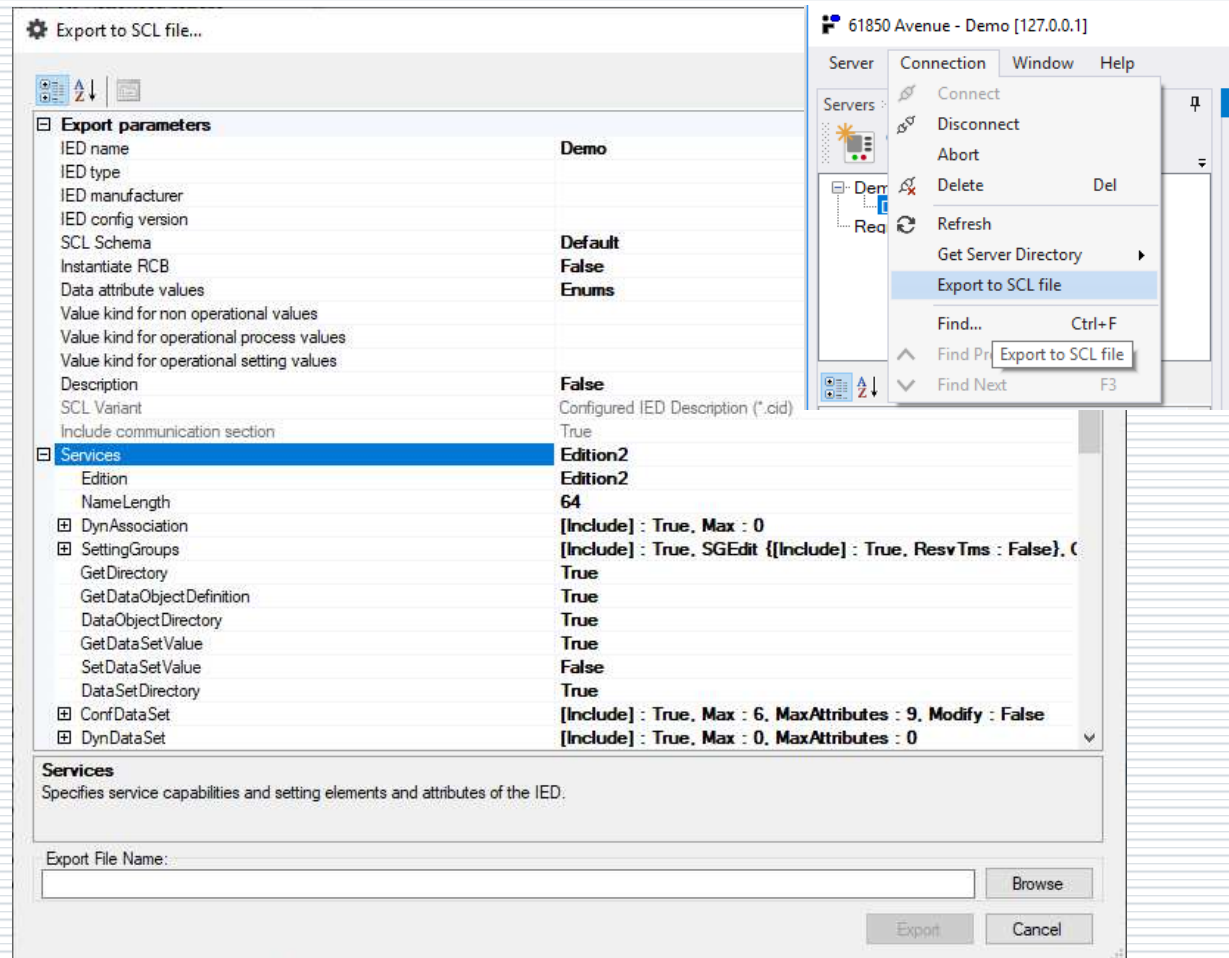
The user can start searching for objects using the keyboard shortcut **Ctrl + F**.



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

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: 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).

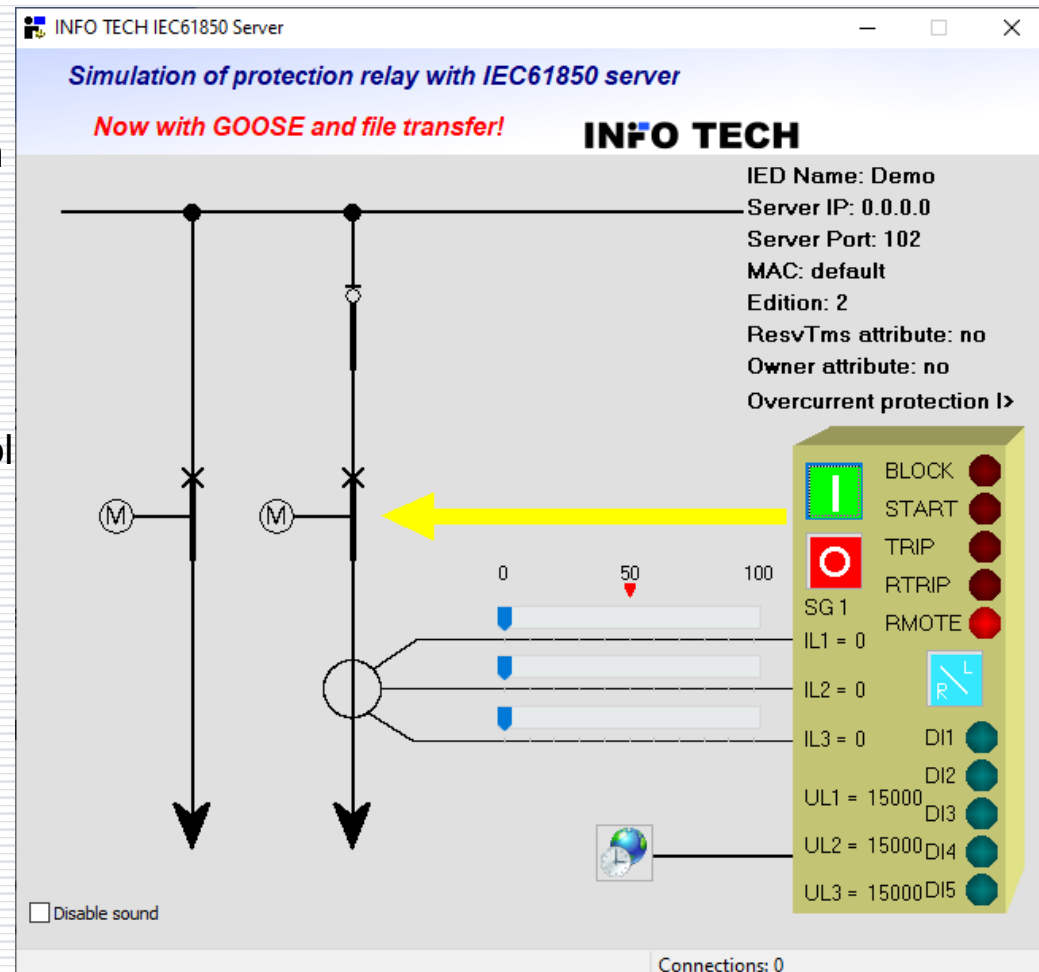
Local and remote monitoring.

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.

