61850 Avenue 2.1
Substation Communication Tool

User guide

Prepared by Wojciech E. Kozlowski
Version: November 2023

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Contents

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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 October 2023, the licensed INFO TECH software is the basis for implementing IEC 61850 interfaces in the products of 53 companies and institutions from 15 countries of Europe, Asia and North America.
- INFO TECH offers also:
  - **Hands-on trainings** on IEC 61850 communication,
  - **Conformance testing** of the IEC 61850 interfaces,
  - **Audits and diagnostics of systems** using IEC 61850 communication.

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

Other known products from this area:

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

61850 Avenue toolset

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

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

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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**


30. Międzynarodowe
Energetyczne Targi Bielskie
„ENERGETAB 2017"

WYRÓŻNIENIE

za produkt:
Biblioteka oprogramowania
INFO TECH IEC61850 Software Library
wraz z programami do testowania i symulacji

zgłoszony przez firmę:

"INFO TECH"
Dr Wojciech E.Kozłowski
Spółka jawna

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!

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Installation procedure

Supported platforms:

PC running

MS Windows

7, 8, 10 and 11.

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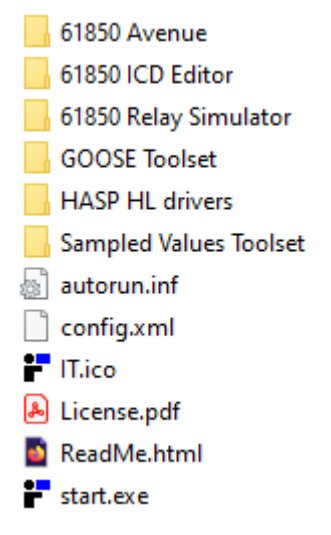
To install the software

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**)

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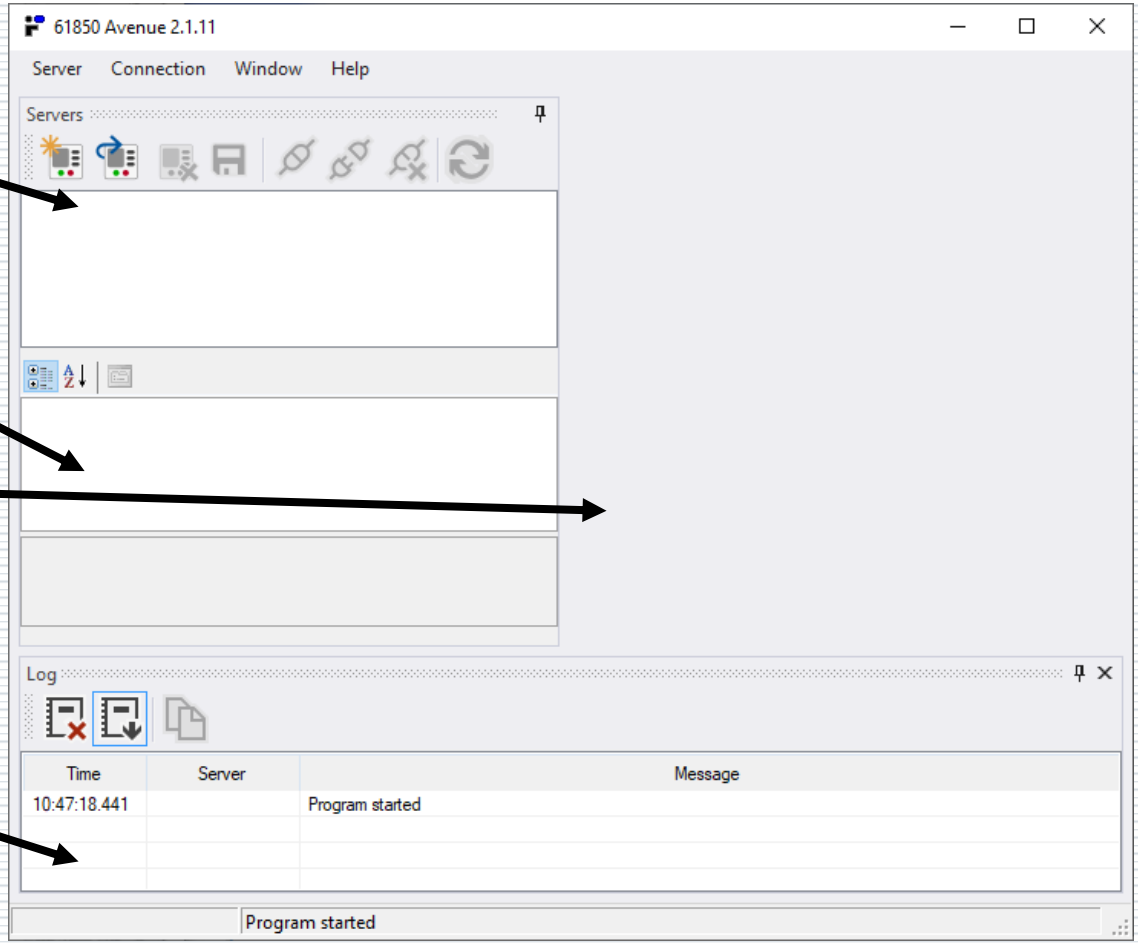
Initial view after the first start-up of 61850 Avenue client

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

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

Main operation view – for folders with server data models.

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



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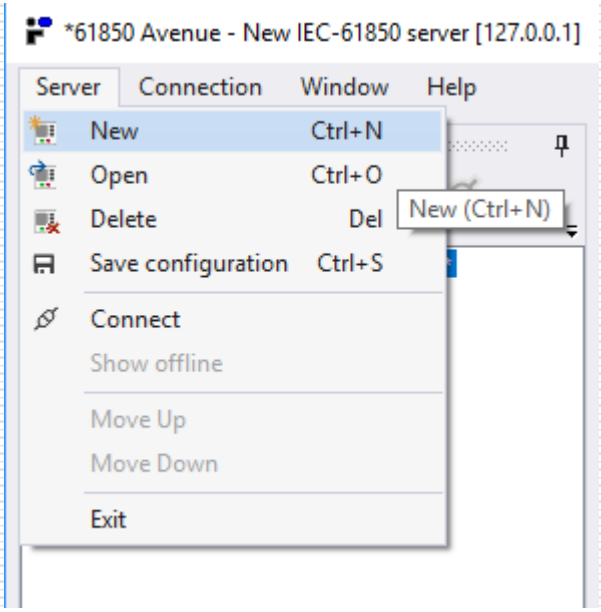
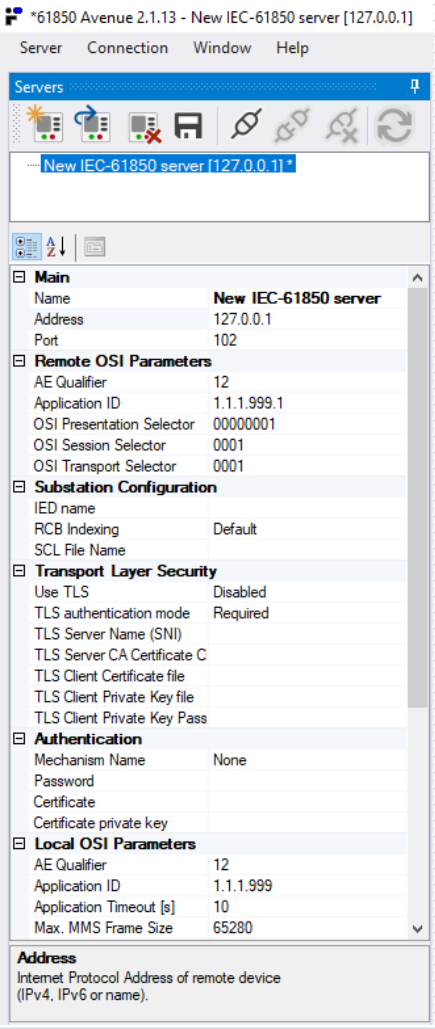
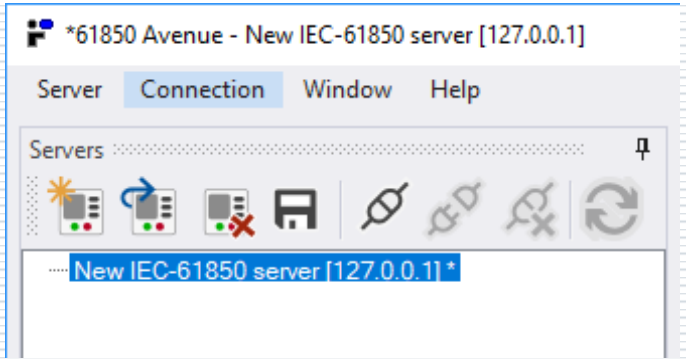
Connection to a new server device with data model browsing



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**.

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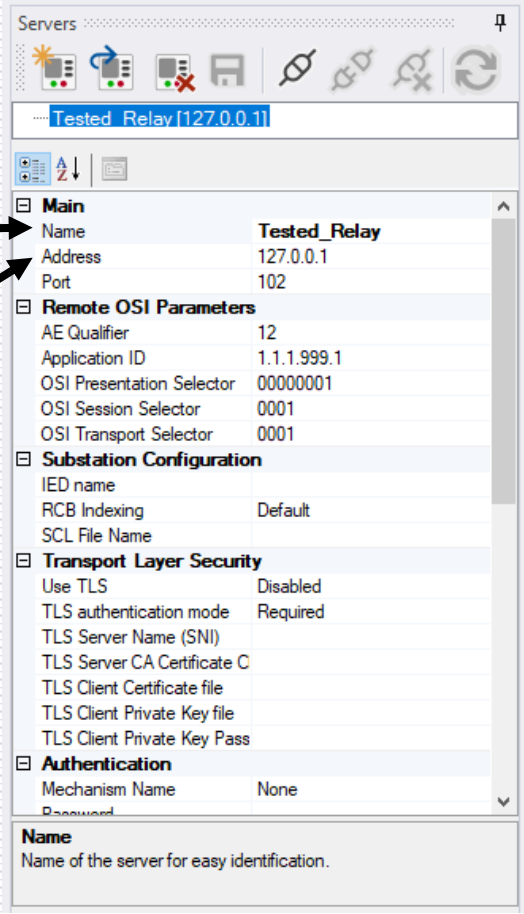
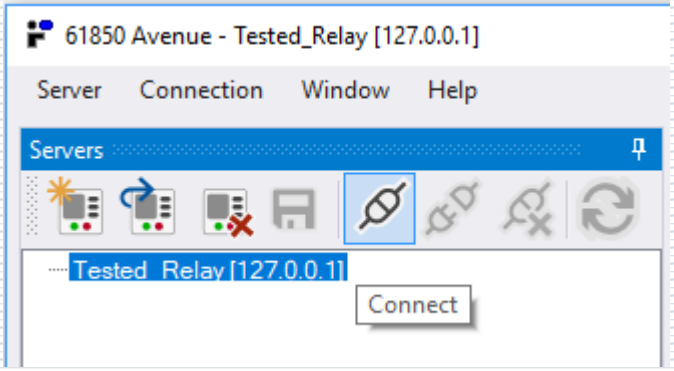
Assigning target name and IP address to a new server device for browsing

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**

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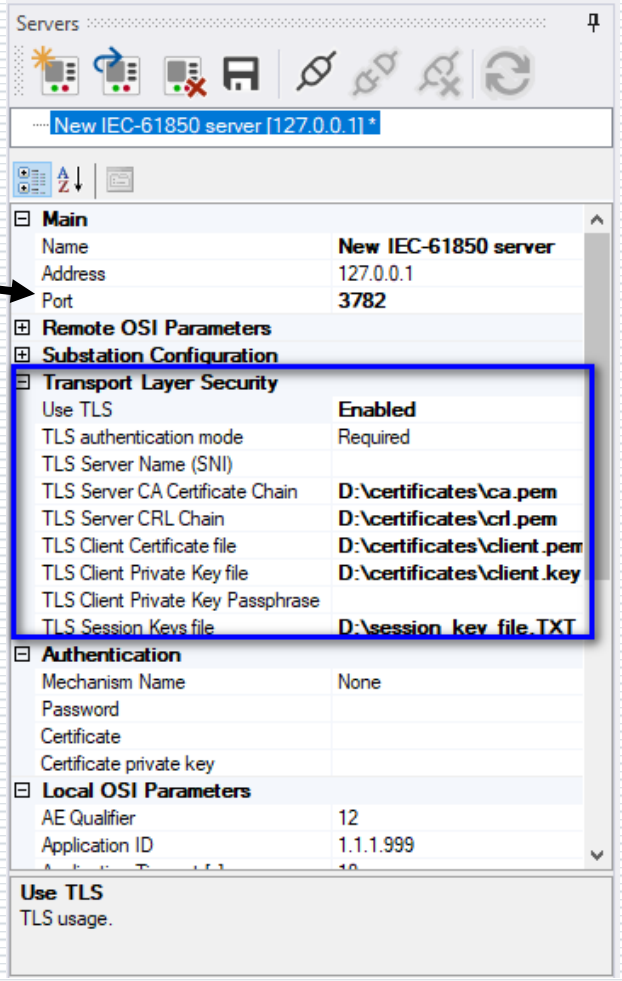
Secure communication using TLS (encryption)

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

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

TLS authentication mode – selection between **Required** authentication using TLS CA certificate or **Optional.**
TLS Server Name (SNI) – TLS Server Name Indication.
TLS CA certificates files – file with a chain of certificates used to verify the certificate of the server to which the client connects.
TLS Server CRL Chain – file with a chain of certificates used to verify the revocation status of SSL/TLS certificates.
TLS own certificates files – client's certificate file.
TLS private key – client's private key file.
TLS private keyphrase – the password used to decrypt the client's private key.
TLS Session Keys file – path to a file containing the TLS session keys.



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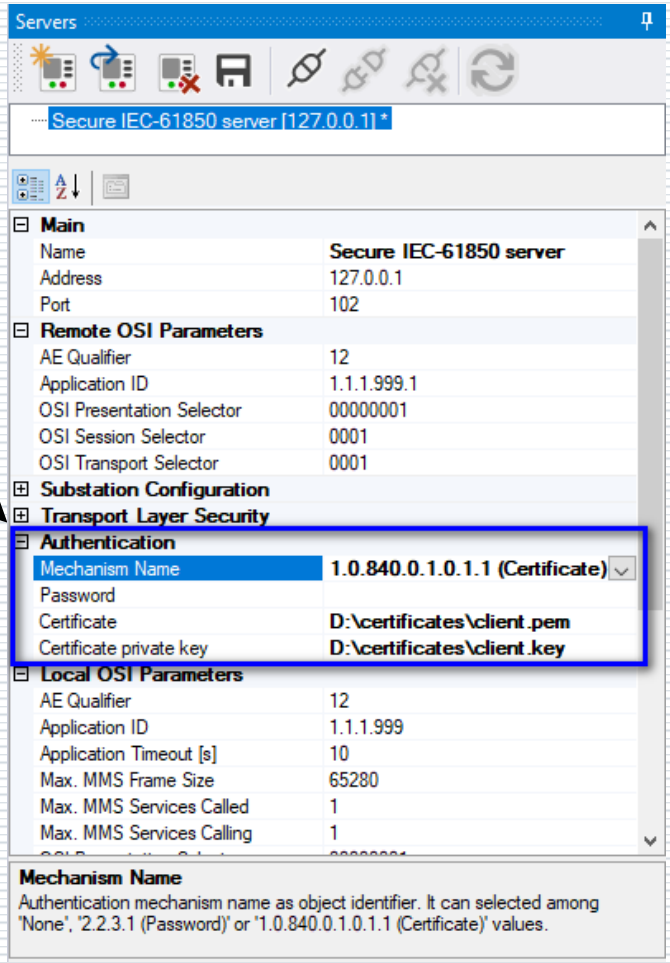
Secure communication using ACSE (authentication)

Use of ACSE for authentication:

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



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

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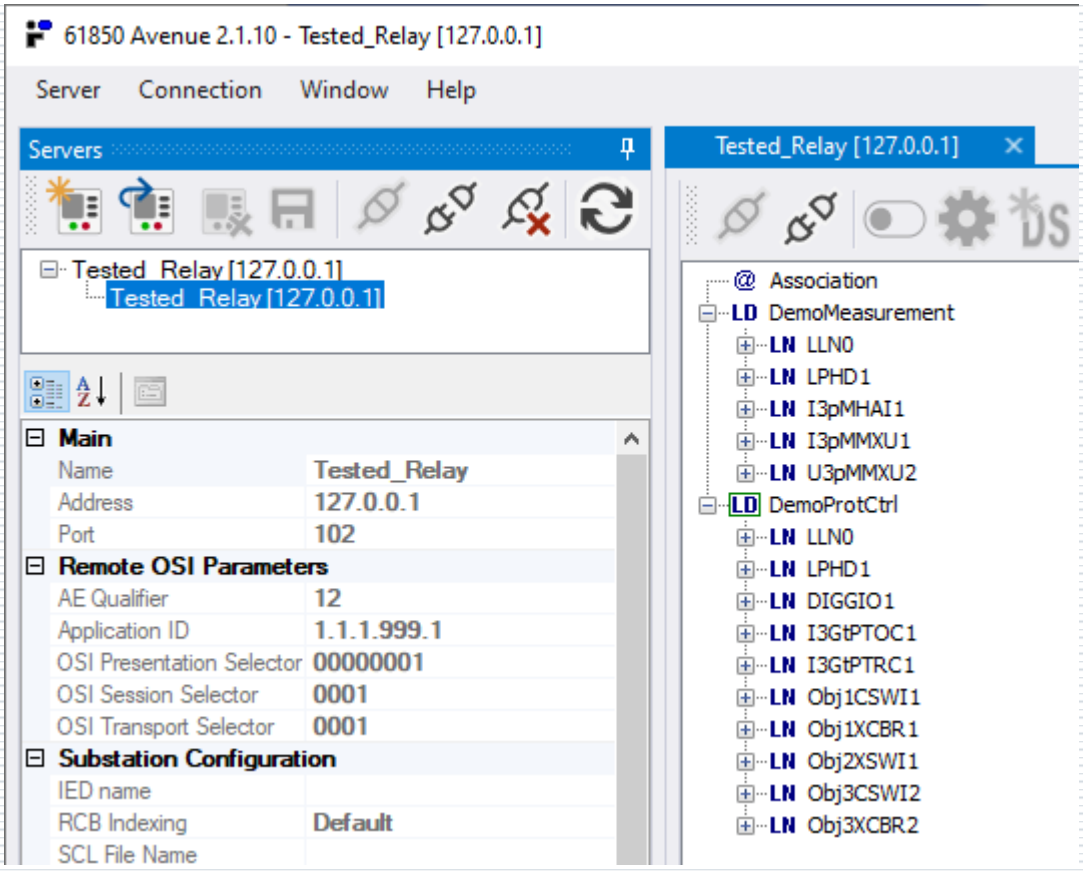
Server device data model displayed after connecting and browsing

Fast exploration of the server device data model.



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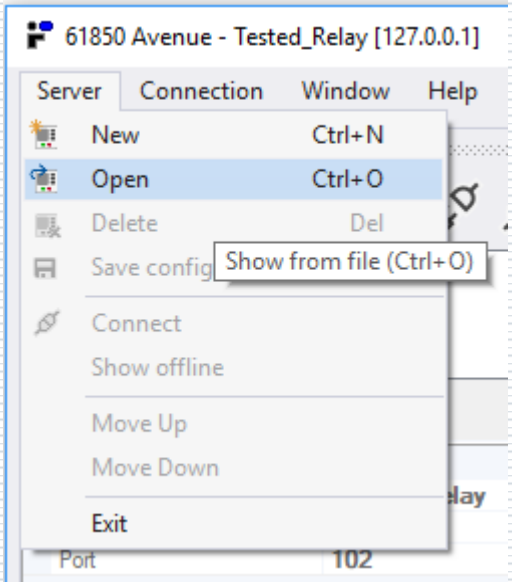
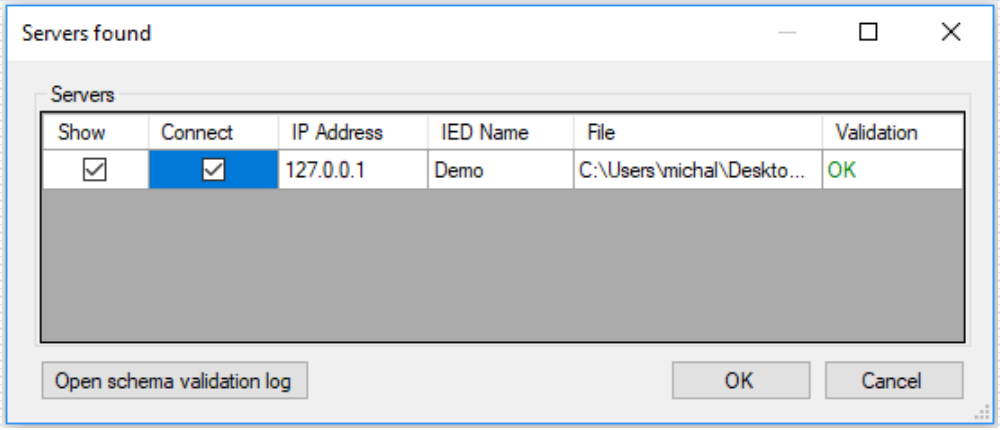
Connection to a new server device using its SCL description file



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.