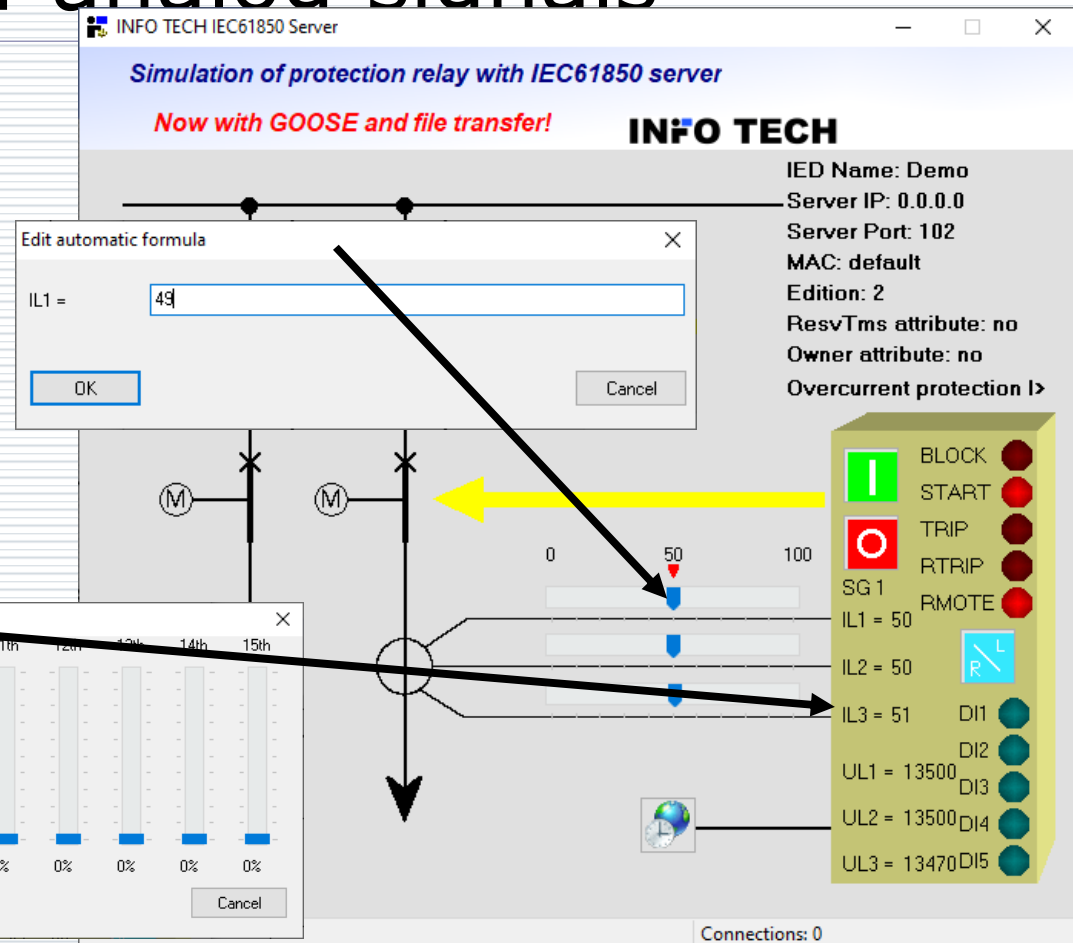


IEC 61850 Relay: simulation of analog signals

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.

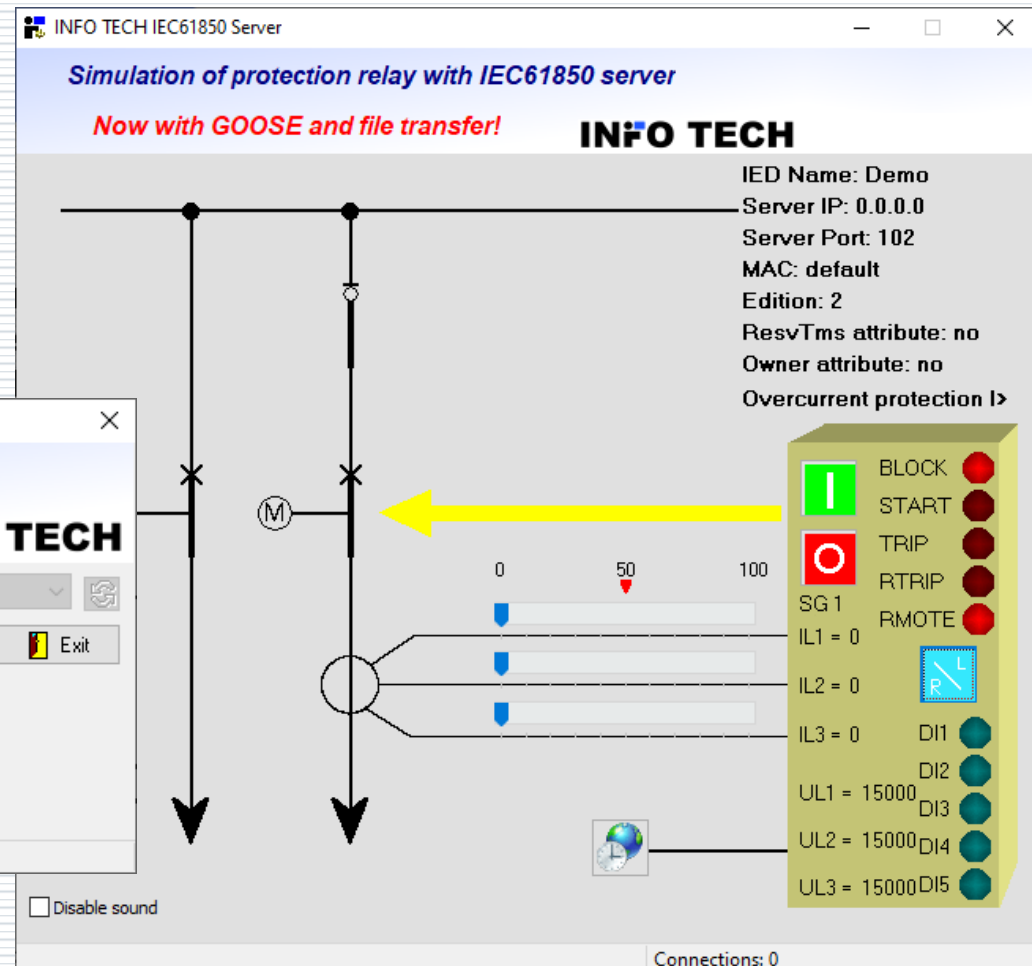
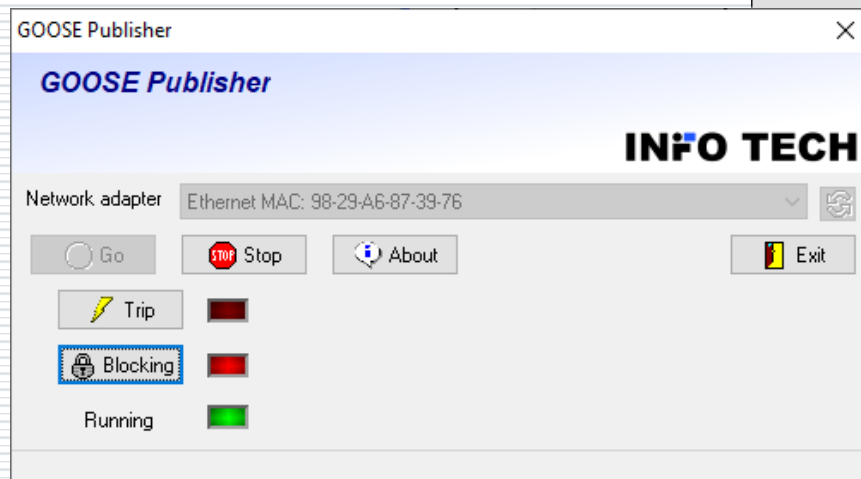
Overcurrent protection with inverse time characteristics.



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.



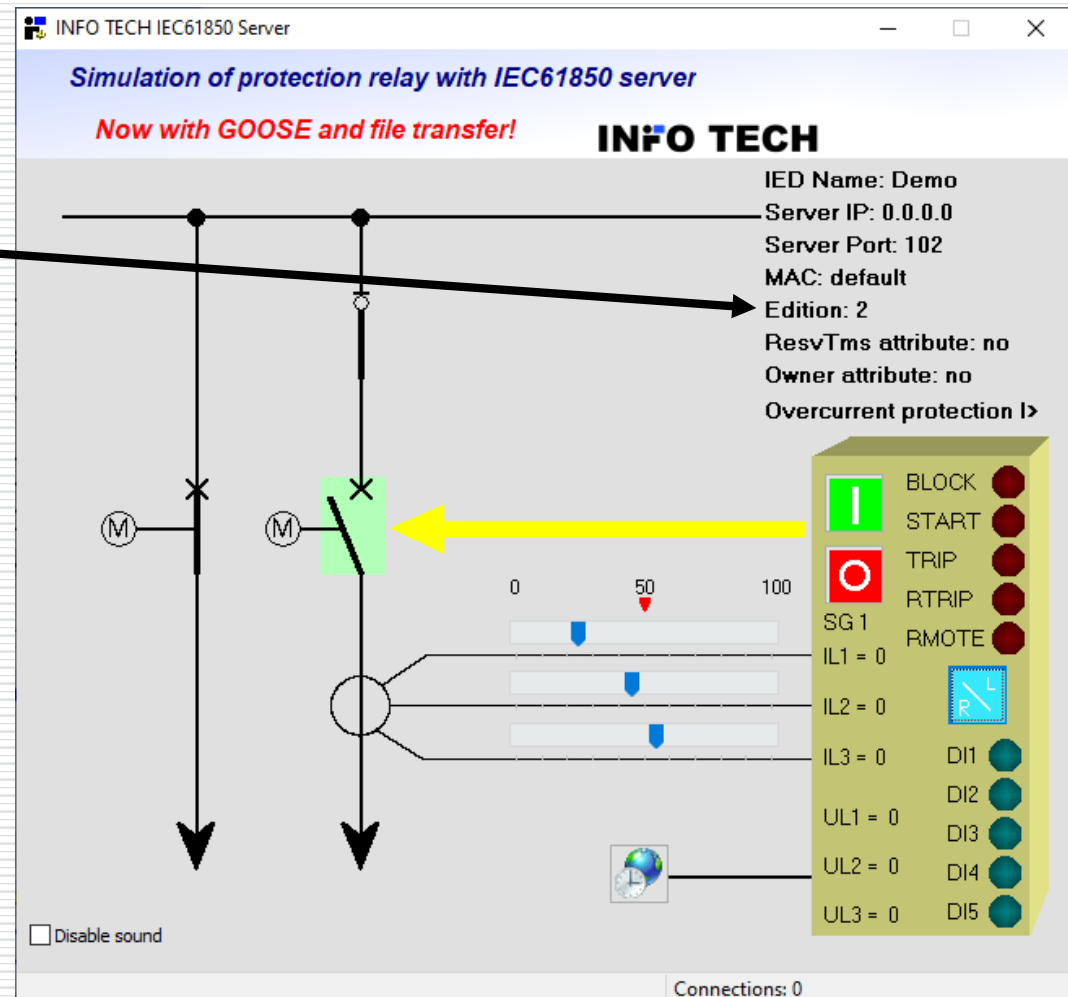
IEC 61850 Relay: options for Edition 1 and Edition 2

Two options of the simulator program execution are available:

- Conformant with IEC 61850 Ed.1
- Conformant with IEC 61850 Ed.2 (with separate ICD files).