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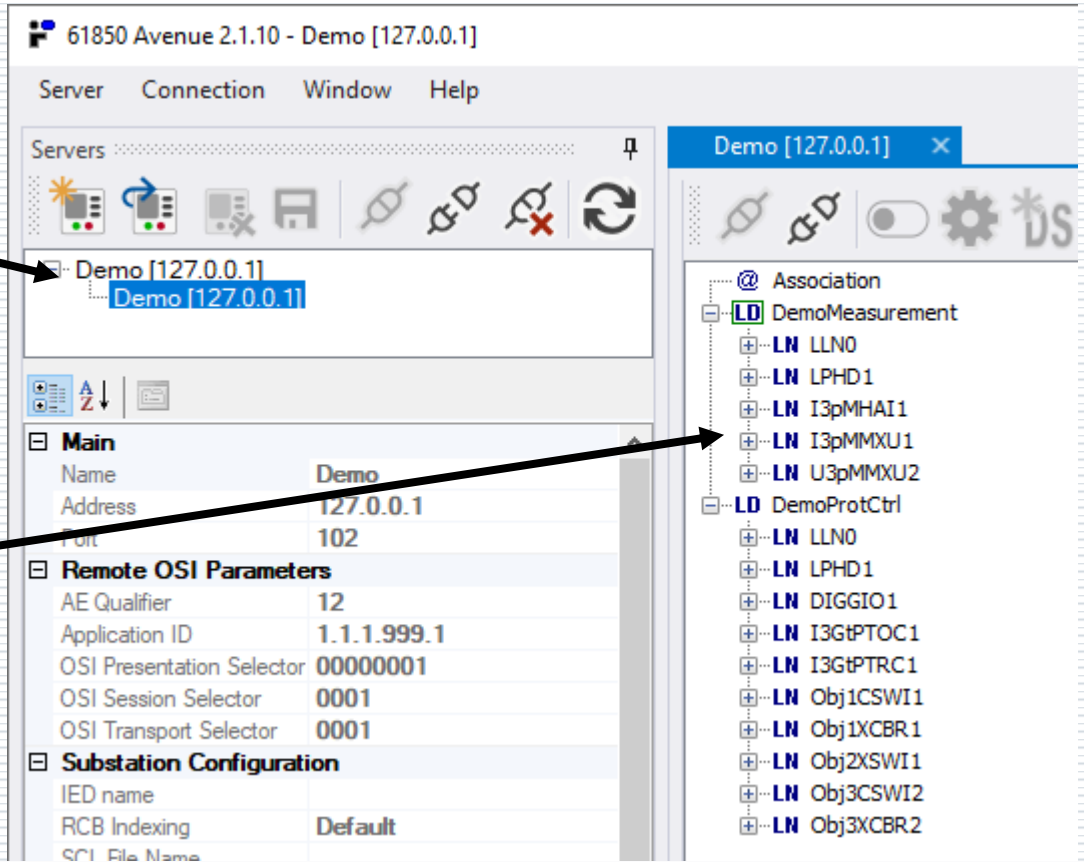
Explanation of Show and Connect options

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.**



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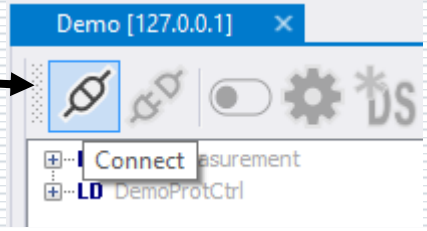
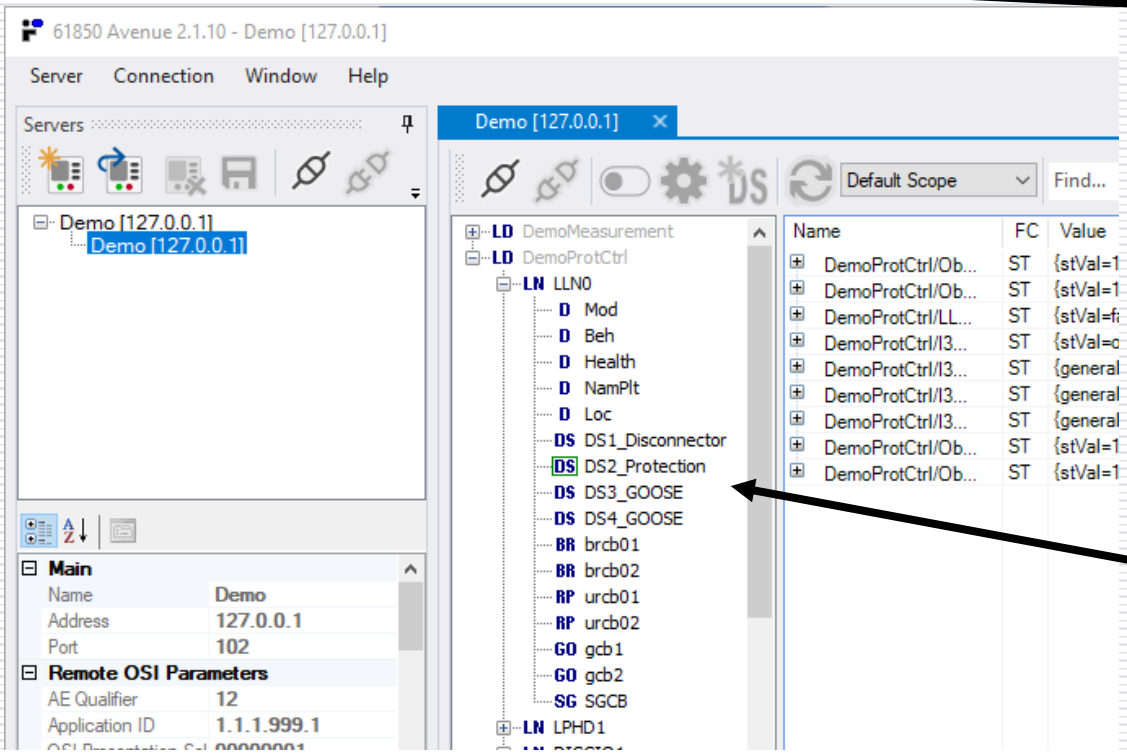
Connection establishing after importing SCL file

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





Off-line model browsing possible.

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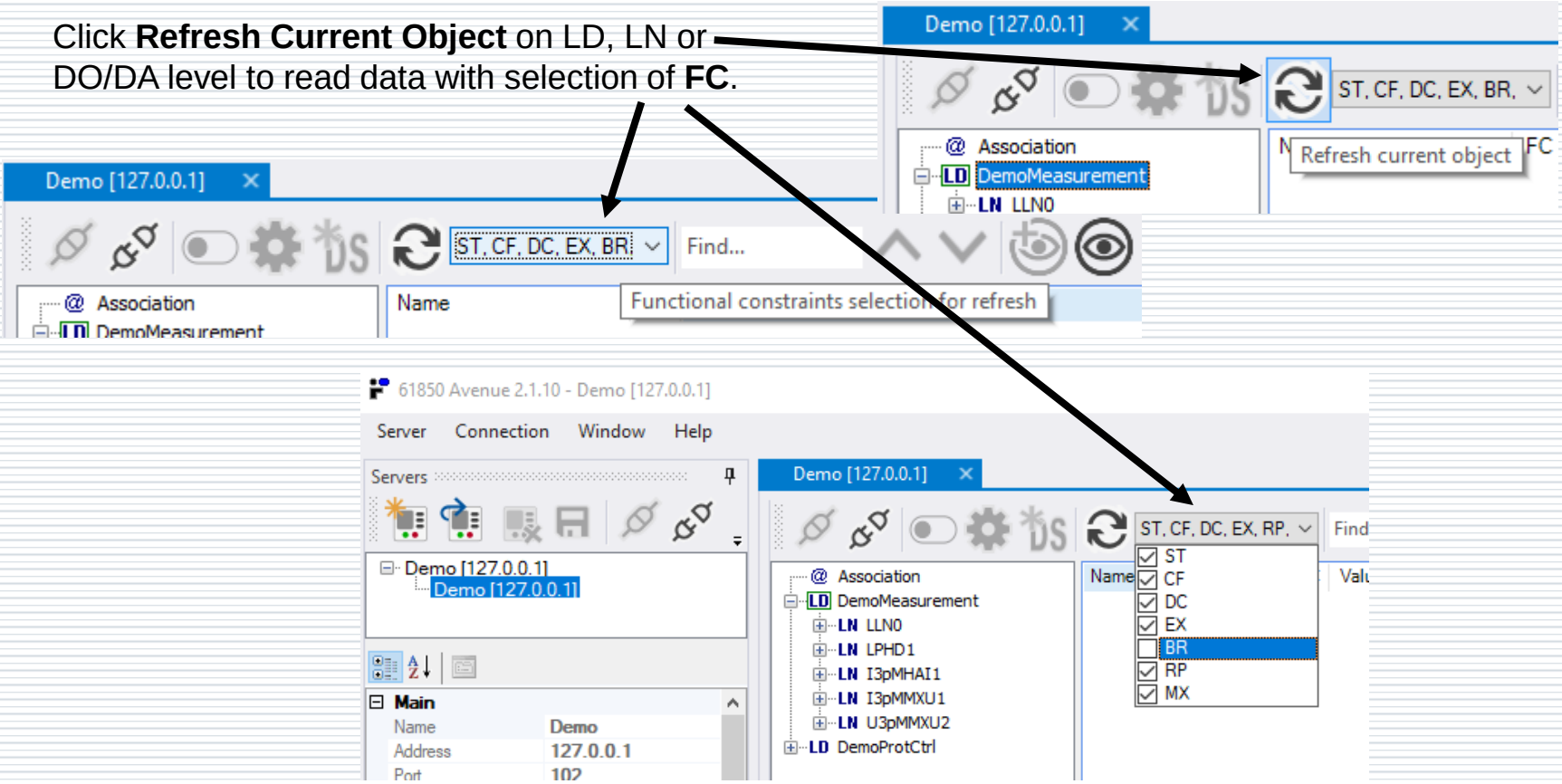
Refresh Current Object on LD, LN or DO/DA

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

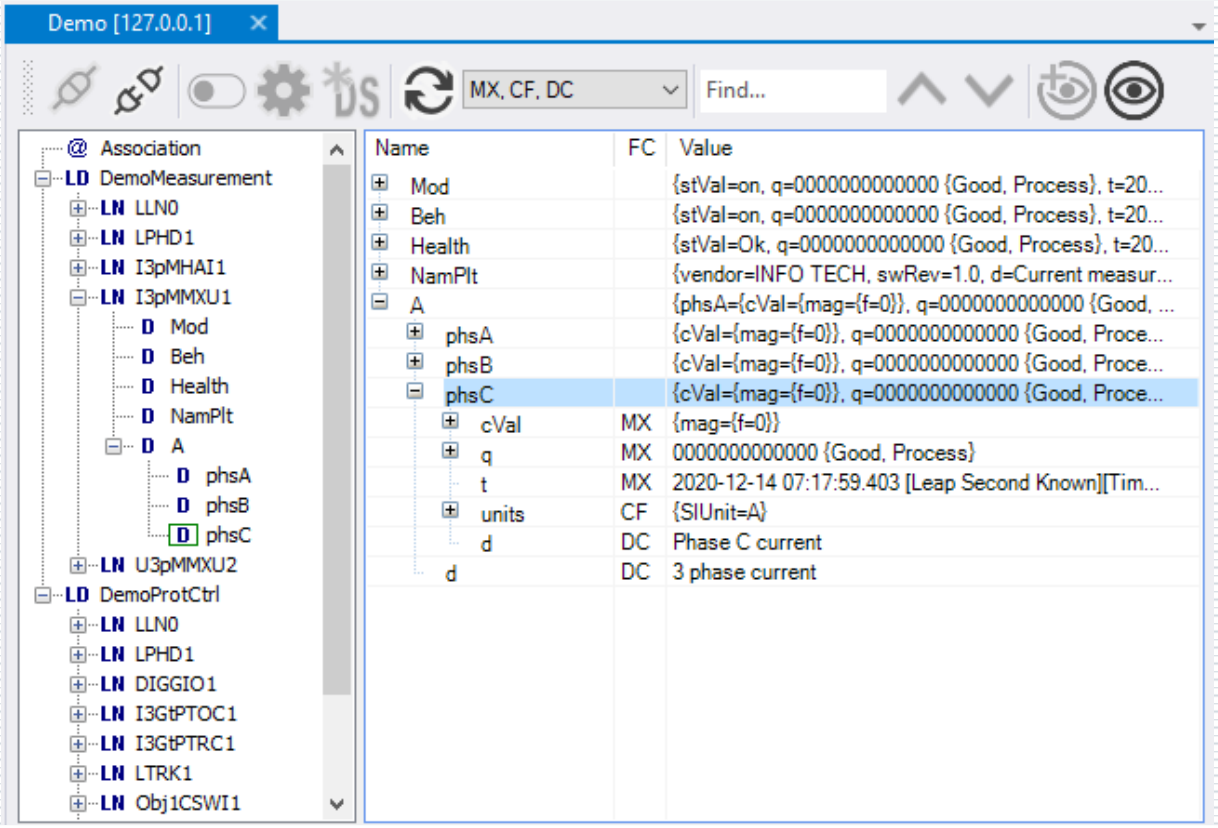


Data model view

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.



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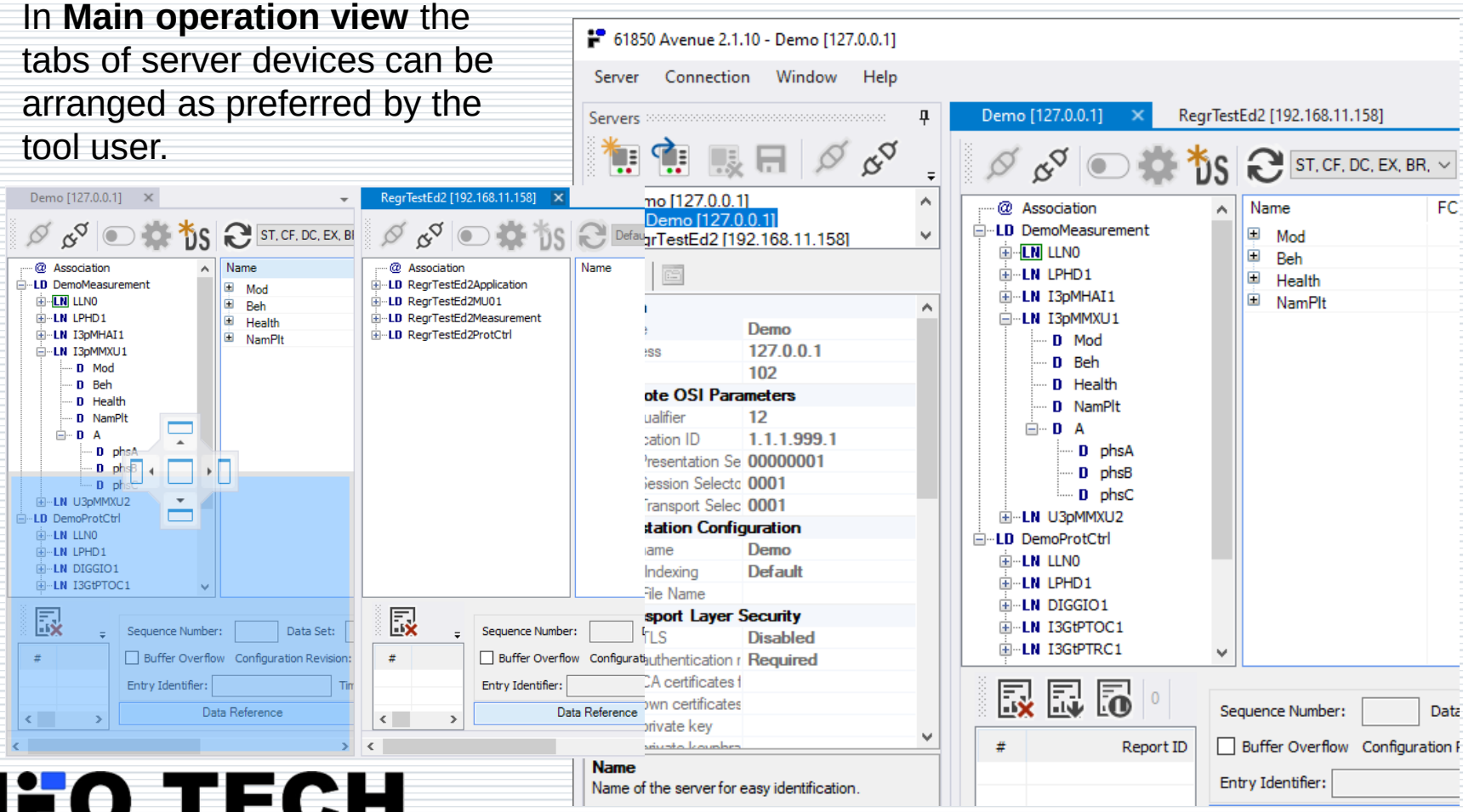
Possible simultaneous connections with multiple servers

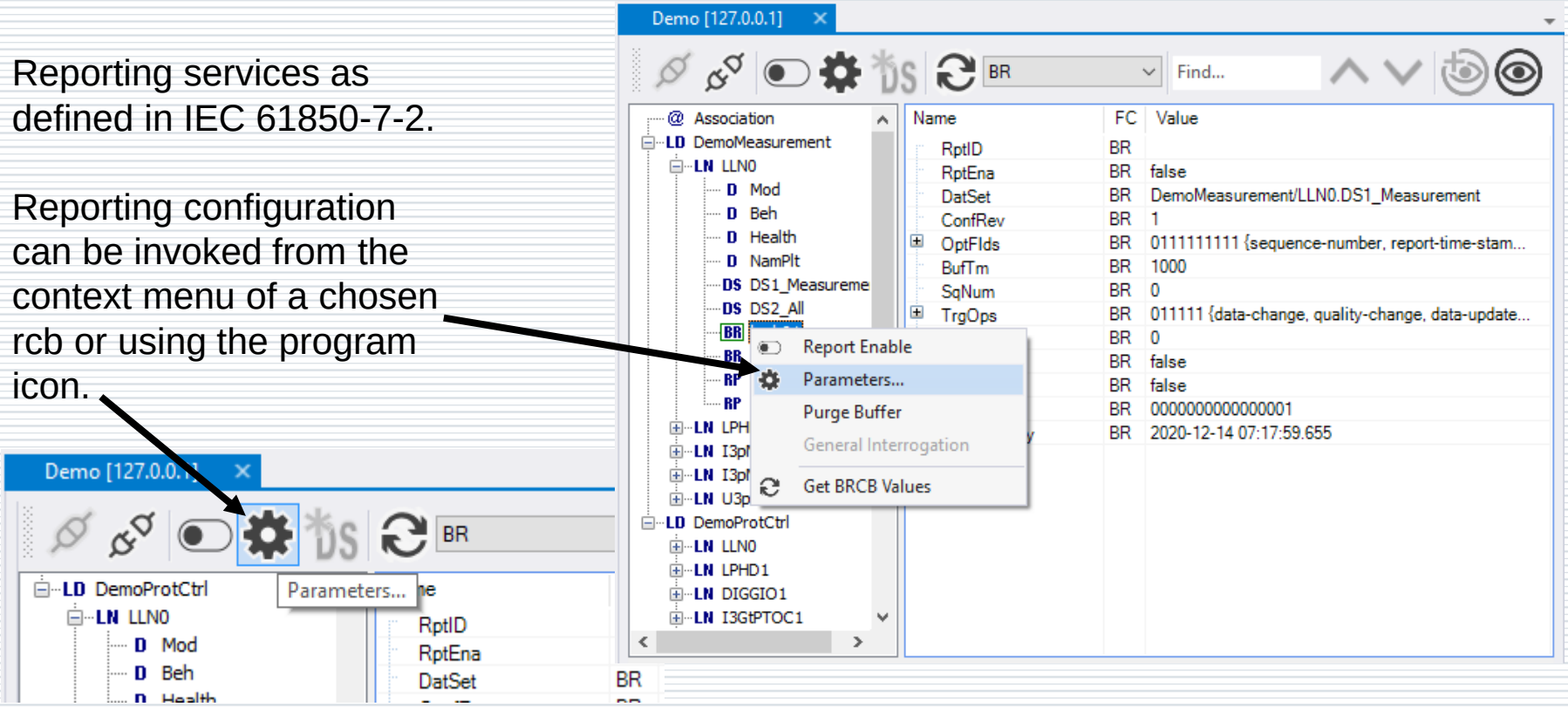
In **Main operation view** the tabs of server devices can be arranged as preferred by the tool user.