Note:

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



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

GO STOP + X

Network adapter: VMware Network Adapter VMnet8 MAC: 00:50:56:C0:00:0

Type: Not routable

Ethernet

Source: 00:50:56:C0:00:08 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

Class of traffic: 32

GOOSE

App ID: 2 H

Fixed: FALSE

DSRef: LLN0\$DS4

CBRef: LLN0\$gcb1

GID: G2

Time: 2020-06-05 10:39:07.590

TTL: 0

StNum: 0

SqNum: 0

CfgRev: 1

NComm: FALSE

Sim/Test: TRUE

Data items

Id	Type	Value	Formula	Data reference
0	BOOL	FALSE		

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 open, pointing to the 'Available GOOSE streams' dialog box. The main window shows configuration fields for Network adapter, GOOSE (App ID, Fixed, DSRef, CBRef, GID, Time), and Ethernet (Source, Destination, VLAN, Priority, CFI, ID, IP Address). The 'Available GOOSE streams' dialog box contains a table with the following data:

Idx	IED	Type	Dest...	App ID	Con...	GOOSE ID	GCB Reference	Dataset elements
1	Demo	Not routable	01-0C...	0001	1	G1	DemoProtCtrl/LLN0\$GO\$qcb1	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]
2	Demo	Not routable	01-0C...	0002	1	G2	DemoProtCtrl/LLN0\$GO\$qcb2	

The 'Use' button is highlighted at the bottom left of the dialog box, and the 'Close' button is at the bottom right.

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 icons for file operations, starting/stopping, and simulation control. The main configuration area is divided into several sections:

- Network adapter:** VMware Network Adapter VMnet8 MAC: 00-50-56-C0-00-0
- Type:** Not routable
- Ethernet:** Source (00:50:56:C0:00:08), Destination (01:0C:CD:01:00:01), M-cast checkbox.
- VLAN:** Priority (4), CFI (Eth), ID (0), M-cast checkbox.
- IP:** Address (239.1.1.35), M-cast checkbox, Class of traffic (32).
- GOOSE:** App ID (2), TTL (0), Fixed (FALSE), StNum (0), SqNum (0), DSRRef (DemoProtCtrl/LLN0\$DS4_GOOSE), CfgRev (1), CBRef (DemoProtCtrl/LLN0\$GO\$gcb2), NComm (FALSE), GID (G2), Time (2020-06-05 10:39:07.590), Sim/Test (TRUE).

Below the configuration fields is a table titled "Data items" with the following structure:

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

GOOSE Sender – dataset elements of both simple and structured types

An 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 interface includes a menu bar (File, Edit, Transmission, Help) and a toolbar with icons for file operations, GOOSE status, and network settings. The main configuration area is divided into several sections:

- Network adapter:** VMware Network Adapter VMnet8 MAC: 00-50-56-C0-00-0
- Type:** Not routable
- Ethernet:** Source (00:50:56:C0:00:08), Destination (01:0C:CD:01:00:01), VLAN (checked), Priority (4), CFI (Eth), ID (0).
- IP:** Address (239.1.1.35), Class of traffic (32).
- GOOSE:** App ID (2), Fixed (FALSE), DSRRef (DemoProtCtrl/LLN0\$D\$4_GOOSE), CBRRef (DemoProtCtrl/LLN0\$G0\$gcb2), GID (G2), Time (2020-06-05 10:39:07.590), TTL (0), StNum (0), SqNum (0), CfgRev (1), NComm (FALSE), Sim/Test (TRUE).
- Data items:** A table listing dataset elements.

Idx	Type	Value	Formula	Data reference
0	BOOL	FALSE		DemoProtCtrl/DIGGIO1.Ind1.stVal [ST]
1	QUALITY	00000000000000		DemoProtCtrl/DIGGIO1.Ind2.stVal [ST]
2	FLOAT	0		DemoProtCtrl/DIGGIO1.Ind3.stVal [ST]
3	TIME	2020-06-05 10:49:34.727		DemoProtCtrl/DIGGIO1.Ind4.stVal [ST]
4	BOOL	FALSE		DemoProtCtrl/DIGGIO1.Ind5.stVal [ST]

GOOSE toolset: GOOSE Receiver – configurable subscriber

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

The screenshot shows the 'GOOSE Sender' application window. The 'Transmission' menu is open, highlighting 'Select Stream'. The 'GOOSE' configuration section on the right includes fields for App ID (2), TTL (4000), StNum (1), SqNum (21), CfgRev (1), NComm (FALSE), and Test (TRUE). Below this is a table titled 'Available GOOSE streams' with columns: Idx, Type, Source MAC, Destination MAC, IP, App ID, Config Rev, GOOSE ID, GCB ref, Messages, TEST, and NDSCOM. The table contains two rows of data. At the bottom of the window are buttons for 'Subscribe', 'Clear', and 'Close'.

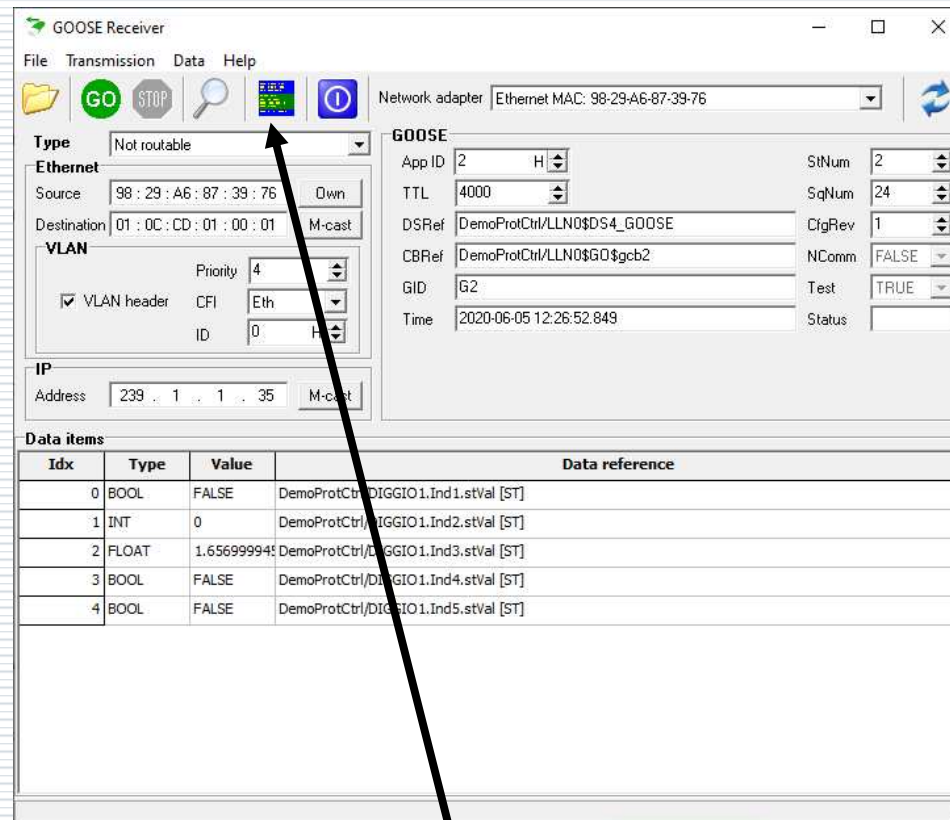
Idx	Type	Source MAC	Destination MAC	IP	App ID	Config Rev	GOOSE ID	GCB ref	Messages	TEST	NDSCOM
1	Not routable	98:29:A6:87:39:76	01:0C:CD:01:00:00	N/A	0001	1	G1	DemoProtCtrl/...	27	TRUE	FALSE
2	Not routable	98:29:A6:87:39:76	01:0C:CD:01:00:01	N/A	0002	1	G2	DemoProtCtrl/...	26	TRUE	FALSE

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

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.



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.

Available GOOSE streams											
Idx	Type	Source MAC	Destination MAC	IP	App ID	Config Rev	GOOSE ID	GCB ref	Messages	TEST	NDSCOM
1	Not routable	98:29:A6:87:3...	01:0C:CD:01:0...	N/A	0002	1	G2	DemoProtCtrl/...	80	TRUE	FALSE
2	Not routable	98:29:A6:87:3...	01:0C:CD:01:0...	N/A	0001	1	G1	DemoProtCtrl/...	11	TRUE	?
3	Not routable	98:29:A6:87:3...	01:0C:CD:01:0...	N/A	0002	1	G2	DemoProtCtrl/...	13	TRUE	?
4	Not routable	98:29:A6:87:3...	01:0C:CD:01:0...	N/A	0002	1	G3	DemoProtCtrl/...	12	TRUE	?