Reporting function in IEC 61850

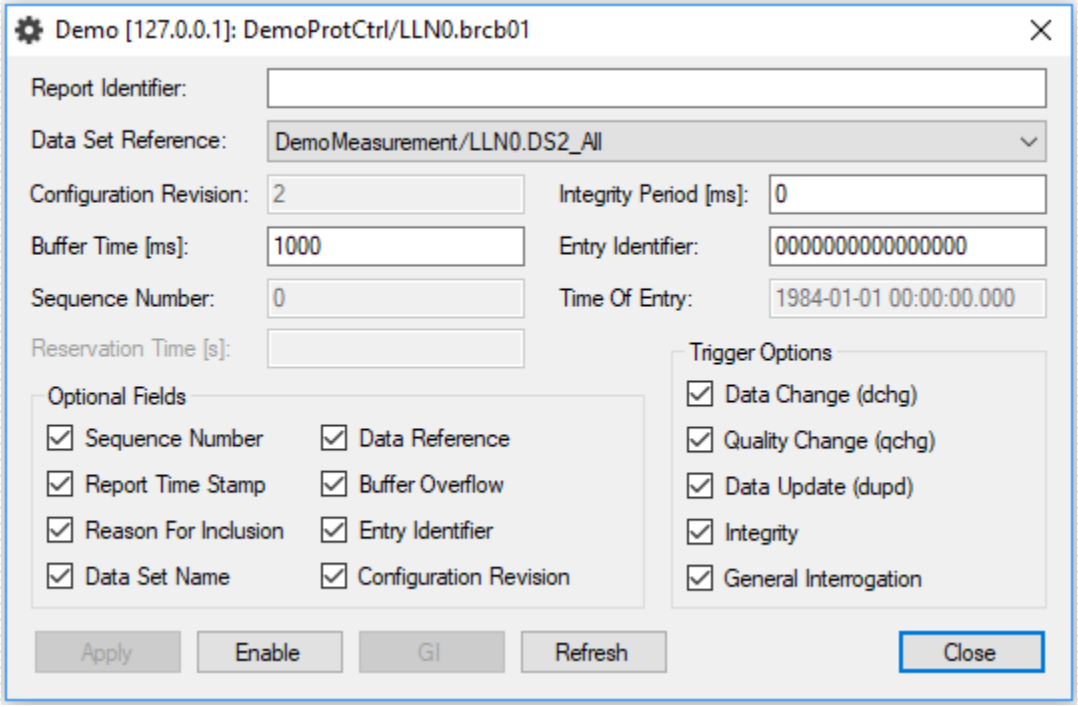
Reporting services as defined in IEC 61850-7-2.

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



Configuration of the reporting function

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



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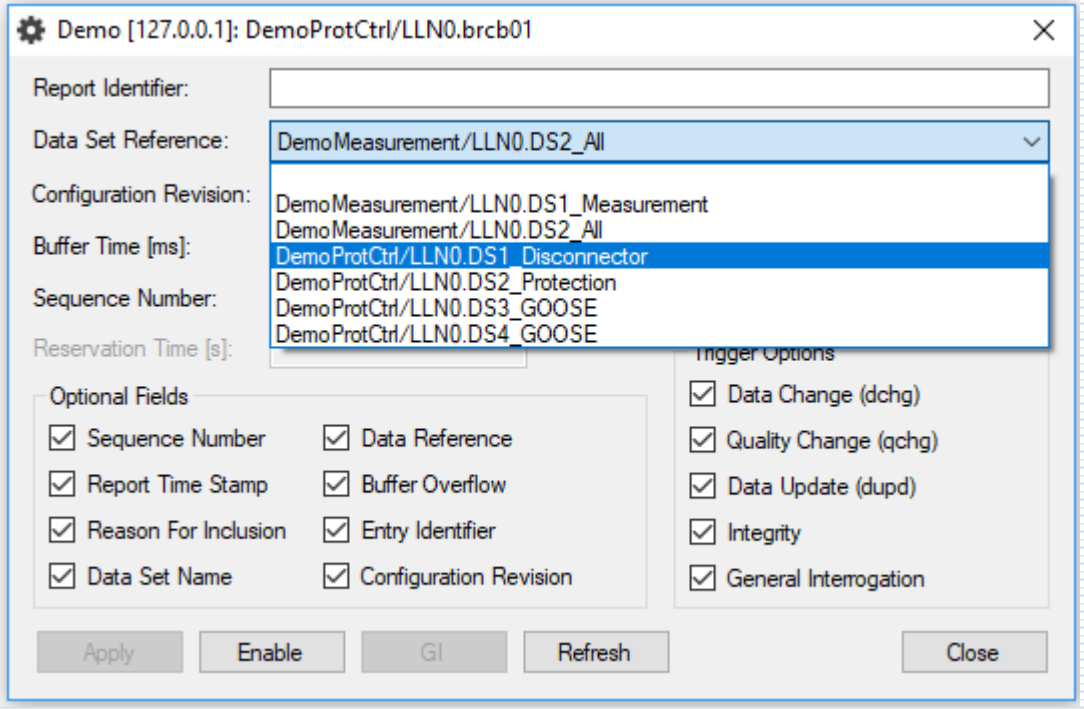
Selection of dataset for reporting

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.



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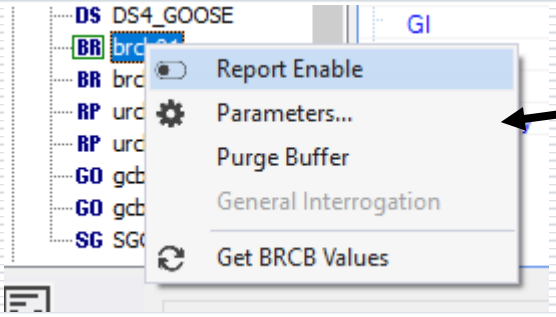
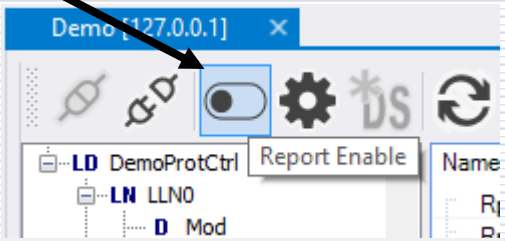
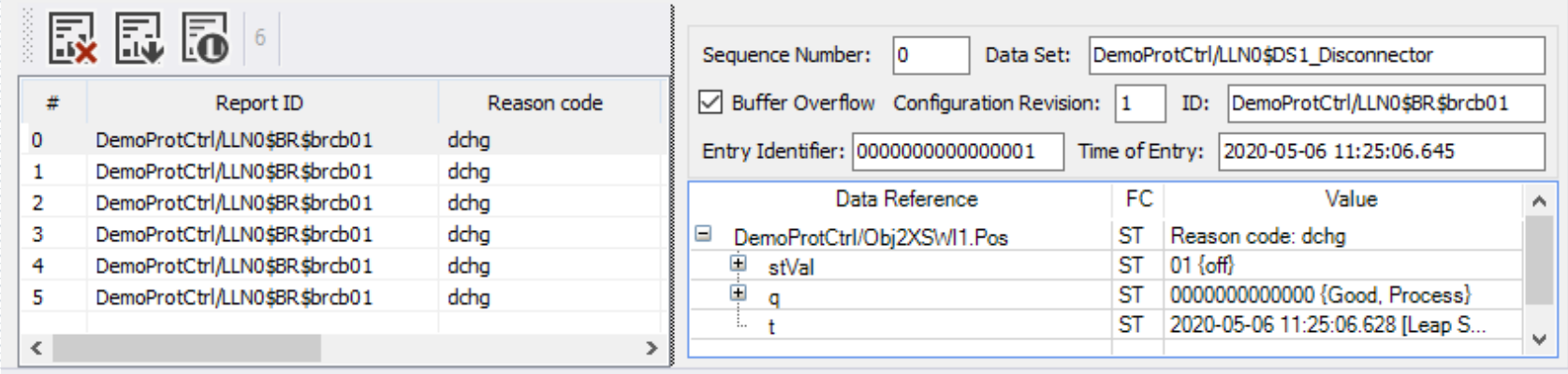
Activation of the reporting function and reports viewing

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







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

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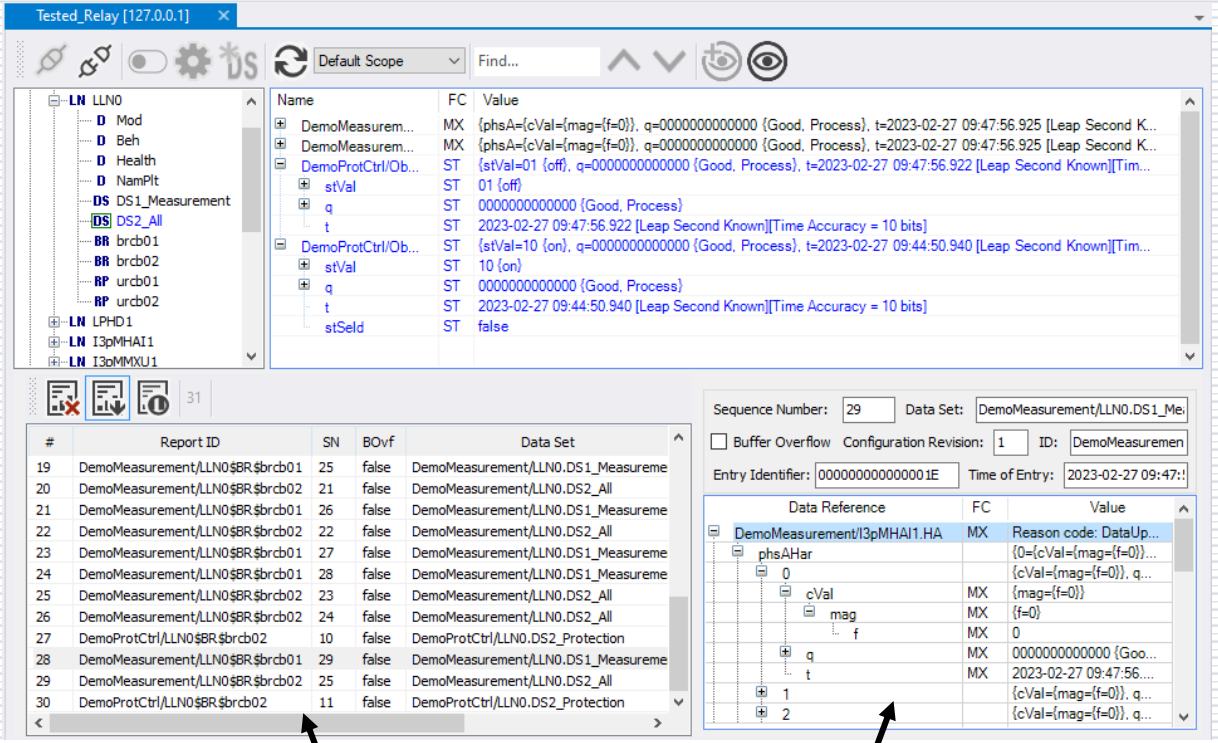
List of reports

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.



List of reports

Detailed view of selected report

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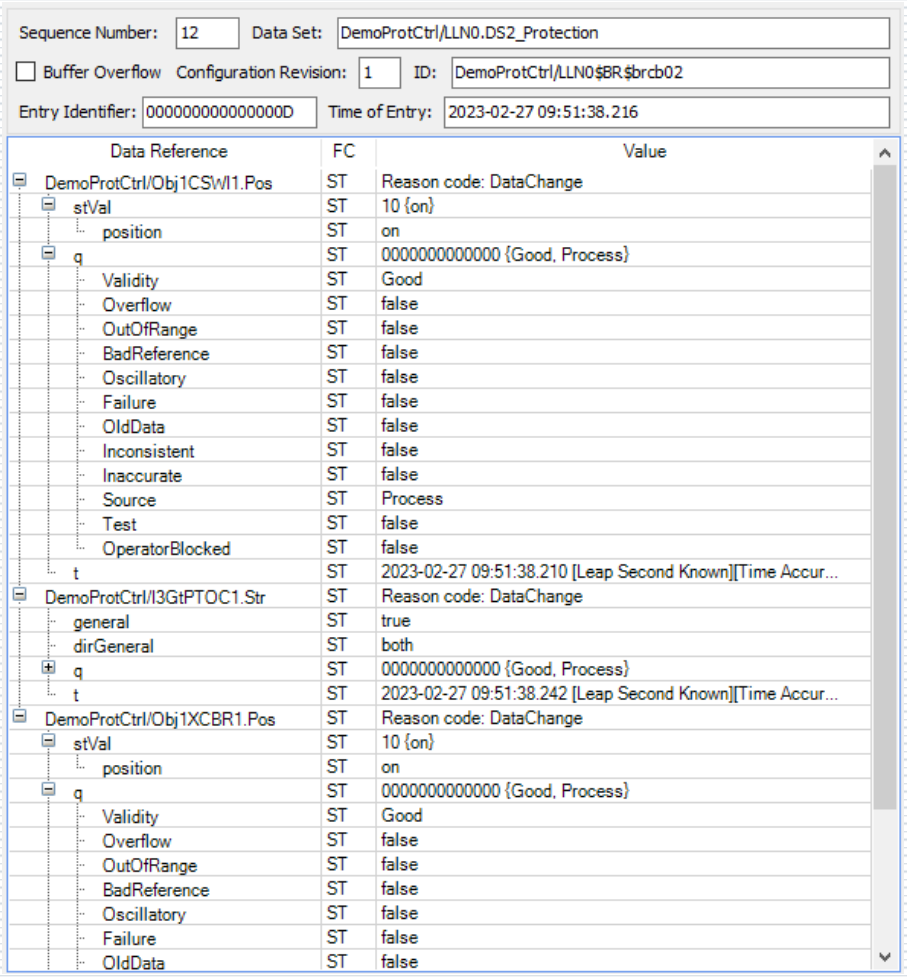
Report detailed content viewing

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.



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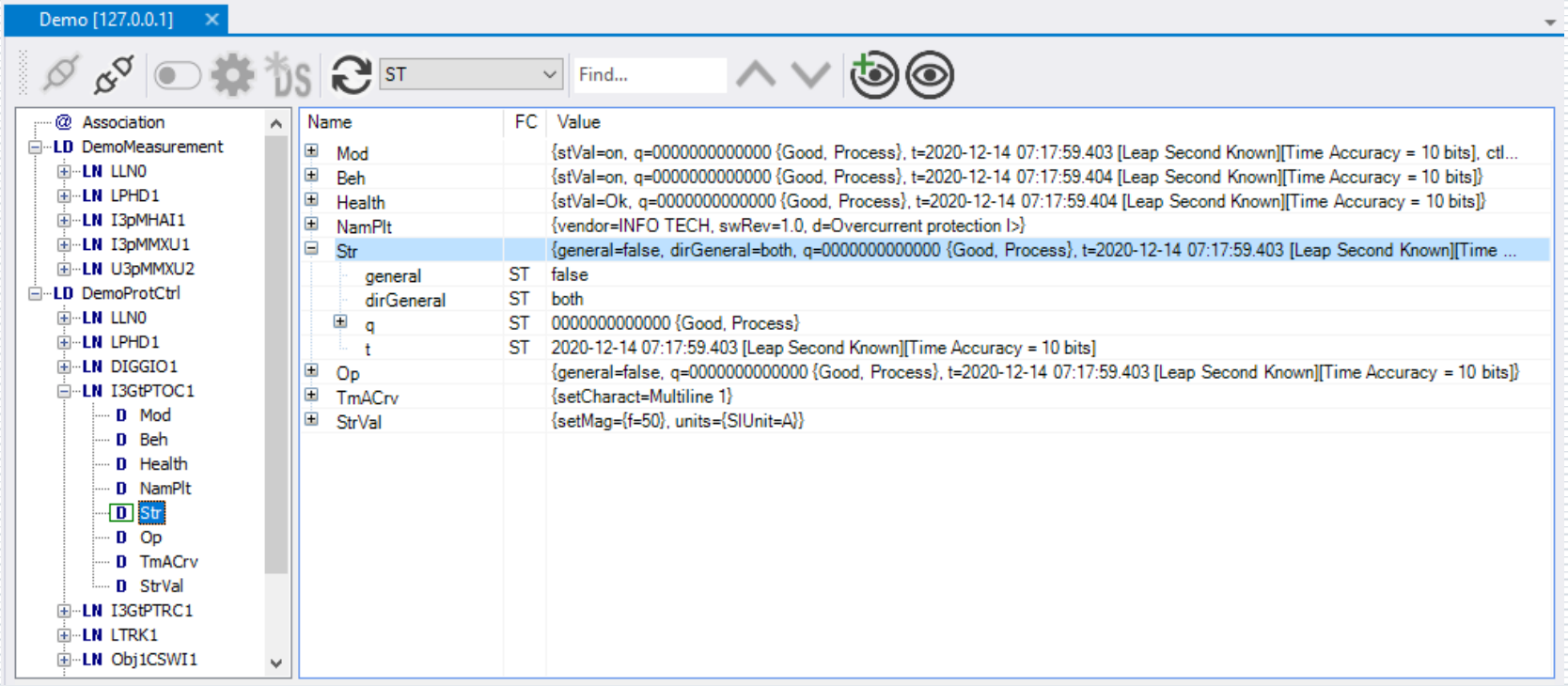
Data model view updates by reports

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.



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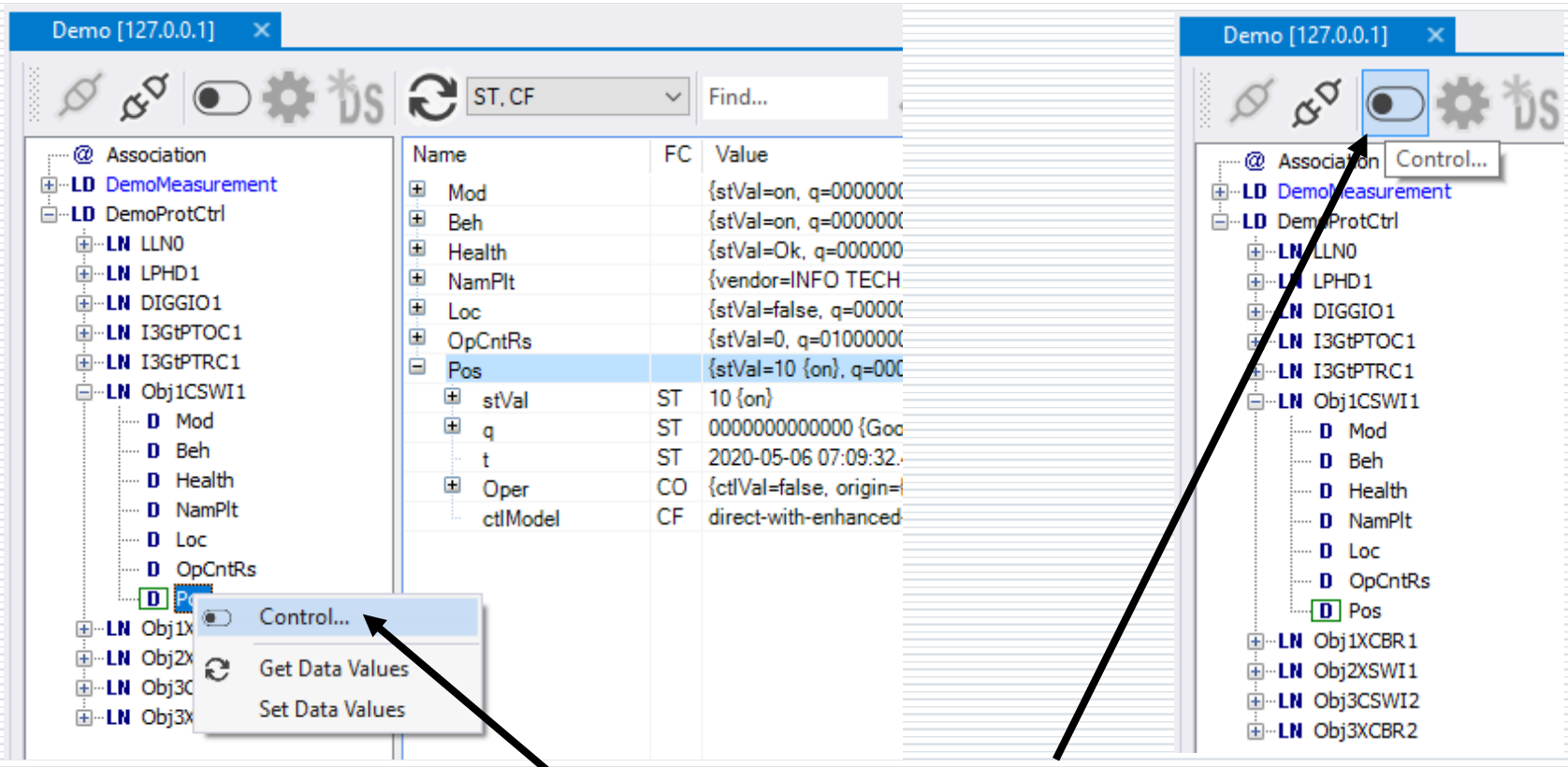
Control services in IEC 61850



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.

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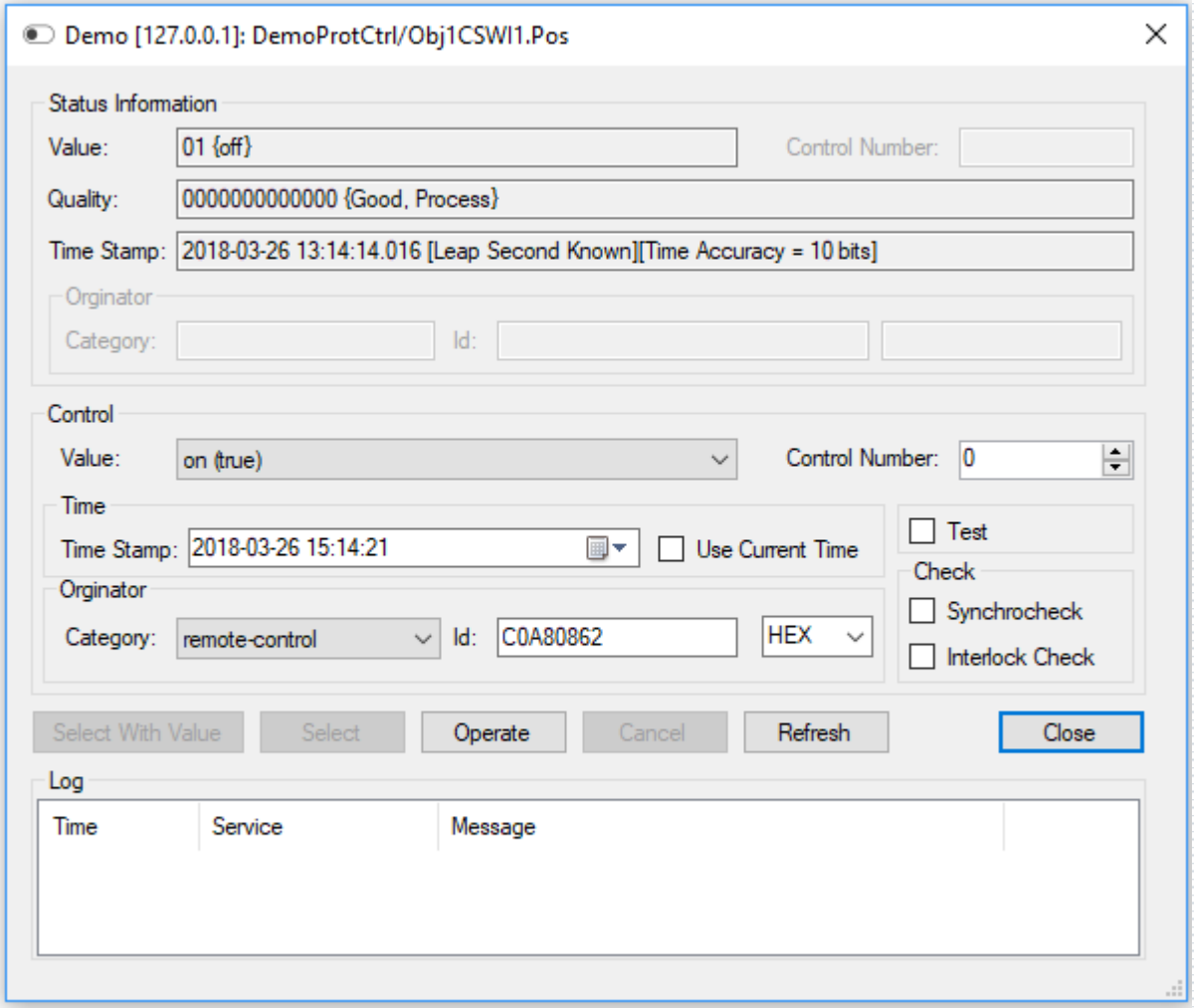
Control models and control command parameters

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.



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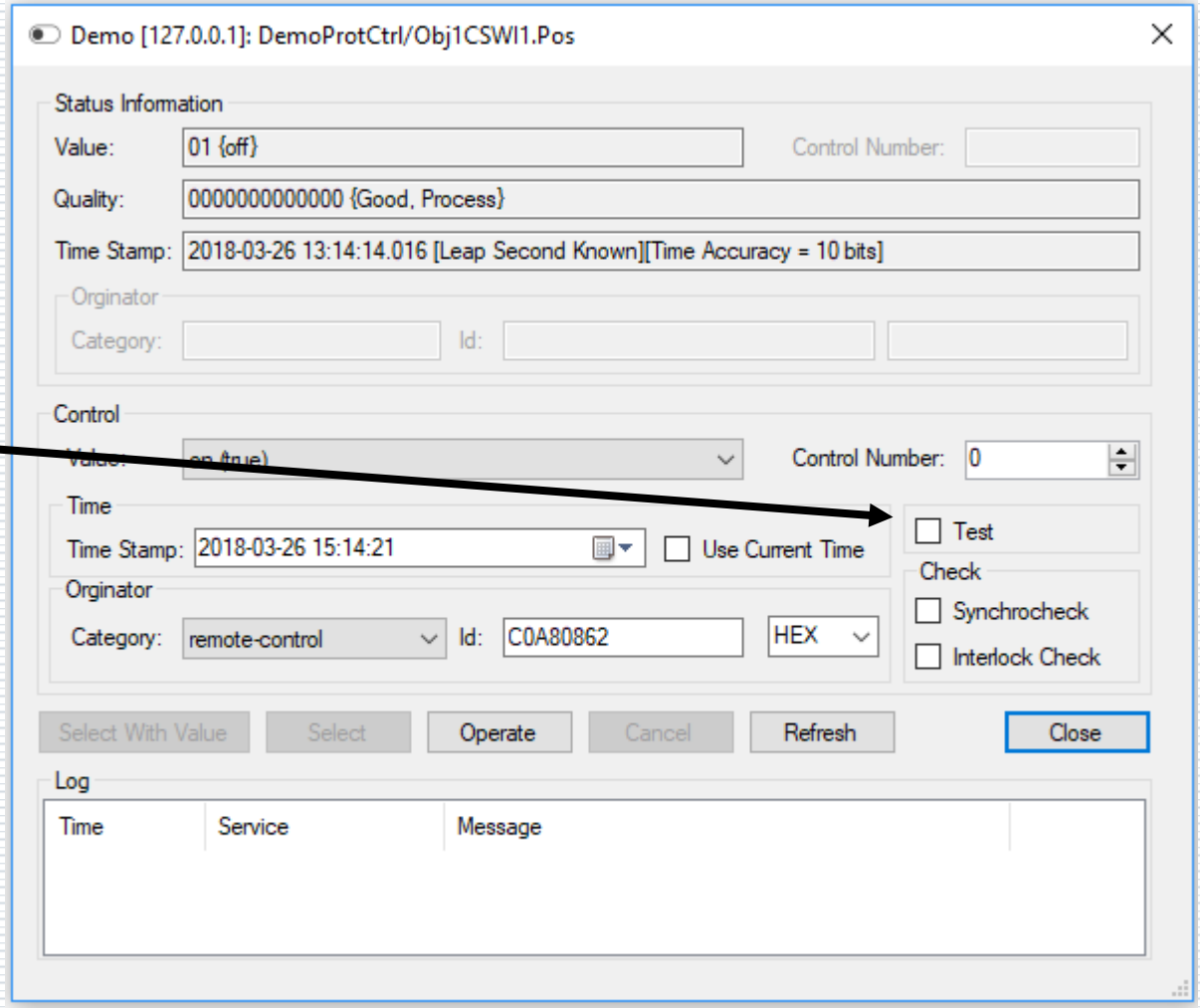
Control commands in test mode

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.



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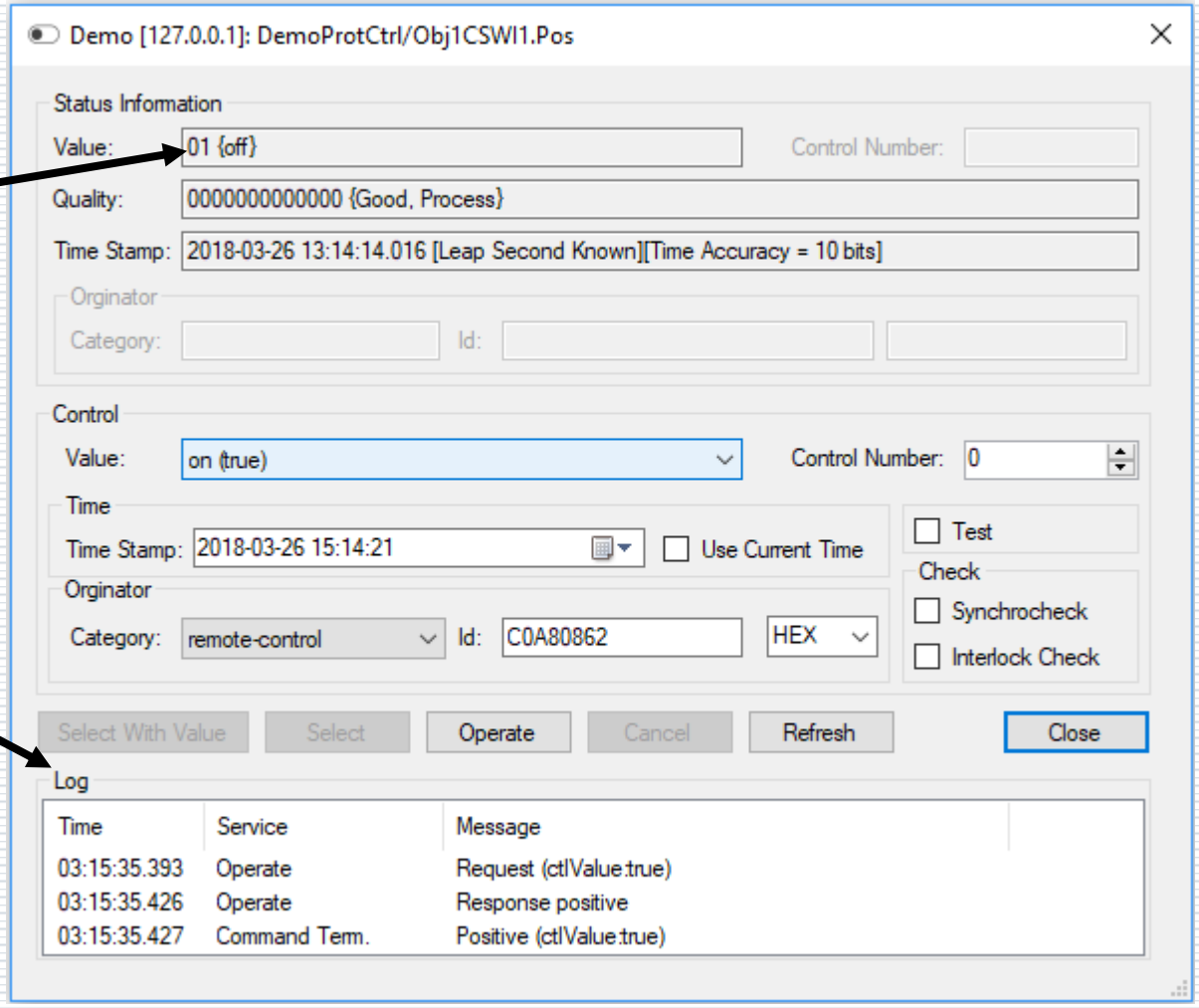
Tracing control commands performance

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

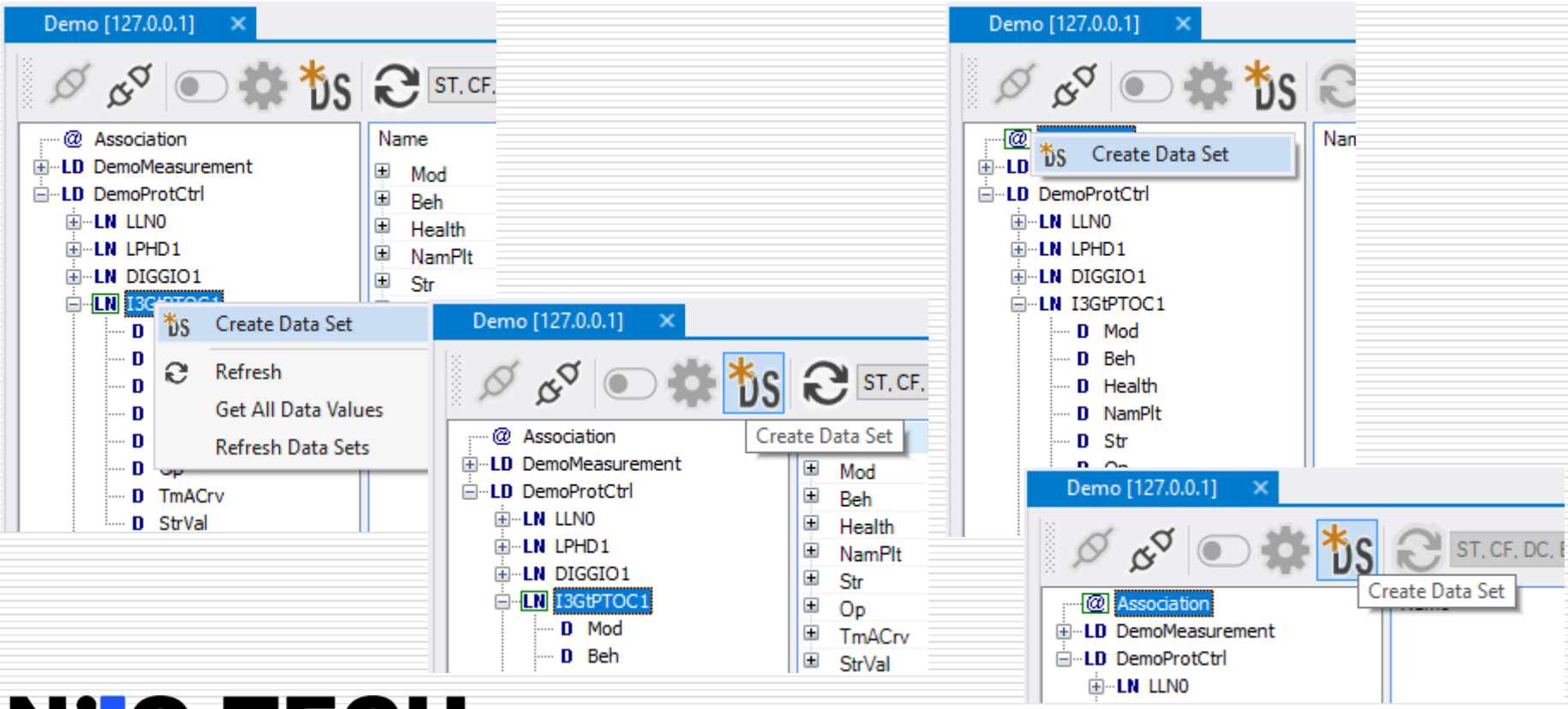
Command execution and its result are easy to trace in the log.



Creating dynamic data sets

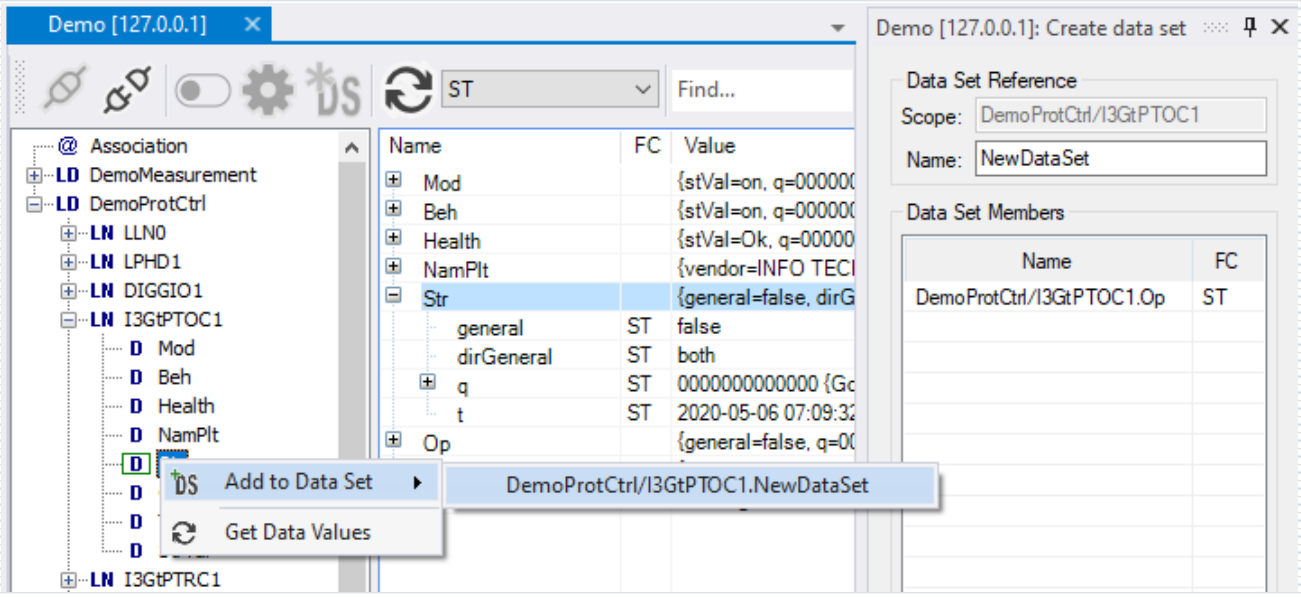
Persistent – created in LN context

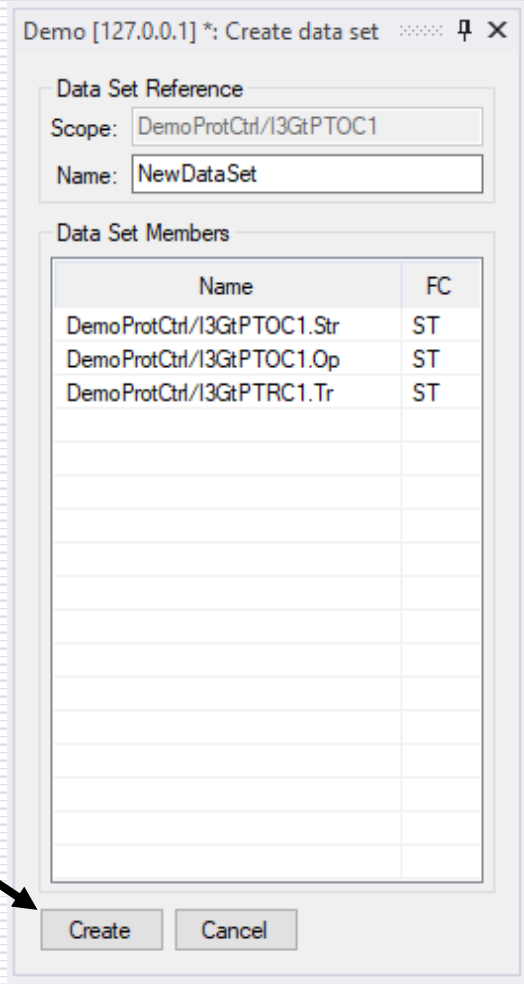
Non-persistent – created in Association context



Steps of defining a new dataset

Upon invoking **Create Data Set** command a dedicated window pops up to enable dataset definitione. 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.