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 shows the 'GOOSE Receiver' application window. The 'Import' menu is open, and the 'GOOSE' configuration tab is active. The 'Network adapter' is set to 'Ethernet MAC: 98-29-A6-87-39-76'. The 'GOOSE' section contains fields for App ID (2), TTL (4000), DSRef (DemoProtCtrl/LLN0\$DS4_GOOSE), CBRef (DemoProtCtrl/LLN0\$GO\$gcb2), GID (G2), and Time (2020-06-05 12:26:52.849). Below this, there is a table of 'Available GOOSE streams' and a 'Data reference' section.

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

The 'Data reference' section lists the following 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]

At the bottom of the window, there is a status bar that reads 'Import GOOSE stream definitions from SCL file'.

GOOSE Receiver – dataset elements of both simple and structured types

An imported configuration of GOOSE Subscriber function may include reception of messages with dataset containing elements of simple or structured types – both options are supported.

The screenshot shows the 'GOOSE Receiver' application window. It has a menu bar with 'File', 'Transmission', 'Data', and 'Help'. Below the menu is a toolbar with icons for file operations, a 'GO' button, a 'STOP' button, a search icon, a status icon, and an information icon. The 'Network adapter' is set to 'Ethernet MAC: 98-29-A6-87-39-76'. The 'Type' is 'Not routable'. Under 'Ethernet', the 'Source' is '98 : 29 : A6 : 87 : 39 : 76' and the 'Destination' is '01 : 0C : CD : 01 : 00 : 01'. The 'VLAN' section is checked, with 'Priority' set to 4, 'CFI' set to 'Eth', and 'ID' set to 0. The 'IP' address is '239 . 1 . 1 . 35'. The 'GOOSE' section contains fields for 'App ID' (2), 'TTL' (4000), 'DSRef' ('DemoProtCtrl/LLN0\$DS4_GOOSE'), 'CBRef' ('DemoProtCtrl/LLN0\$GO\$gcb2'), 'GID' ('G2'), and 'Time' ('2020-06-05 12:26:52.849'). On the right, 'StNum' is 2, 'SqNum' is 137, 'CigRev' is 1, 'NComm' is 'FALSE', 'Test' is 'TRUE', and 'Status' is empty. Below these settings is a 'Data items' table.

Idx	Type	Value	Data reference
0	BOOL	FALSE	
1	INT	0	
2	FLOAT	1.656999945	
3	BOOL	FALSE	
4	BOOL	FALSE	

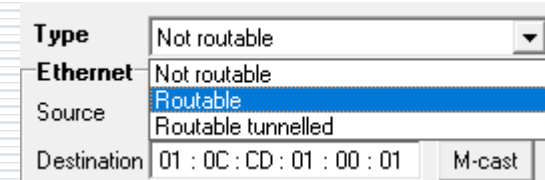
GOOSE Sender and GOOSE Receiver support also routable messages

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

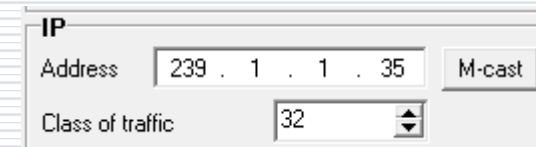
Not routable – GOOSE message as Ethernet frame

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



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



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



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 current sampling rate, network frequency, etc.

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

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

Sampled Values Sender

File Transmission Help

Network adapter: Ethernet MAC: D4-81-D7-68-85-A2

Type: Not routable

Ethernet

Source: D4:81:D7:68:85:A2 Own

Destination: 01:0C:CD:04:00:02 M-cast

VLAN

☒ VLAN header 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: Training

Config Rev: 1

SVID: SVID

Signal sampling

Network: 50 Hz

Samples/Cycle: 80

Synchronized: No

Signal values

Signal	Frequency [Hz]	Amplitude [A]	Phase [deg]	Amplitude [V]	Phase [deg]
I1	50.00	100.00	0.00	1000.00	0.00
I2	50.00	100.00	120.00	1000.00	120.00
I3	50.00	100.00	-120.00	1000.00	-120.00
Io	50.00	0.00	0.00	0.00	0.00
U1	50.00	100.00	0.00	1000.00	0.00
U2	50.00	100.00	120.00	1000.00	120.00
U3	50.00	100.00	-120.00	1000.00	-120.00
Uo	50.00	0.00	0.00	0.00	0.00

Sampled Values Quality

Quality Bit	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 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"/>
Overflow	<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"/>
Out of Range	<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"/>
Bad Reference	<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"/>
Oscillatory	<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"/>
Failure	<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"/>
Old Data	<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"/>
Inconsistent	<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"/>
Inaccurate	<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"/>
Substituted/Process	<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"/>
Test	<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"/>
Operator Blocked	<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"/>
Derived	<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"/>

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: Not routable

Ethernet Source: 98 : 29 : A6 : 87 : 39 : 76 Own Destination: 01 : 0C : CD : 04 : 00 : 00 M-cast

VLAN Priority: 4

☒ VLAN header 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

Amplitude [A]: I1: 100.00 I2: 100.00 I3: 100.00 Io: 0.00

Phase [deg]: I1: 0.00 I2: 120.00 I3: -120.00 Io: 0.00

Amplitude [V]: U1: 1000.00 U2: 1000.00 U3: 1000.00 Uo: 0.00

Phase [deg]: U1: 0.00 U2: 120.00 U3: -120.00 Uo: 0.00

Sampled Values Quality

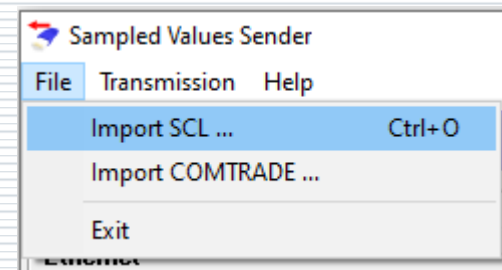
	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Questionable	<input type="checkbox"/>	<input type="checkbox"/>	<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 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"/>

Signal sampling Network: 50 Hz Samples/Cycle: 80 Synchronized: No

Buttons: GO GO STOP

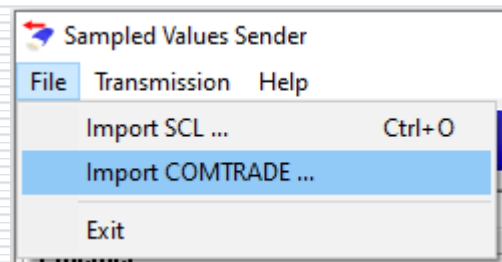
SV toolset: SAV Sender - configuration from files

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

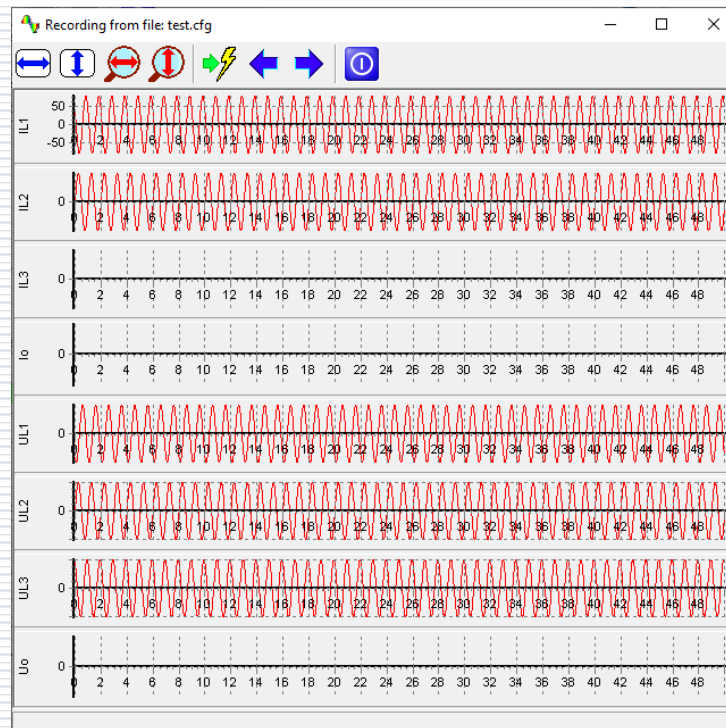
☐ Calculate (for Io)

☐ Calculate (for 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	Notr...	98:29:A6:87...	01:0C:CD:0...	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

Source: 98:29:A6:87:39:76 Destination: 01:0C:CD:04:00:00 M-cast

VLAN: Priority: 4 CFI: Eth ID: 0 H

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

Communication status: Status: OFF line Lost messages: 0 Clear

Sampled Values Quality

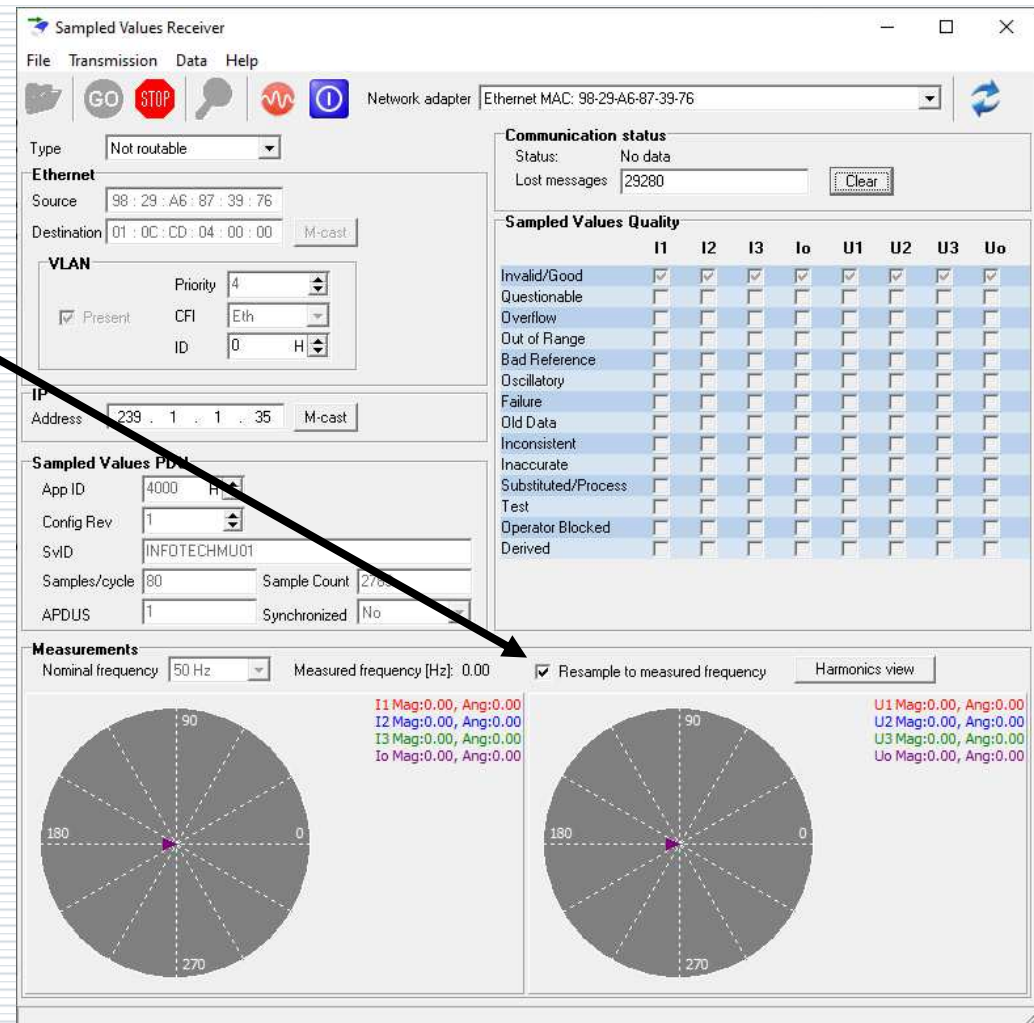
	I1	I2	I3	Io	U1	U2	U3	Uo
Invalid/Good	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" 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"/>

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

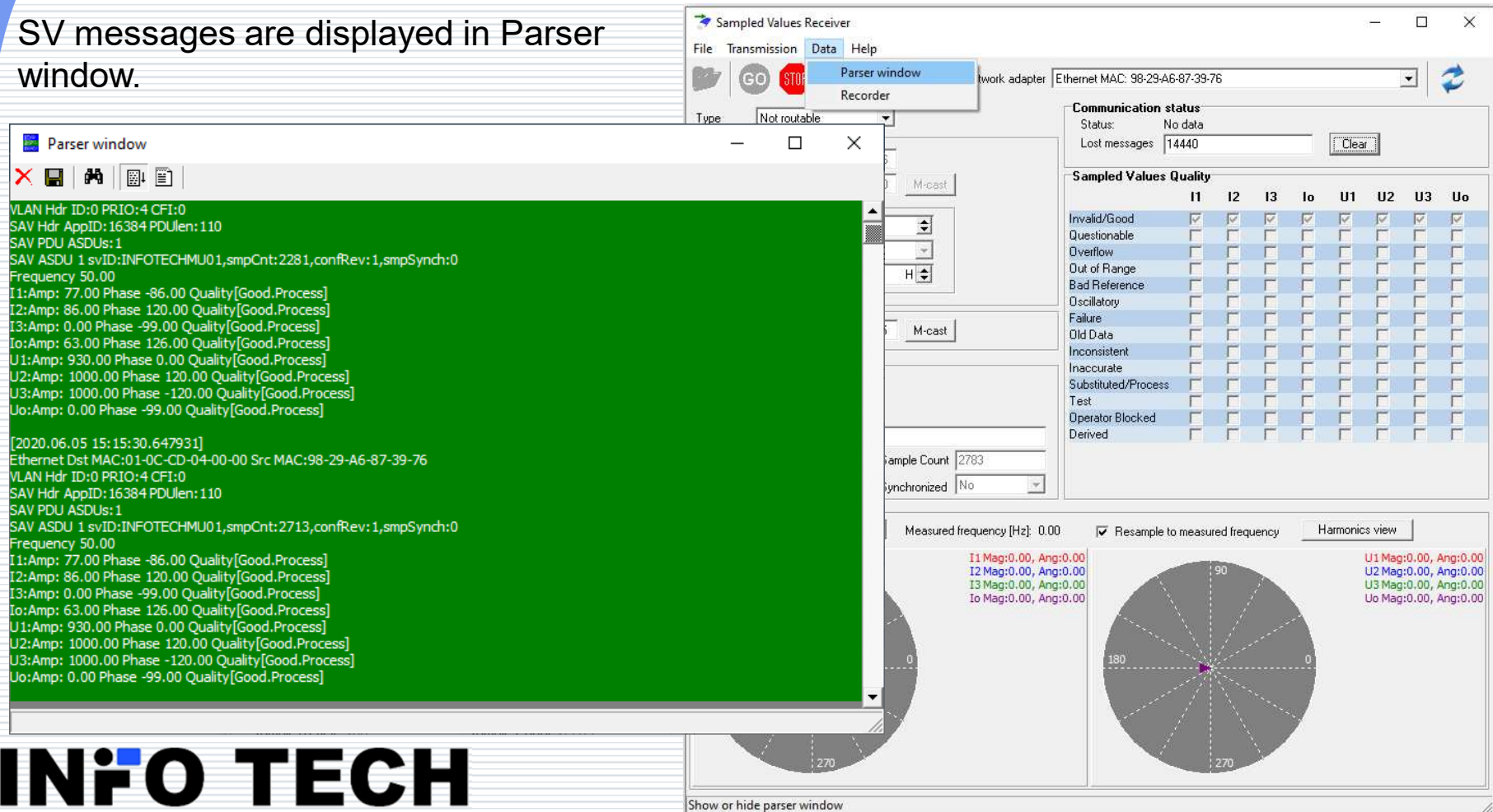
Signal characteristics are computed in real-time based on the incoming sampled values message stream.

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.



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

Available SAV streams

Idx	Type	Source MAC	Destination MAC	IP	App ID	Config Rev	SV ID	Mess...	Simul...
1	Not r...	98:29:A6:87:39:76	01:0C:CD:04:00:00	N/A	4000	1	INFOTECHMU01	112482	FALSE
2	Not r...	98:29:A6:87:39:78	01:0C:CD:04:00:00	N/A	4001	1	INFOTECHMU01	59310	FALSE
3	Not r...	98:29:A6:87:39:79	01:0C:CD:04:00:00	N/A	4001	1	INFOTECHMU01	9459	FALSE
4	Not r...	98:29:A6:87:39:79	01:0C:CD:04:00:00	N/A	4001	1	INFOTECHMU012	32183	FALSE

Subscribe Clear Close

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).