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

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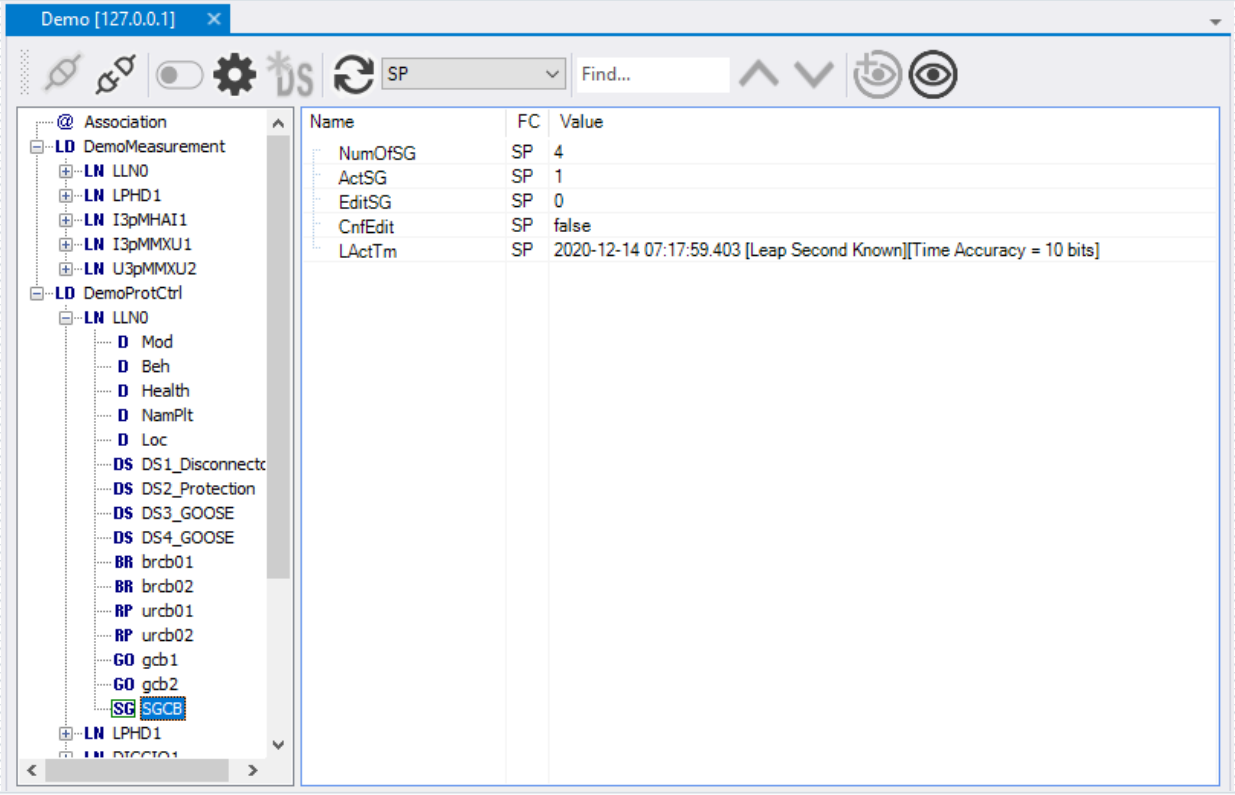
Activation and edition of Setting Groups

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.



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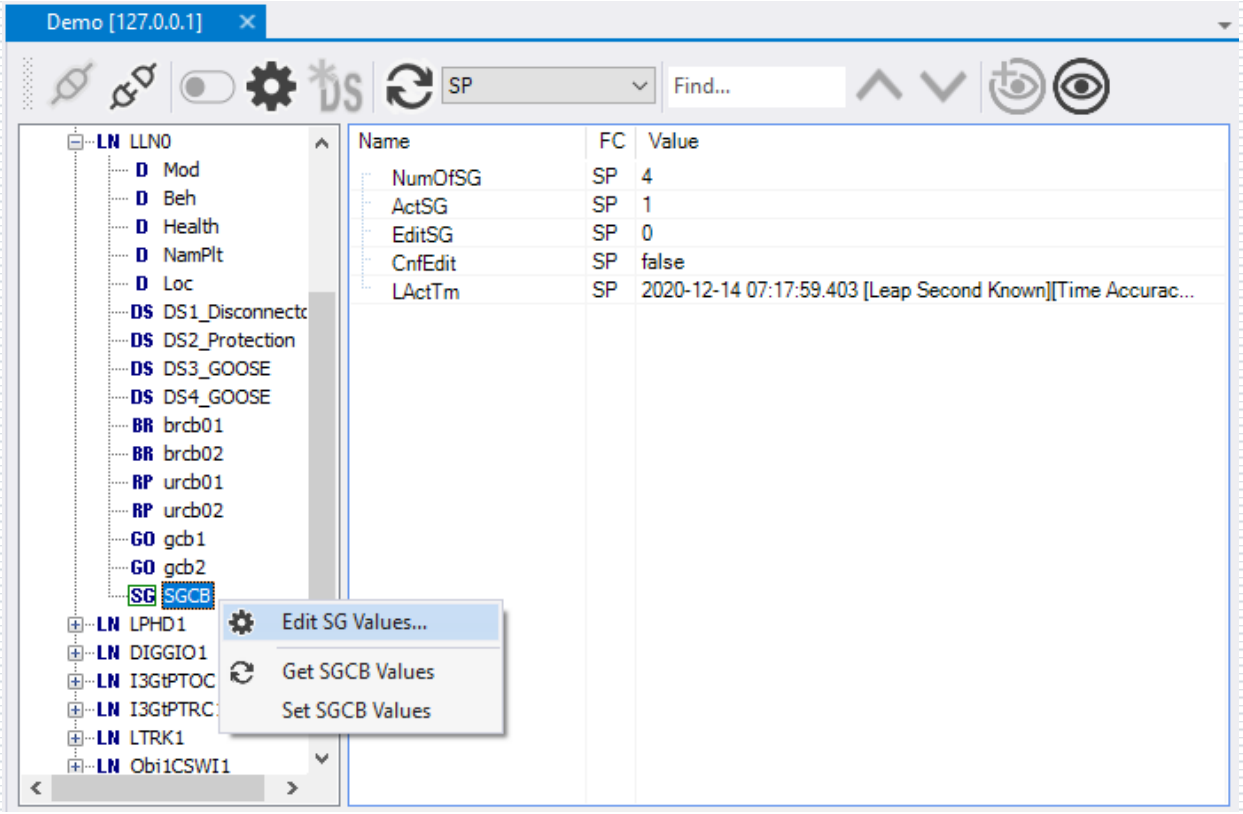
Operations on SGCB

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.



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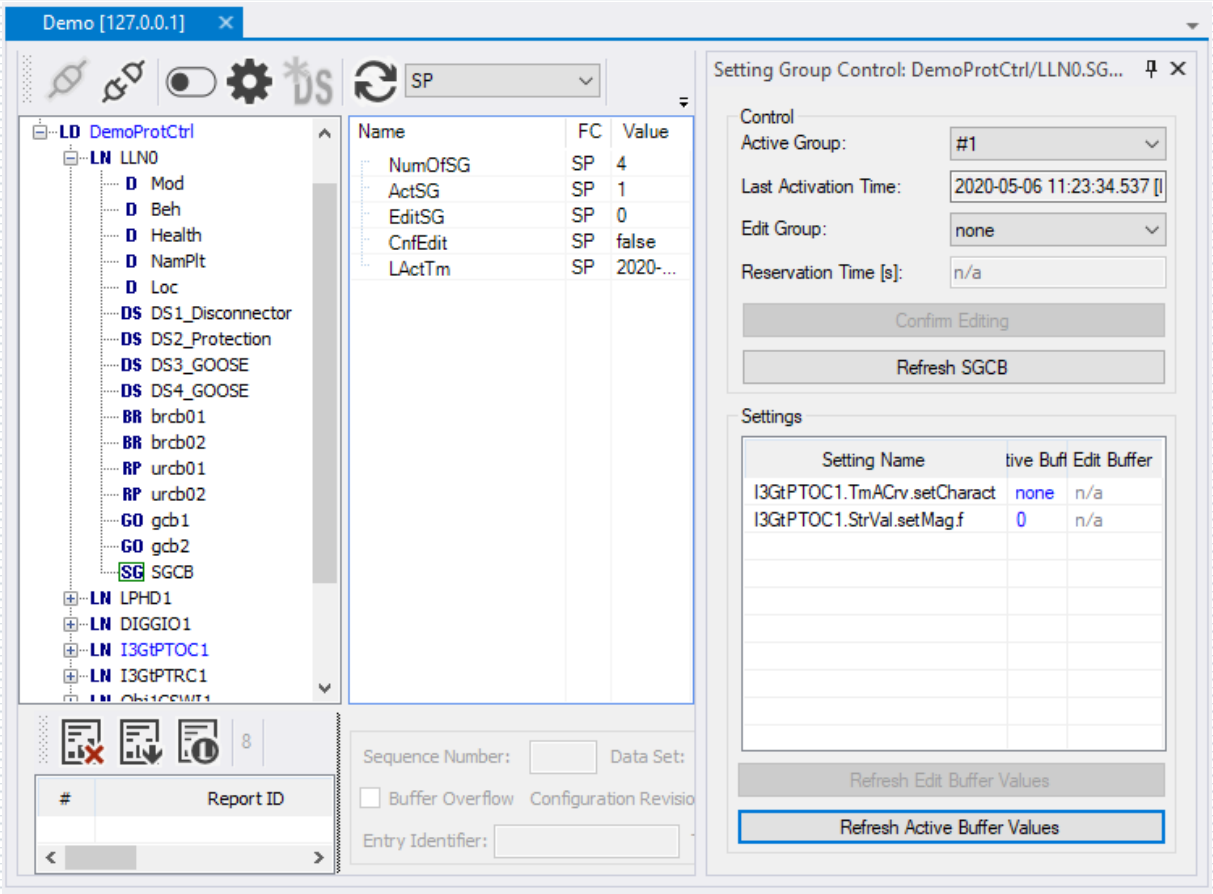
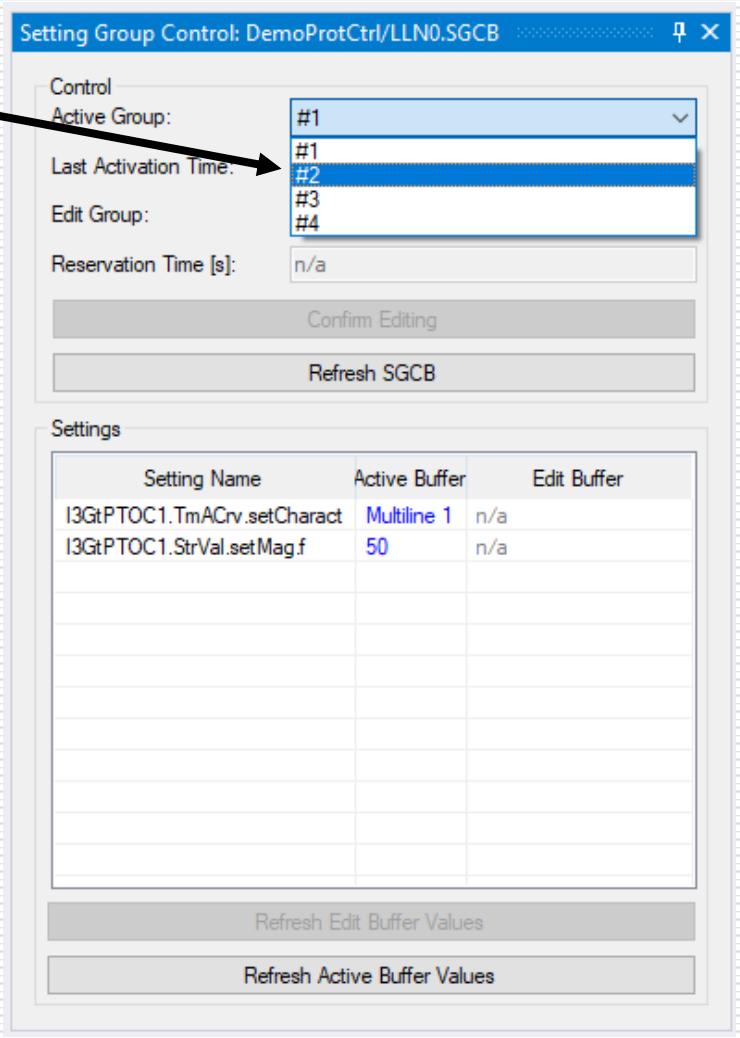
Setting Group Control window

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.



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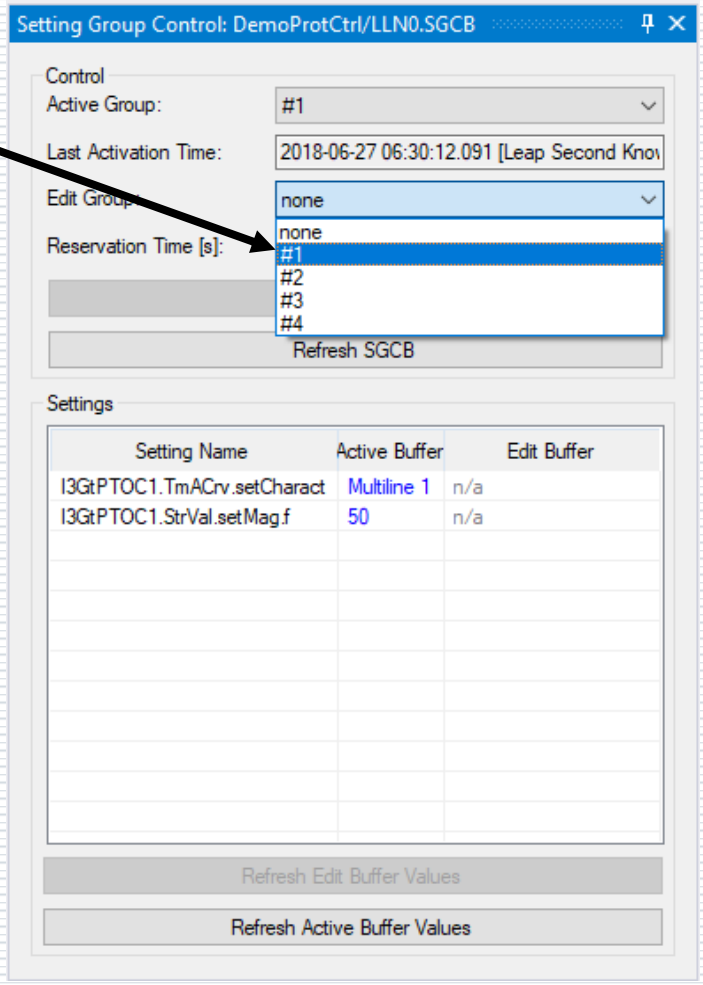
Selection of the setting group for editing

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).



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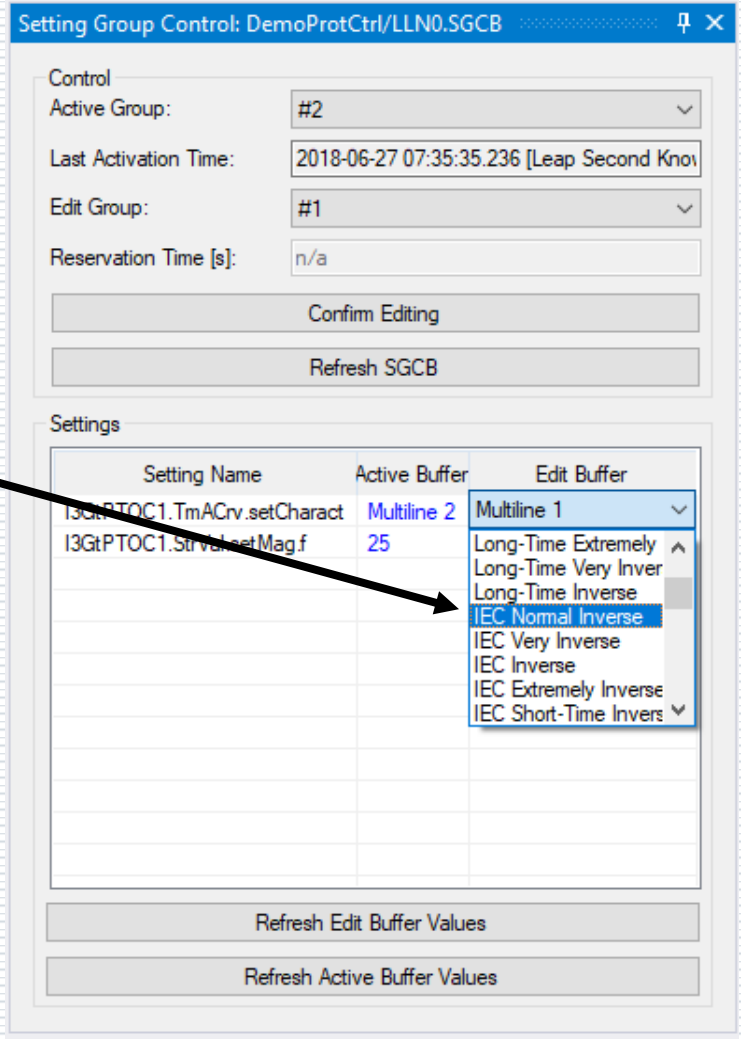
Change of setting values in the group selected for editing

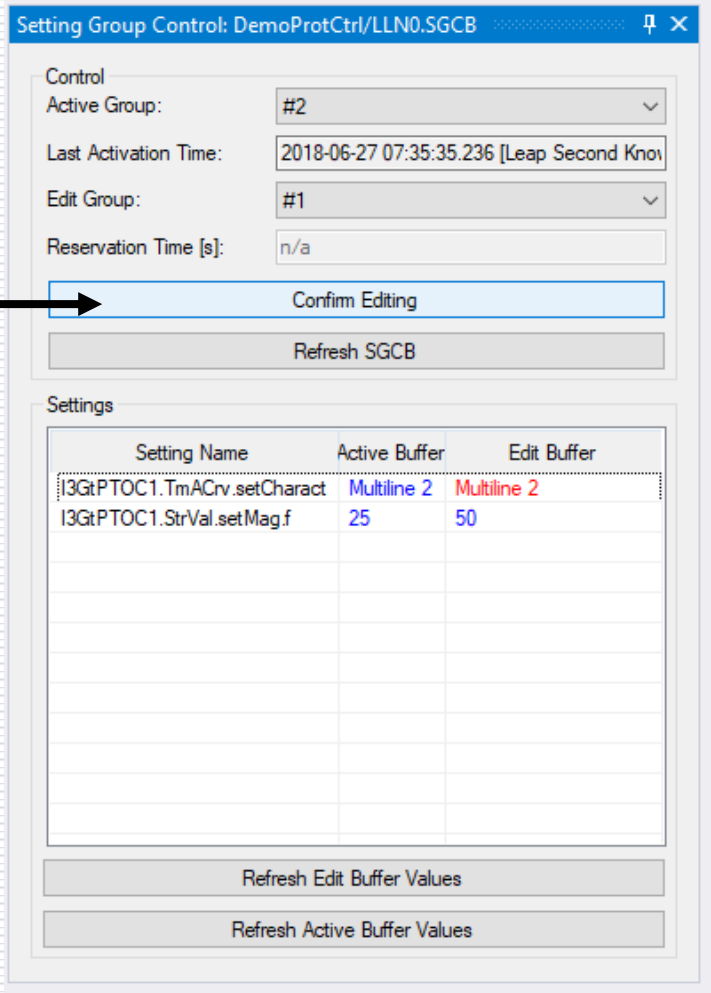
Setting values from the group selected for editing are presented in the list below (**Edit Buffer** column shows attributes of FC=SE) – there is no need to search this information in the data model.
For settings of enum type a new value can be selected from a drop-down list.