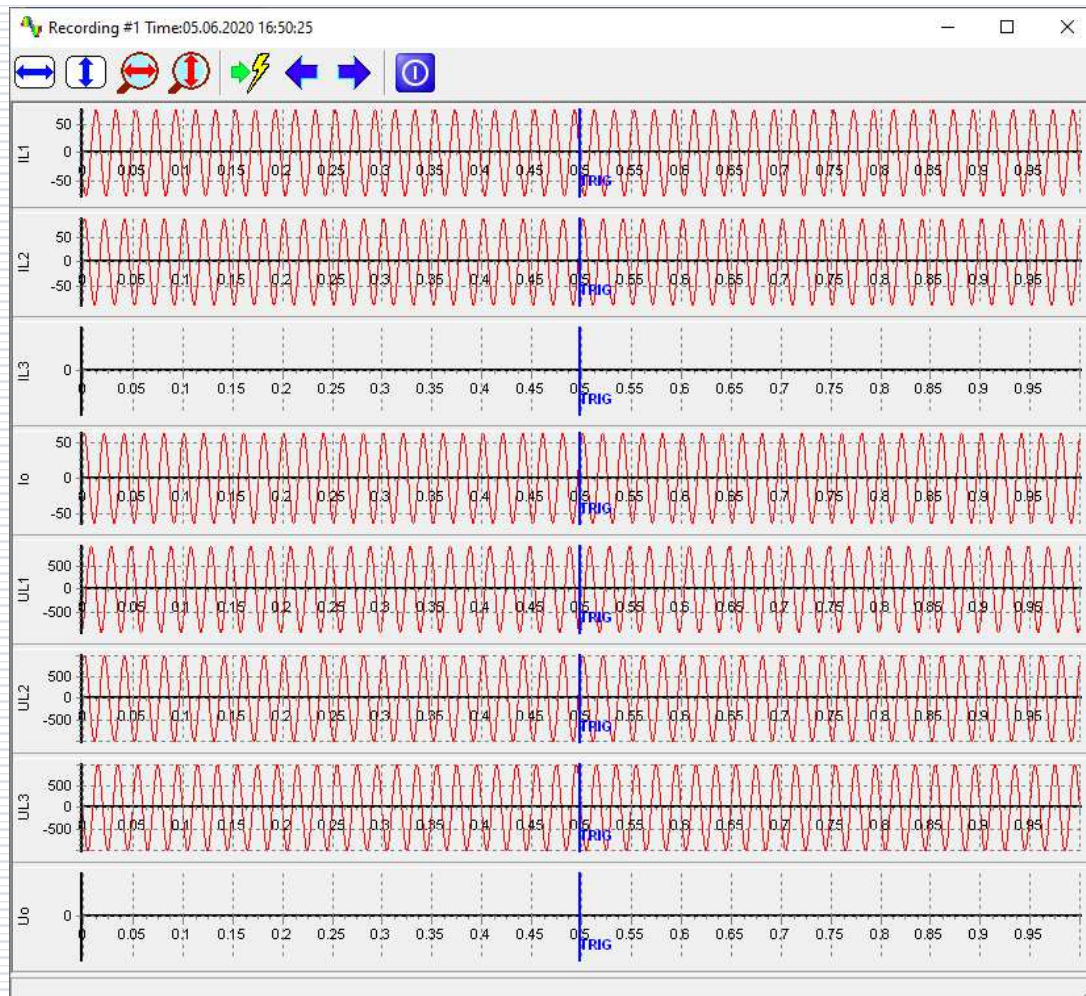
The screenshot displays the SAV Receiver software interface, which is used for recording and saving sampled values in a COMTRADE format file. The interface is divided into several panels:

- 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 eight recording slots. Slot #1 is 'Done' with a trigger time of 05.06.2020 16:50:26. 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.
- Transmission Panel:** This panel shows the network adapter settings. It includes a 'File' menu, 'Transmission' and 'Data' buttons, and a 'Help' button. The network adapter is set to 'Ethernet MAC: 98-29-A6-87-39-76'. The 'Type' is set to 'Not routable'. The 'Source' is set to '98-29-A6-87-39-76'. The 'Destination' is set to '00:00:00:00:00:00'. The 'M-cast' button is also visible.
- Sampled Values Quality Panel:** This panel displays the quality of the sampled values. It includes a table with columns for 'Invalid/Good', 'Questionable', 'Overflow', 'Out of Range', 'Bad Reference', 'Oscillatory', 'Failure', 'Old Data', 'Inconsistent', 'Inaccurate', 'Substituted/Process', 'Test', 'Operator Blocked', and 'Derived'. The table has rows for I1, I2, I3, Io, U1, U2, U3, and Uo. The 'Sample Count' is 3999, and the 'Synchronized' checkbox is checked.
- Measured frequency [Hz]: 50.00** and **Resample to measured frequency** checkbox.
- Harmonics view** button.
- Phasor Diagrams:** Two circular phasor diagrams are shown. The left diagram shows the measured frequency (50.00 Hz) and the right diagram shows the resampled frequency (50.00 Hz). The diagrams include vectors for I1, I2, I3, Io, U1, U2, U3, and Uo.

SV toolset: SAV Receiver

– viewing recorded COMTRADE file

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



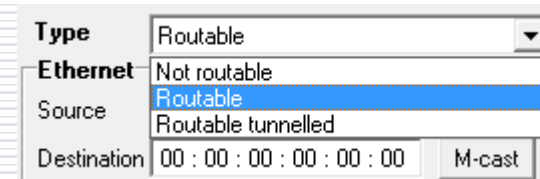
SAV Sender and SAV Receiver support also routable messages

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

Not routable – SV message as Ethernet frame

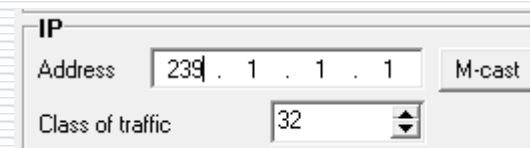
Routable – sent over IP between IEDs, data part of SV frame routed using IP packets and UDP protocol, locally forwarded by receiving IED as Ethernet SV frame

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



The screenshot shows a configuration window with the following fields:

Type	Routable
Ethernet	Not routable
Source	Routable
Destination	00 : 00 : 00 : 00 : 00 : 00
	M-cast



The screenshot shows an IP configuration window with the following fields:

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

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

File Transfer Tool



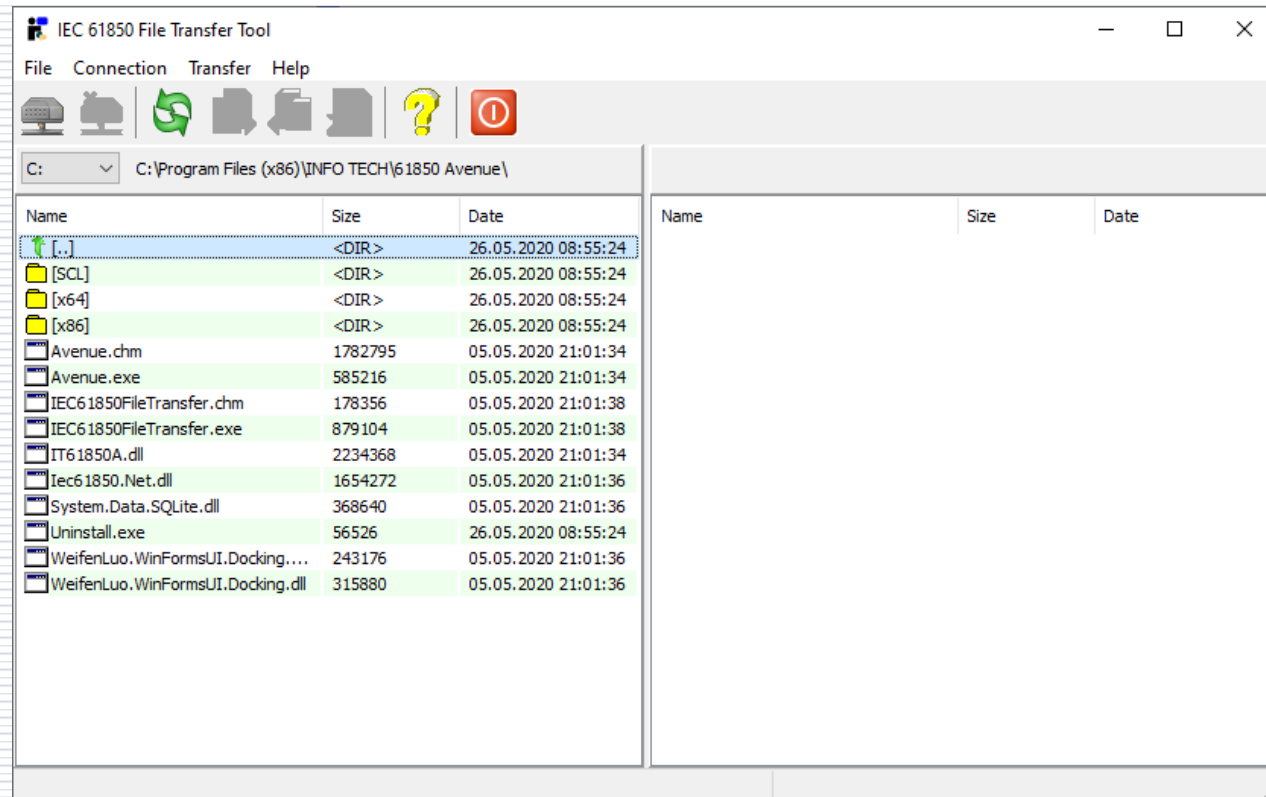
File Transfer Tool – to test access to files in server devices

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.

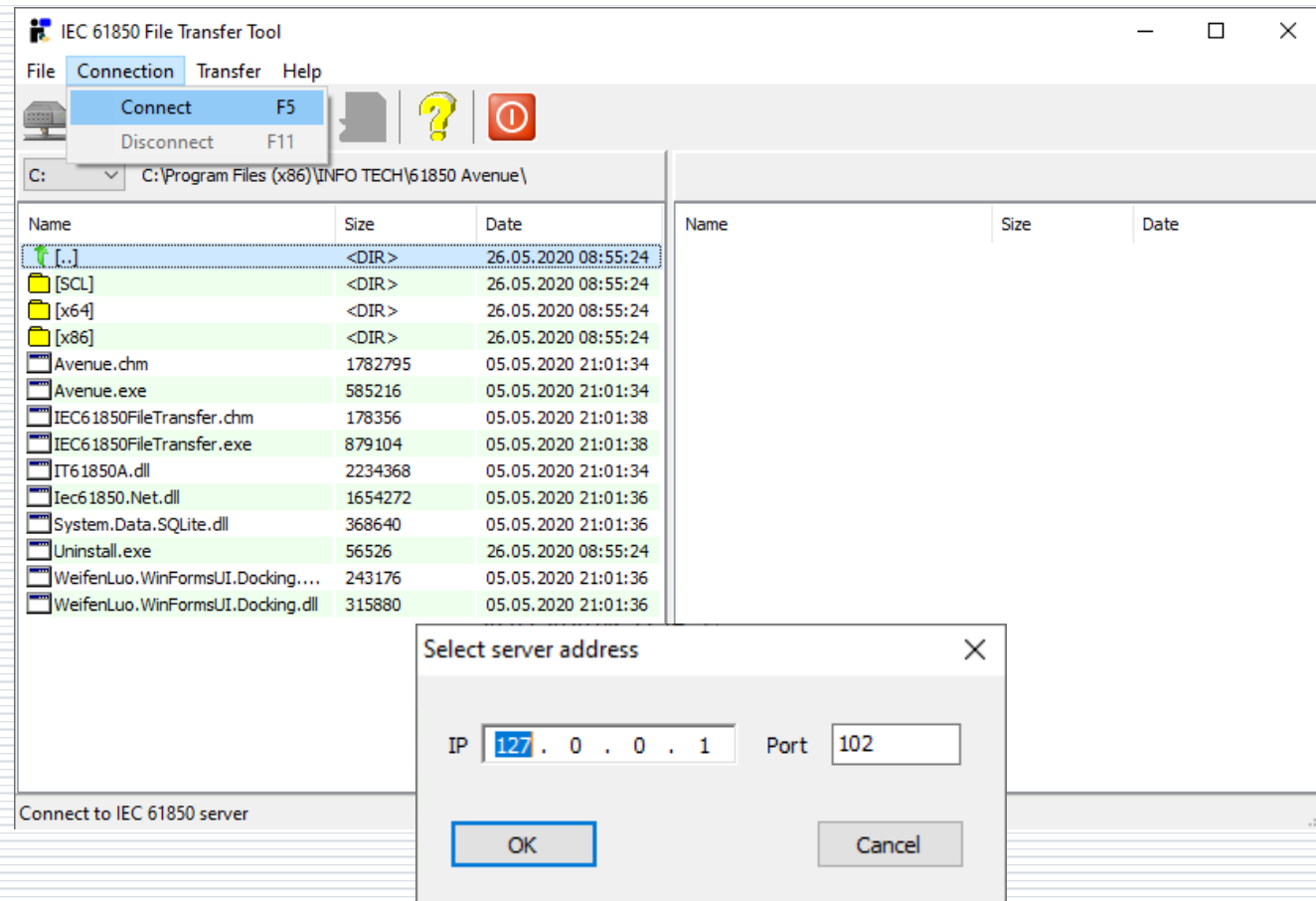


Connection to server device as a file server

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.

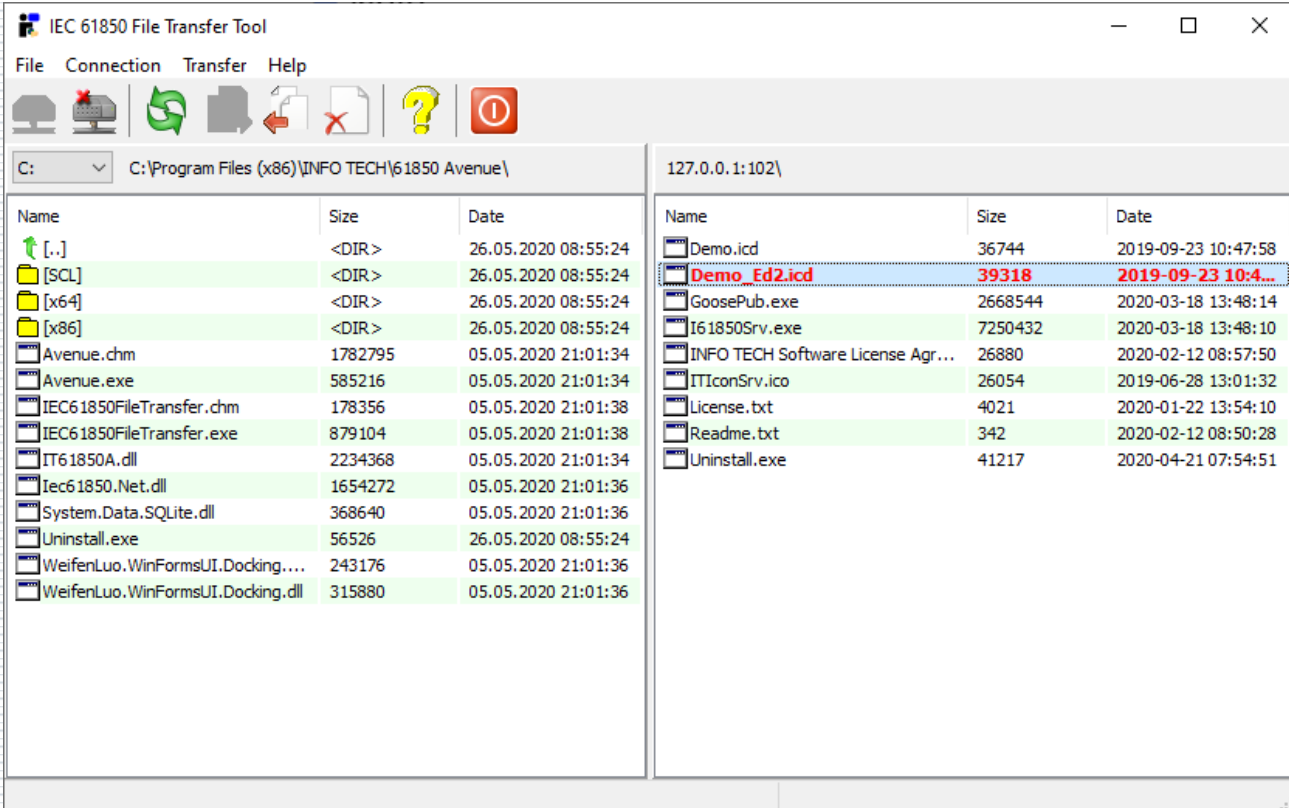


View of the file system in the server device

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.



The screenshot displays the IEC 61850 File Transfer Tool interface. The left pane shows a hierarchical file system view for the local path C:\Program Files (x86)\INFO TECH\61850 Avenue\, listing directories like [SCL], [x64], [x86] and various files including Avenue.chm, Avenue.exe, IEC61850FileTransfer.chm, IEC61850FileTransfer.exe, IT61850A.dll, Iec61850.Net.dll, System.Data.SQLite.dll, Uninstall.exe, WeifenLuo.WinFormsUI.Docking..., and WeifenLuo.WinFormsUI.Docking.dll. The right pane shows a flat file system view for the remote path 127.0.0.1:102\, listing files like Demo.icd, Demo_Ed2.icd (highlighted in red), GoosePub.exe, I61850Srv.exe, INFO TECH Software License Agr..., ITIconSrv.ico, License.txt, Readme.txt, and Uninstall.exe. The Demo_Ed2.icd file is highlighted in red, indicating it is the selected file.

Name	Size	Date
[.]	<DIR>	26.05.2020 08:55:24
[SCL]	<DIR>	26.05.2020 08:55:24
[x64]	<DIR>	26.05.2020 08:55:24
[x86]	<DIR>	26.05.2020 08:55:24
Avenue.chm	1782795	05.05.2020 21:01:34
Avenue.exe	585216	05.05.2020 21:01:34
IEC61850FileTransfer.chm	178356	05.05.2020 21:01:38
IEC61850FileTransfer.exe	879104	05.05.2020 21:01:38
IT61850A.dll	2234368	05.05.2020 21:01:34
Iec61850.Net.dll	1654272	05.05.2020 21:01:36
System.Data.SQLite.dll	368640	05.05.2020 21:01:36
Uninstall.exe	56526	26.05.2020 08:55:24
WeifenLuo.WinFormsUI.Docking....	243176	05.05.2020 21:01:36
WeifenLuo.WinFormsUI.Docking.dll	315880	05.05.2020 21:01:36

Name	Size	Date
Demo.icd	36744	2019-09-23 10:47:58
Demo_Ed2.icd	39318	2019-09-23 10:4...
GoosePub.exe	2668544	2020-03-18 13:48:14
I61850Srv.exe	7250432	2020-03-18 13:48:10
INFO TECH Software License Agr...	26880	2020-02-12 08:57:50
ITIconSrv.ico	26054	2019-06-28 13:01:32
License.txt	4021	2020-01-22 13:54:10
Readme.txt	342	2020-02-12 08:50:28
Uninstall.exe	41217	2020-04-21 07:54:51