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



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.



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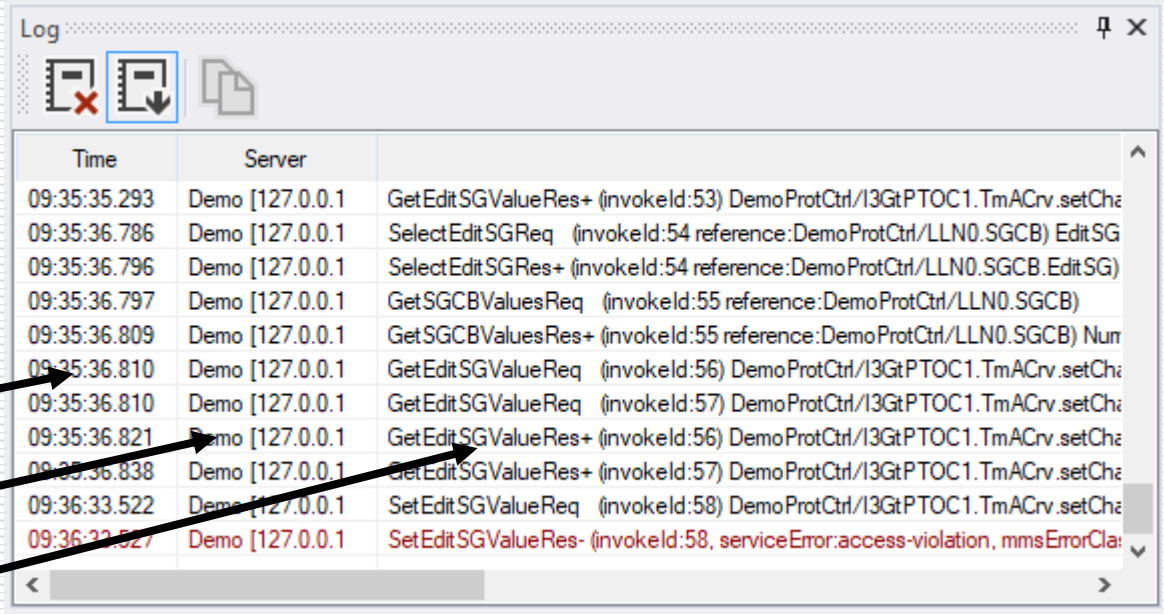
Log view

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.



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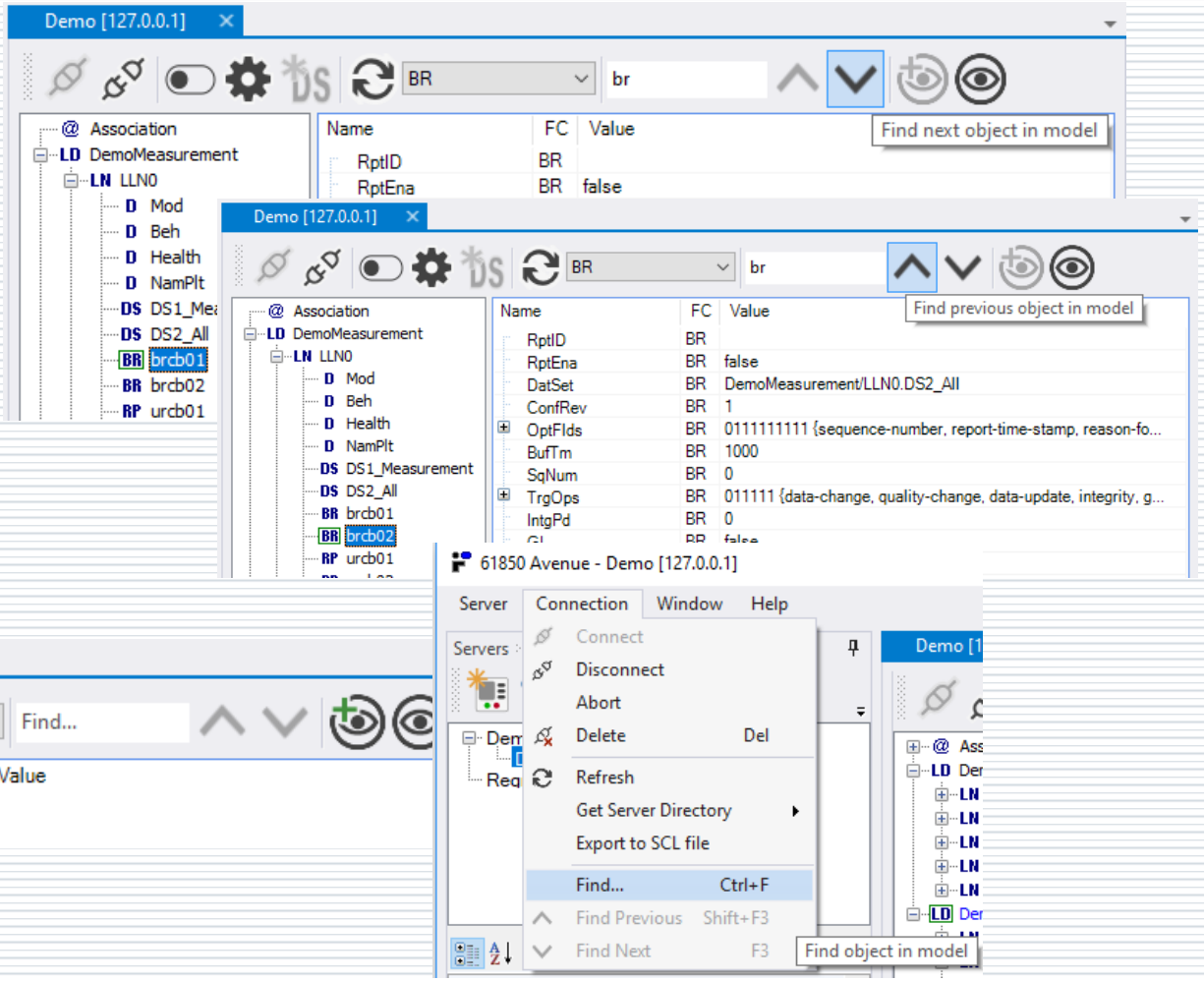
Finding objects

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**.



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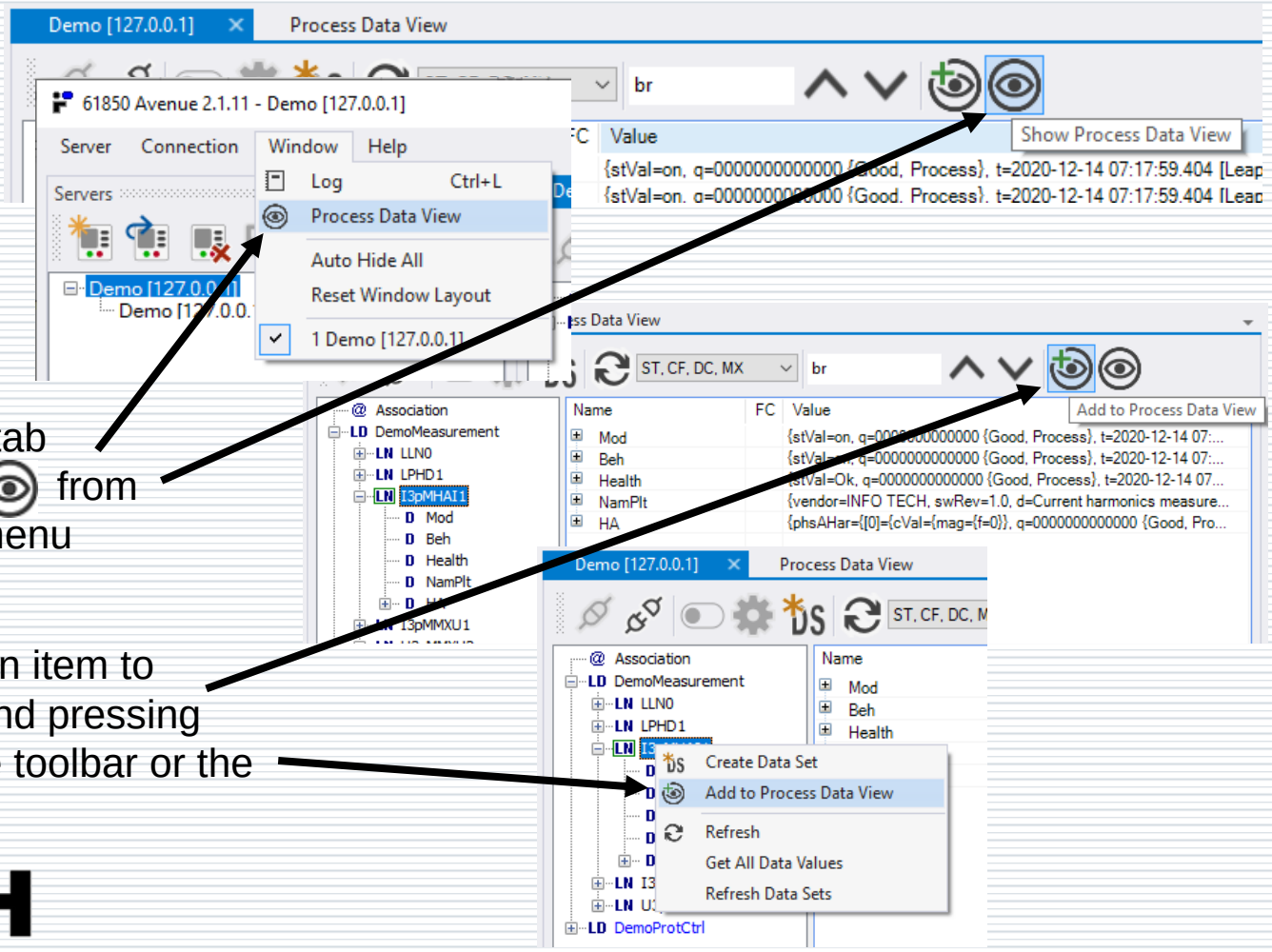
Process Data View - adding objects

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



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

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

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Process Data View (PDV) - toolbar

PDV toolbar is composed of the following elements:

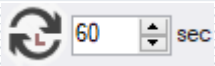
Confirming update of all items by button

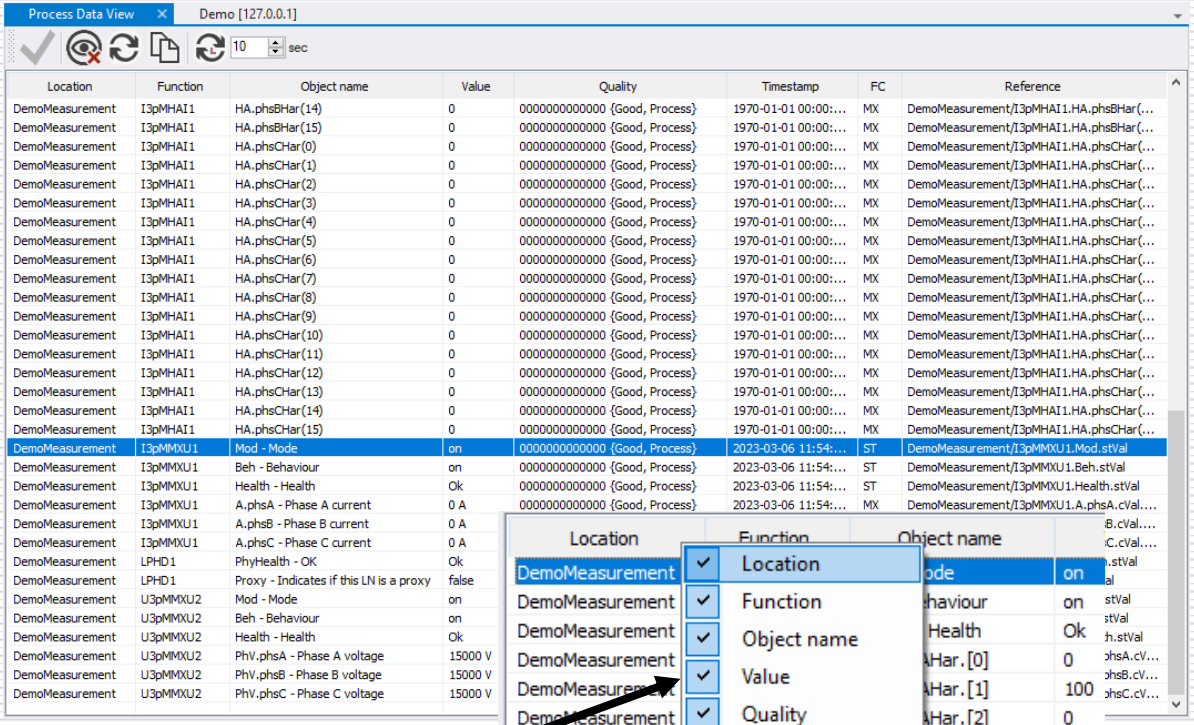
Removing item(s) from PDV by button

Refreshing selected items by button

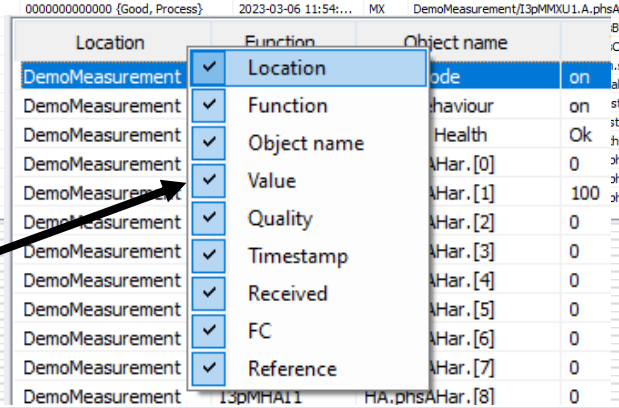
Copying selection by button

Data polling settings





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



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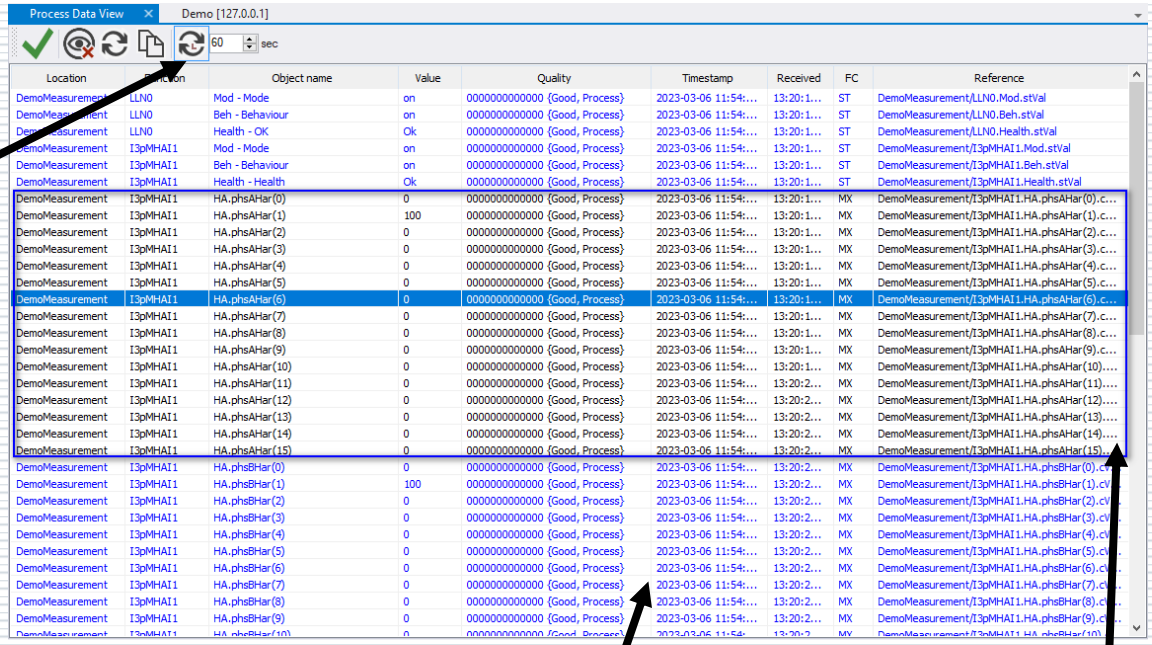
Process Data View (PDV) – data polling

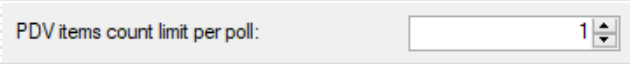
After adding items to PDV, the user can enable (or disable) cyclic data polling by clicking 

Enabled data poling.



The configurable parameters for cyclic polling of PDV items are:

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



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

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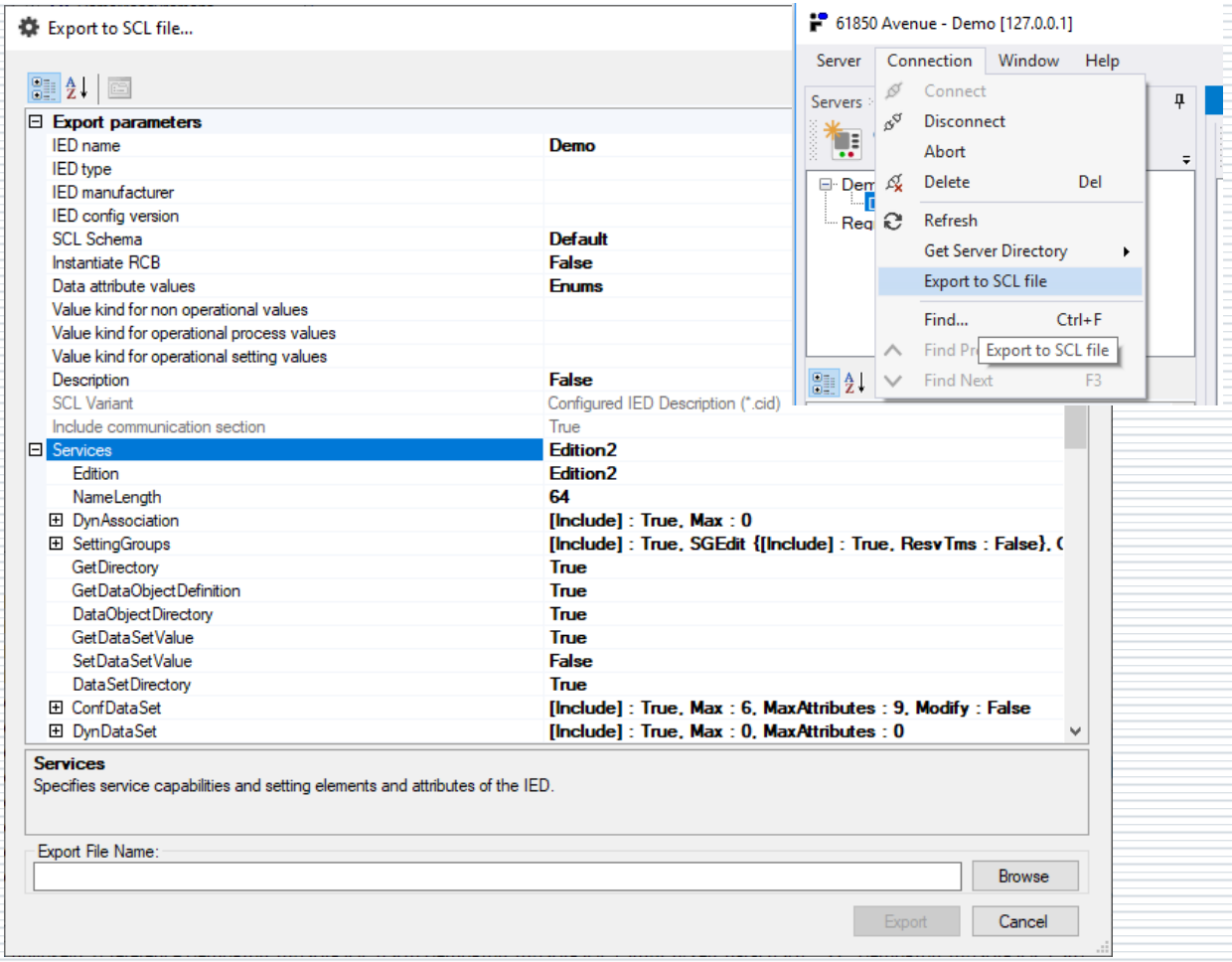
Generation of ICD/CID file

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.