File transfer operations

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

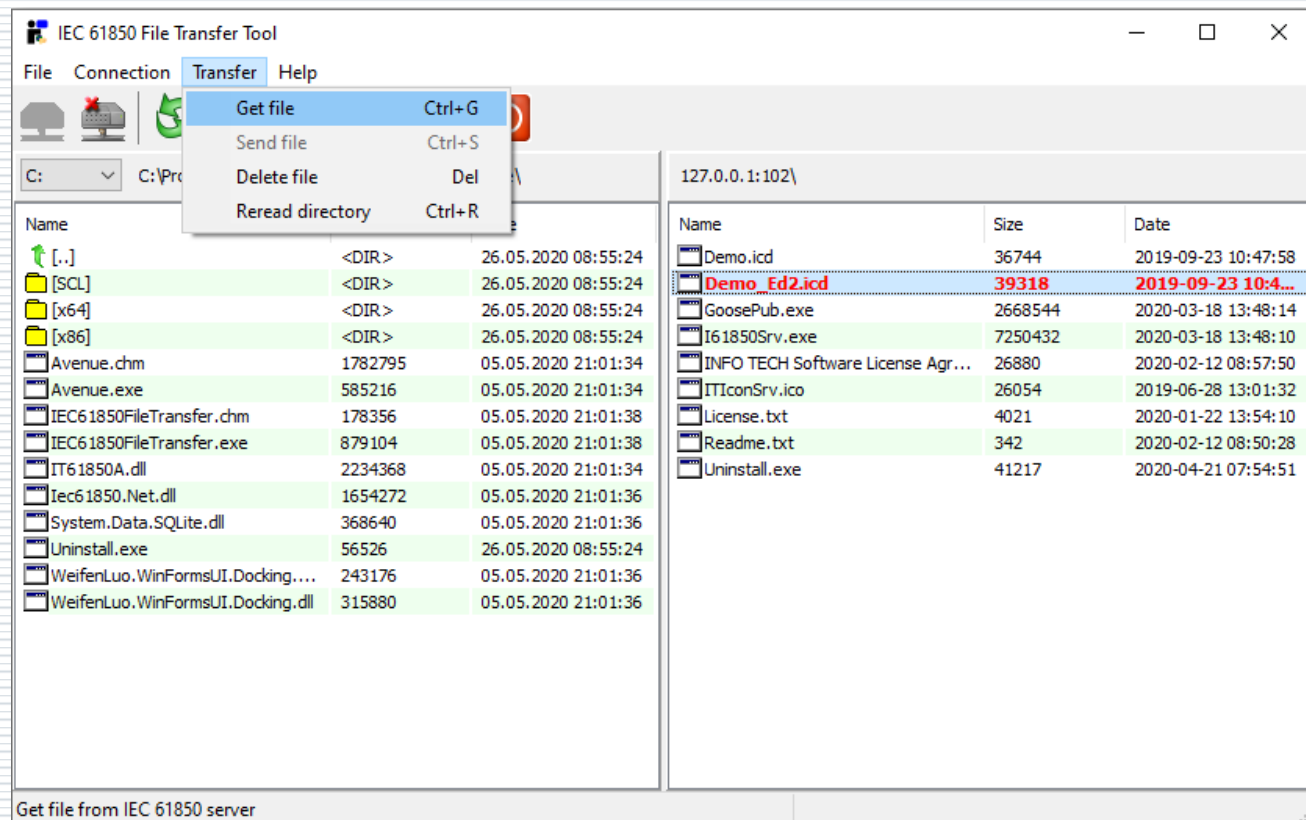
Possible operations in **Transfer** menu:

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

From scratch or
by modification of
an existing file.

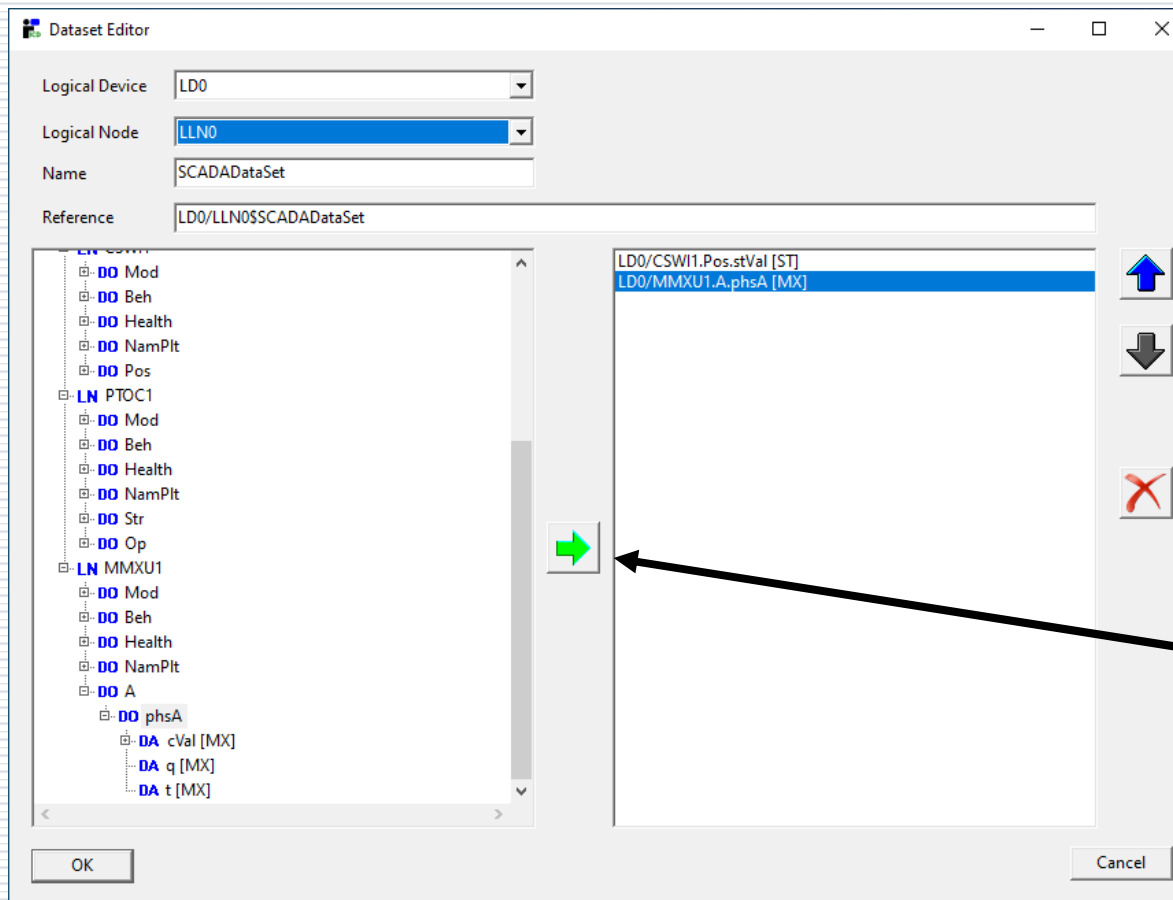
The screenshot displays the 61850 ICD Editor software interface. The main window, titled "61850 ICD Editor - Untitled", shows a project tree on the left with a "TEMPLATE" folder containing "LD LD0", "LN LLN0", "LN LPHD1", "LN CSWI1", and "LN PTOC1". The "LN PTOC1" folder is expanded, showing "DO Beh" and "DO Str" sub-folders. The "DO Beh" folder contains "DA stVal [ST]", "DA q [ST]", and "DA t [ST]". The "DO Str" folder contains "DA general [ST]", "DA dirGeneral [ST]", "DA q [ST]", and "DA t [ST]". The "DO Op" folder contains "DA general [ST]".

Overlaid on the main window are two dialog boxes. The "Add new Logical Node" dialog box is open, showing a "Class" dropdown menu with "XCBR" selected. The "LN name" field is empty. Below the "LN name" field, there is a list of "This LN is" options: "XCBR", "TVBR", "TVTR", "TWPH", "XSXWI", "YEFN", "YLTC", and "YPSH". The "Control Block Editor" dialog box is also open, showing a "Control block type" dropdown menu with "Unbuffered Report CB" selected. The "Name" field is empty. The "DataSet" field is empty. The "Report ID" field is empty. The "Buffering time" field is set to "1000". The "Integrity period" field is set to "0". The "Config revision" field is set to "1". The "Instances" field is set to "1". The "Option fields" section has several checkboxes: "Sequence number", "Time stamp", "DataSet reference", "Reason code", "Data reference", "Entry ID", "Configuration revision", and "Buffer overflow". The "Triggering options" section has several checkboxes: "Data change", "Quality change", "Data update", "Integrity scan", and "General interrogation".

Annotations on the image include:

- "Add LD" pointing to the "LD LD0" folder in the project tree.
- "Add LN with selection of optional DO and DA" pointing to the "Add new Logical Node" dialog box.
- "Add RCB, GCB, SGCB, SVCB with setting attribute values" pointing to the "Control Block Editor" dialog box.

Dataset creation by selection of elements from the data model



Buttons for changing order of elements in dataset.

Button for removing element of dataset.

Button for adding an element of data model to dataset.

Possible applications of 61850 ICD Editor program

- ❑ 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.

Contact: www.infotech.pl

INFO TECH sp.j.
Edisona 14
PL 80-172 Gdansk
Poland

office@infotech.pl

Tel. (+48) 58 3018527
Mob. (+48) 602 799756