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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

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61850 Relay Simulator

Feeder bay model with circuit breaker and disconnector.

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

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

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

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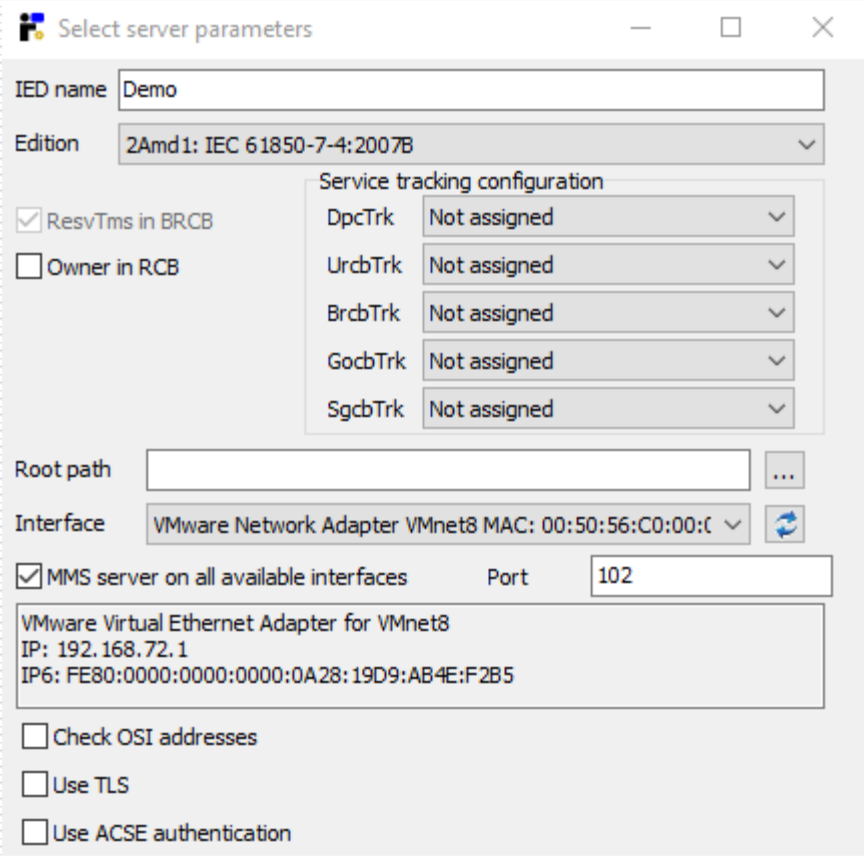
IEC 61850 Relay: Setup in the start view - edition

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

Other connection parameters:

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

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



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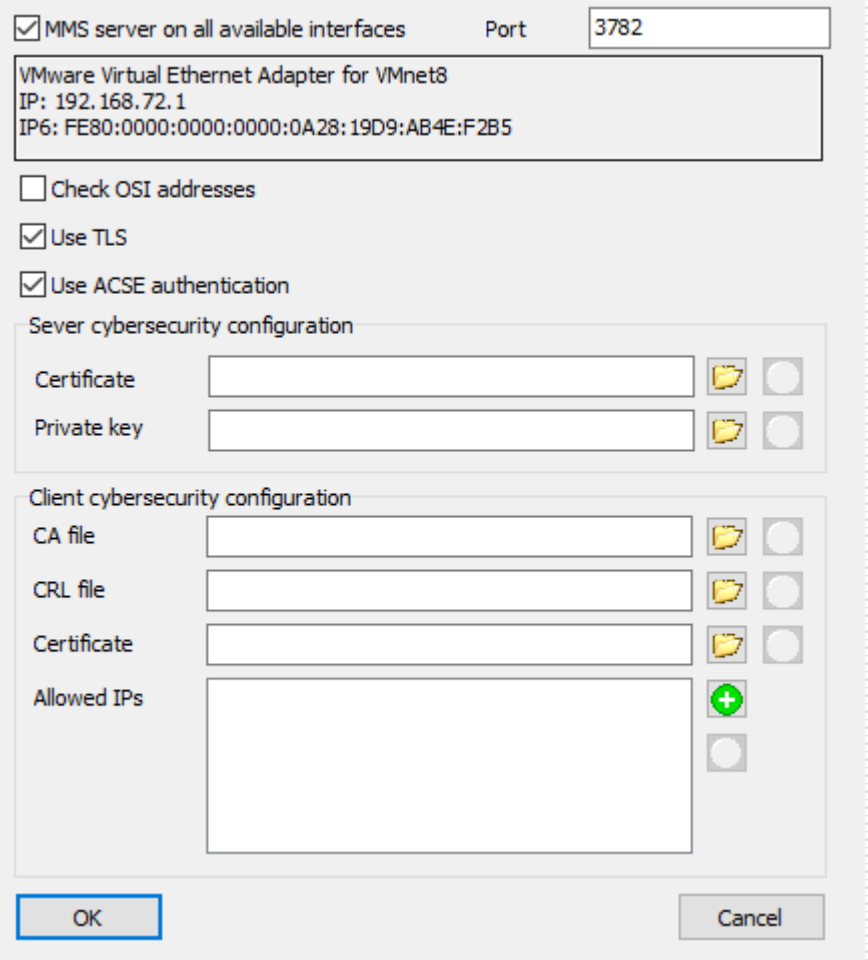
IEC 61850 Relay: Setup in the start view – TLS & ACSE

When using TLS and ACSE:

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



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IEC 61850 Relay: Outgoing feeder bay simulator

Feeder bay model with circuit breaker and disconnector.

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

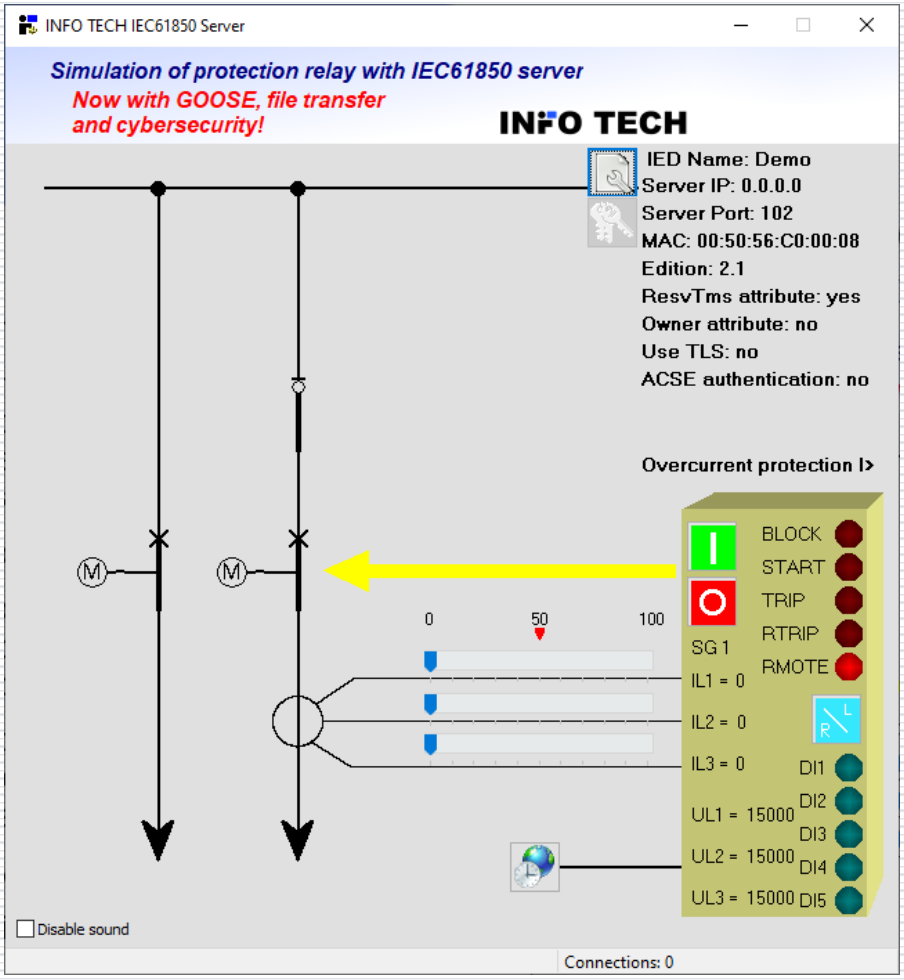
Local and remote monitoring.

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.



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

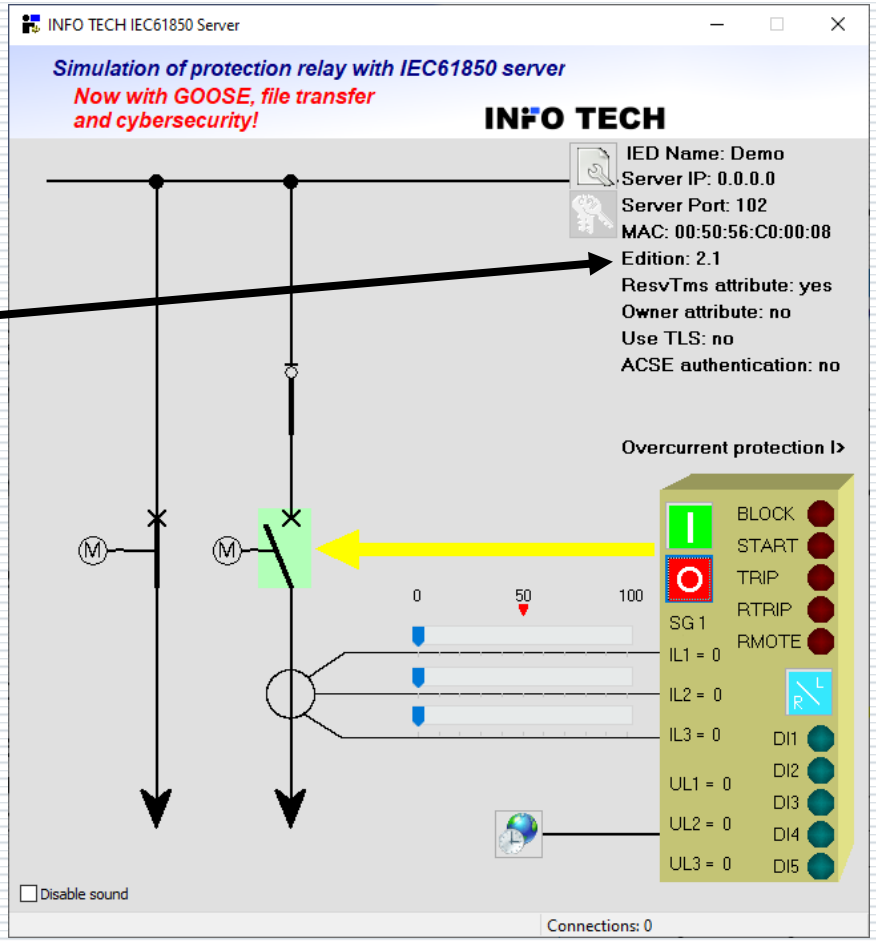
Three options of the simulator program execution are available:

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

(with different ICD files).

Note:

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



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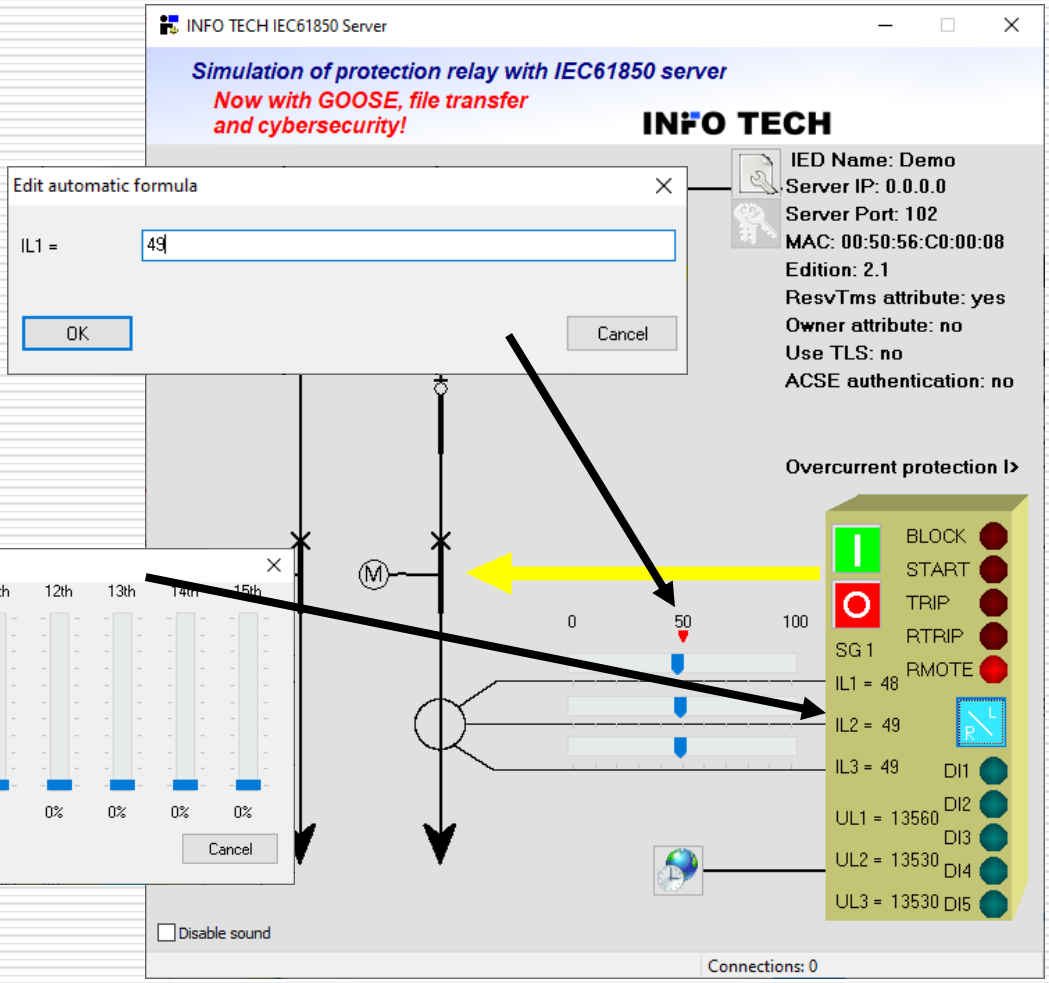
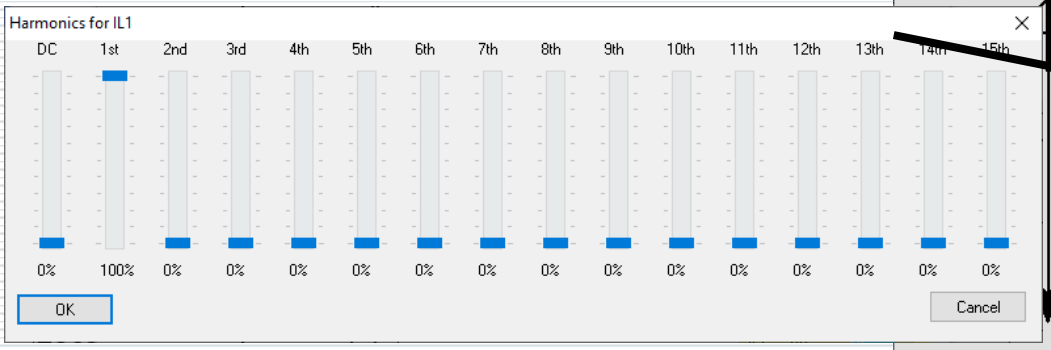
IEC 61850 Relay: simulation of analog signals

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.





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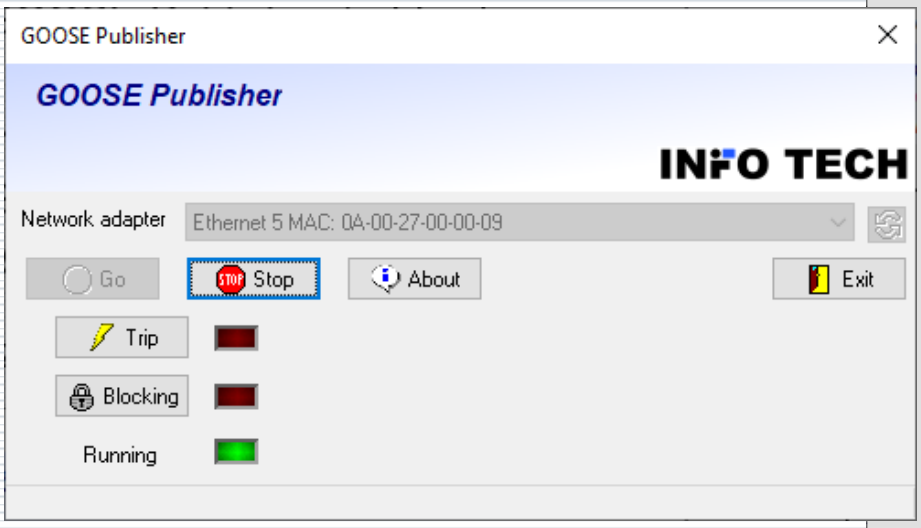
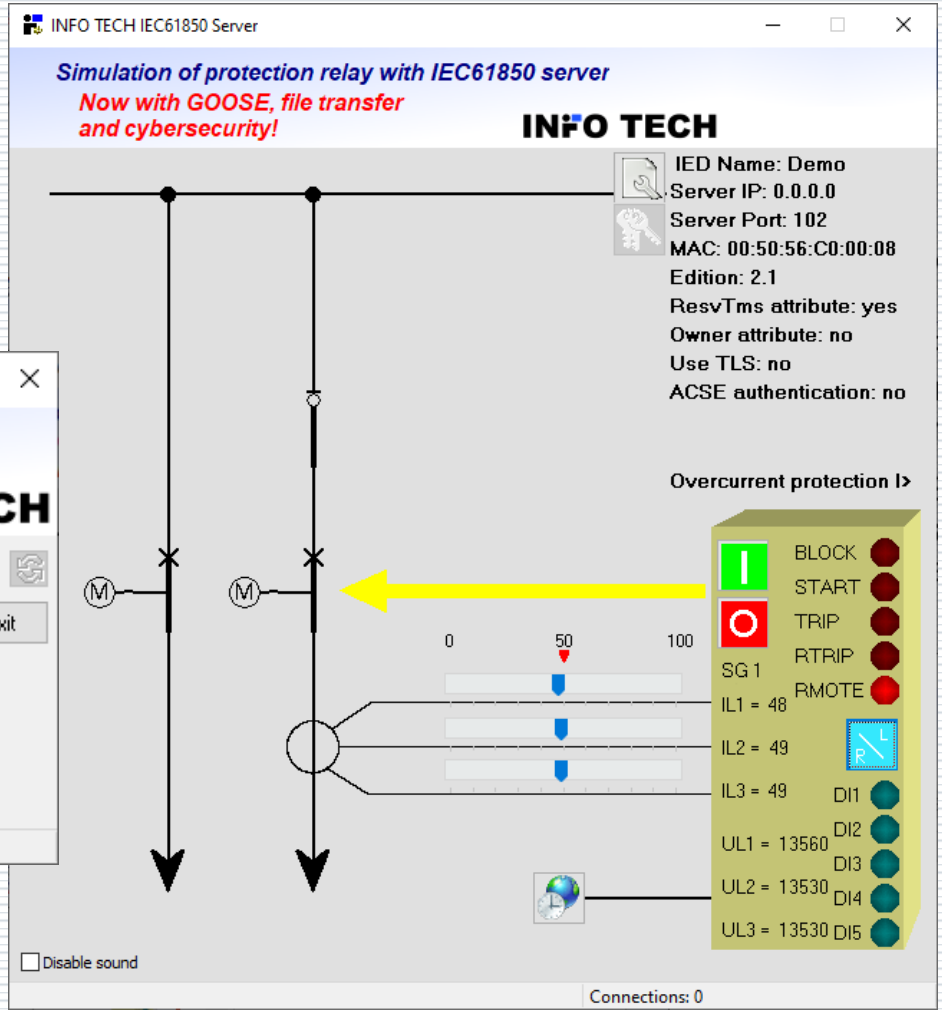
IEC 61850 Relay: GOOSE communication

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

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





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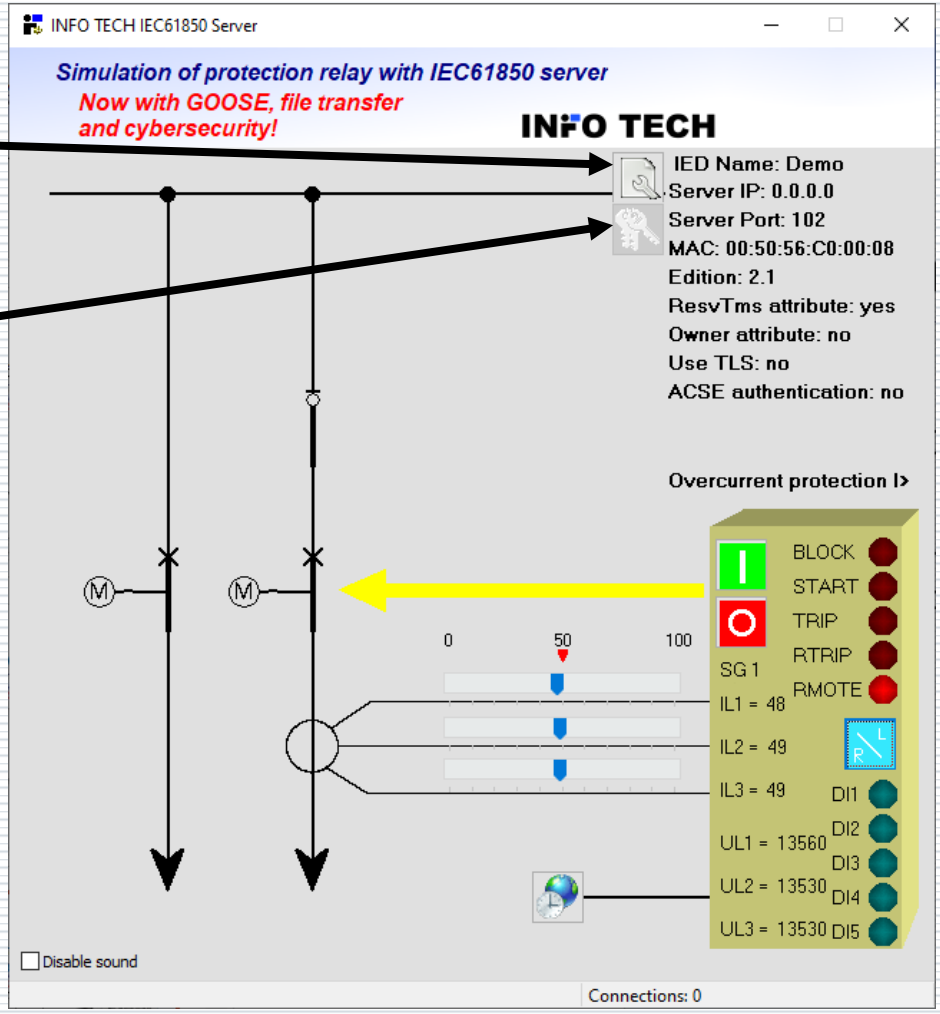
IEC 61850 Relay: Export of configuration files

Export of ICD file.

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



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GOOSE Toolset

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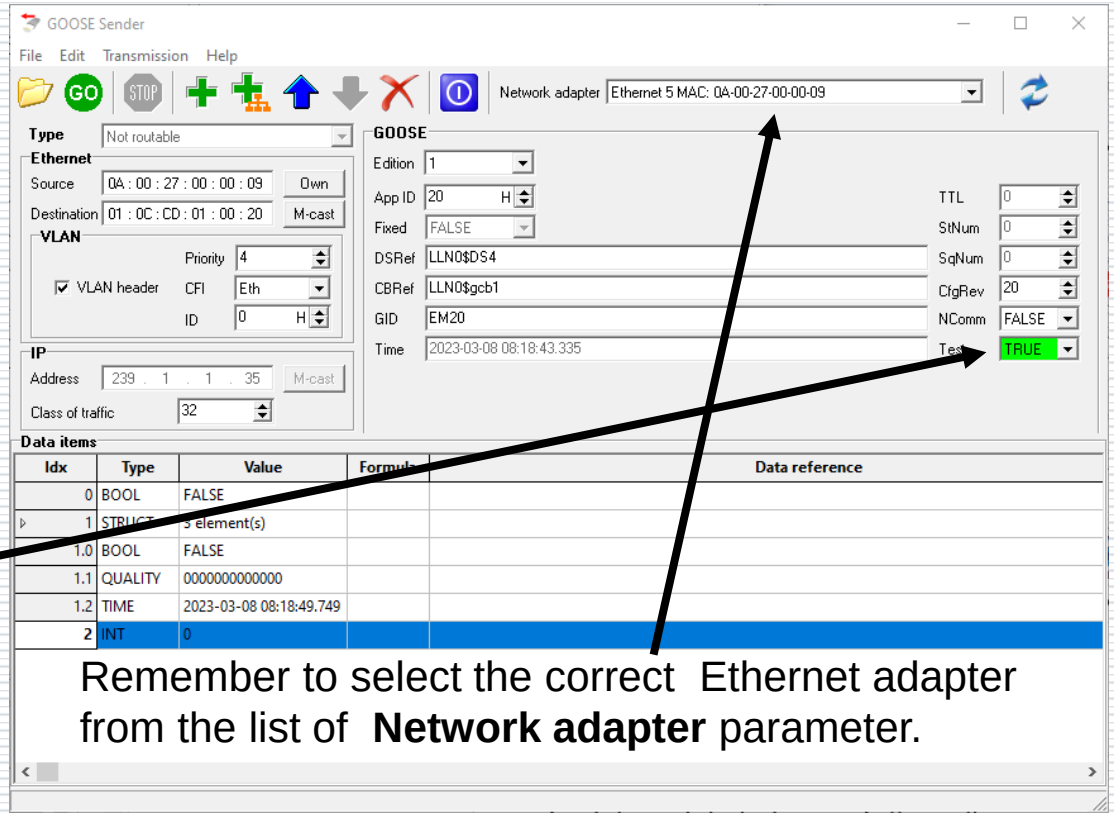
GOOSE toolset: GOOSE Sender – configurable publisher

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 – 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 si 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 baase 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 <= 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
*	Multiplification 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 mod 2 gives 1 (result and operands are treated as integers)
+	Sum i.e. 2+2 gives 4
-	Substract i.e. 4-2 gives 2
-	Substract i.e. 4-2 gives 2
-	Substract i.e. 4-2 gives 2
<	Less than i.e. 3 < 2 gives 0 (false)
<=	Less than or equal to i.e. 1 <= 2 gives 1 (true)
>=	Greater than or equal to i.e. 4 >= 2 gives 1 (true)
>	Greater than i.e. 4-2 gives 2
=	Equal to i.e. 4 = 2 gives 0 (false)
<>	Not equal to i.e. 4 <> 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 ...

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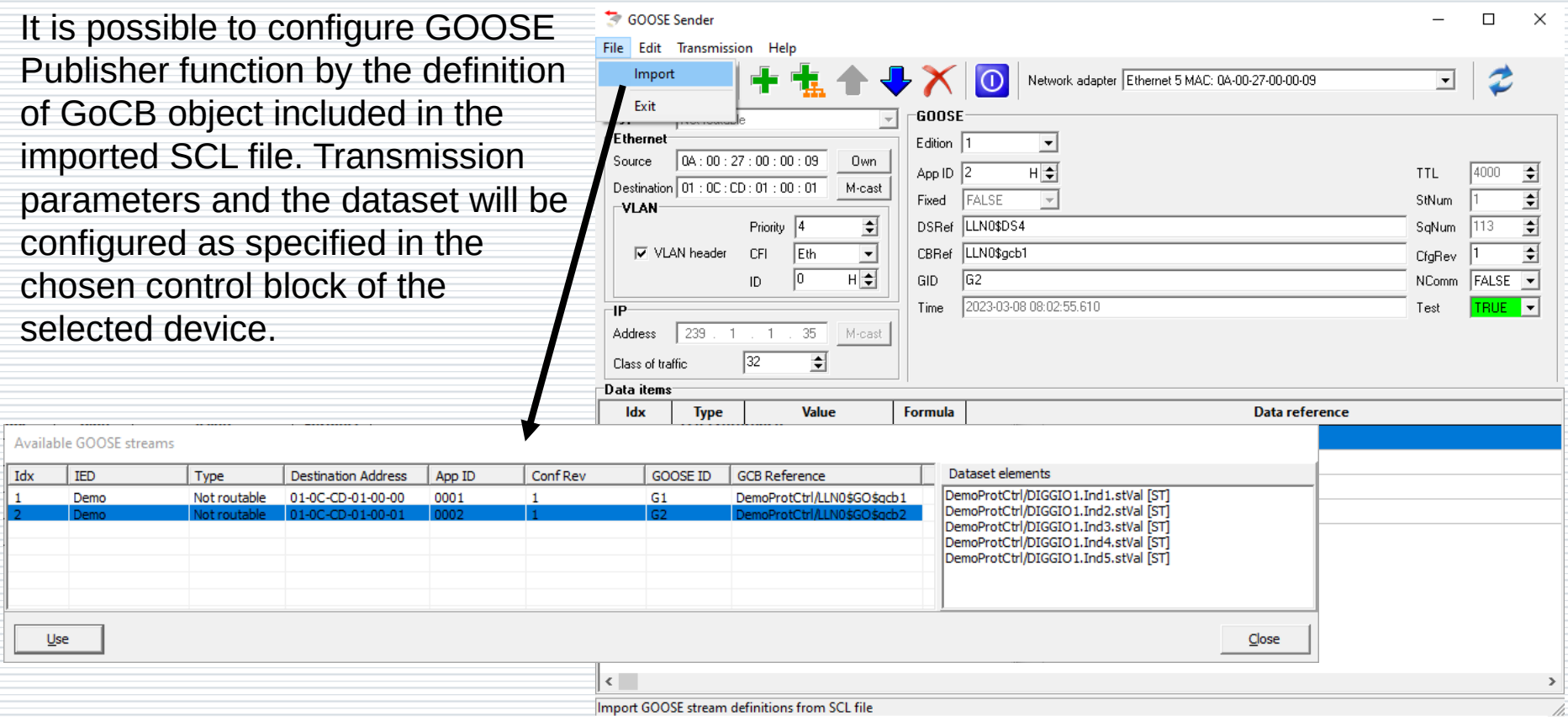
GOOSE Sender – configuration based on imported SCL file

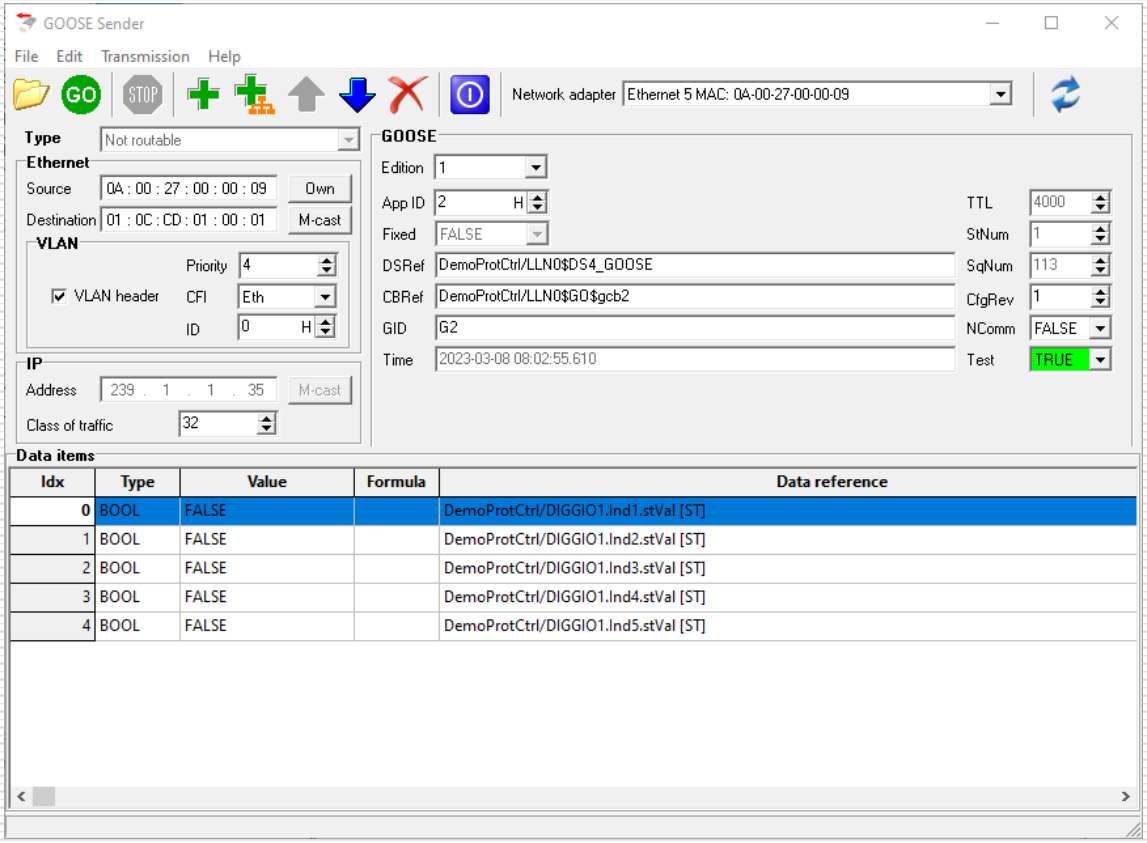
It is possible to configure GOOSE Publisher function by the definition of GoCB object included in the imported SCL file. Transmission parameters and the dataset will be configured as specified in the chosen control block of the selected device.



GOOSE Sender – simulation of another device

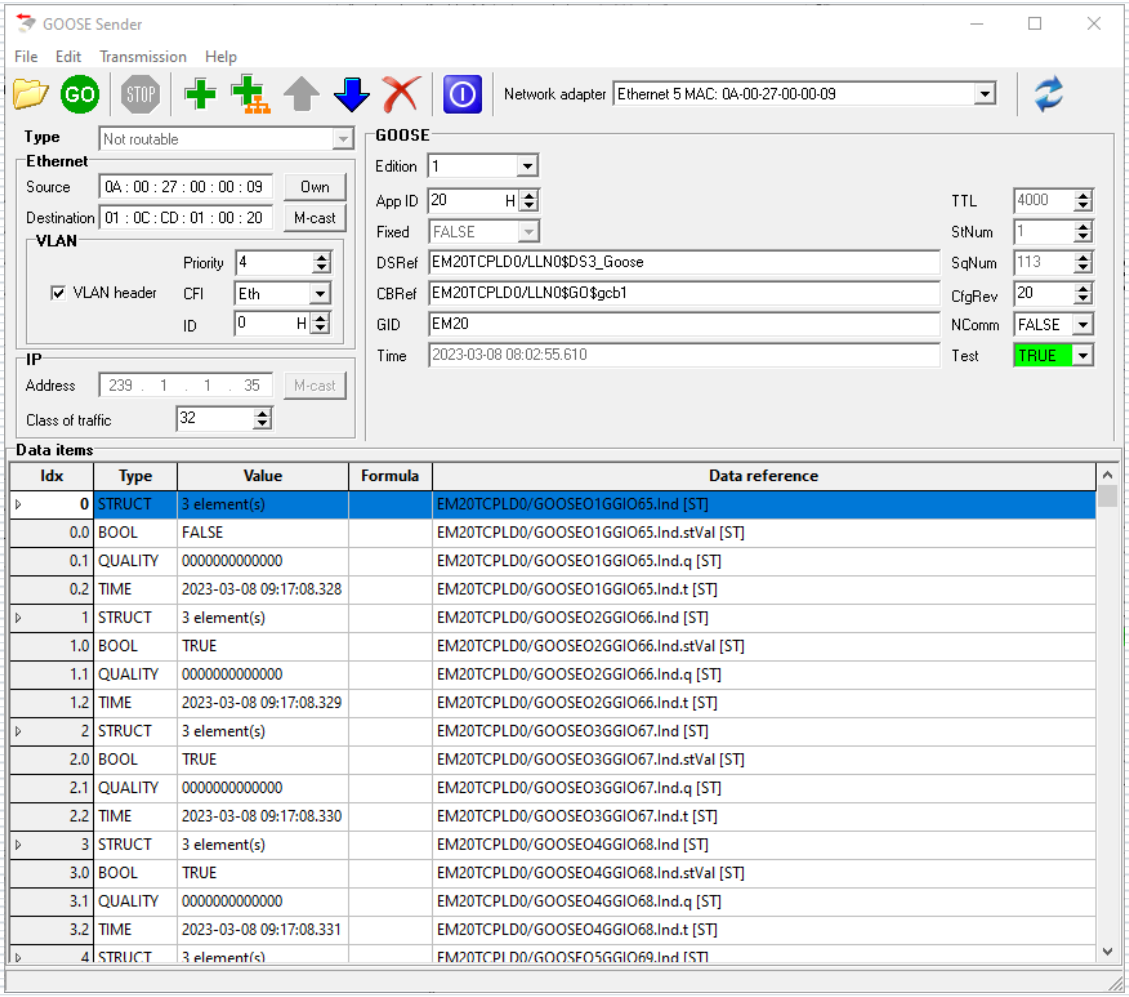
In this way the program can simulate the transmission performed by another device. It allows to test how GOOSE messages will be received and processed by devices with GOOSE Subscriber function.

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



GOOSE Sender – dataset elements of both simple and structured types

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



Idx	Type	Value	Formula	Data reference
0	STRUCT	3 element(s)		EM20TCPLD0/GOOSEO1GGIO65.Ind [ST]
0.0	BOOL	FALSE		EM20TCPLD0/GOOSEO1GGIO65.Ind.stVal [ST]
0.1	QUALITY	0000000000000		EM20TCPLD0/GOOSEO1GGIO65.Ind.q [ST]
0.2	TIME	2023-03-08 09:17:08.328		EM20TCPLD0/GOOSEO1GGIO65.Ind.t [ST]
1	STRUCT	3 element(s)		EM20TCPLD0/GOOSEO2GGIO66.Ind [ST]
1.0	BOOL	TRUE		EM20TCPLD0/GOOSEO2GGIO66.Ind.stVal [ST]
1.1	QUALITY	0000000000000		EM20TCPLD0/GOOSEO2GGIO66.Ind.q [ST]
1.2	TIME	2023-03-08 09:17:08.329		EM20TCPLD0/GOOSEO2GGIO66.Ind.t [ST]
2	STRUCT	3 element(s)		EM20TCPLD0/GOOSEO3GGIO67.Ind [ST]
2.0	BOOL	TRUE		EM20TCPLD0/GOOSEO3GGIO67.Ind.stVal [ST]
2.1	QUALITY	0000000000000		EM20TCPLD0/GOOSEO3GGIO67.Ind.q [ST]
2.2	TIME	2023-03-08 09:17:08.330		EM20TCPLD0/GOOSEO3GGIO67.Ind.t [ST]
3	STRUCT	3 element(s)		EM20TCPLD0/GOOSEO4GGIO68.Ind [ST]
3.0	BOOL	TRUE		EM20TCPLD0/GOOSEO4GGIO68.Ind.stVal [ST]
3.1	QUALITY	0000000000000		EM20TCPLD0/GOOSEO4GGIO68.Ind.q [ST]
3.2	TIME	2023-03-08 09:17:08.331		EM20TCPLD0/GOOSEO4GGIO68.Ind.t [ST]
4	STRUCT	3 element(s)		EM20TCPLD0/GOOSEO5GGIO69.Ind [ST]

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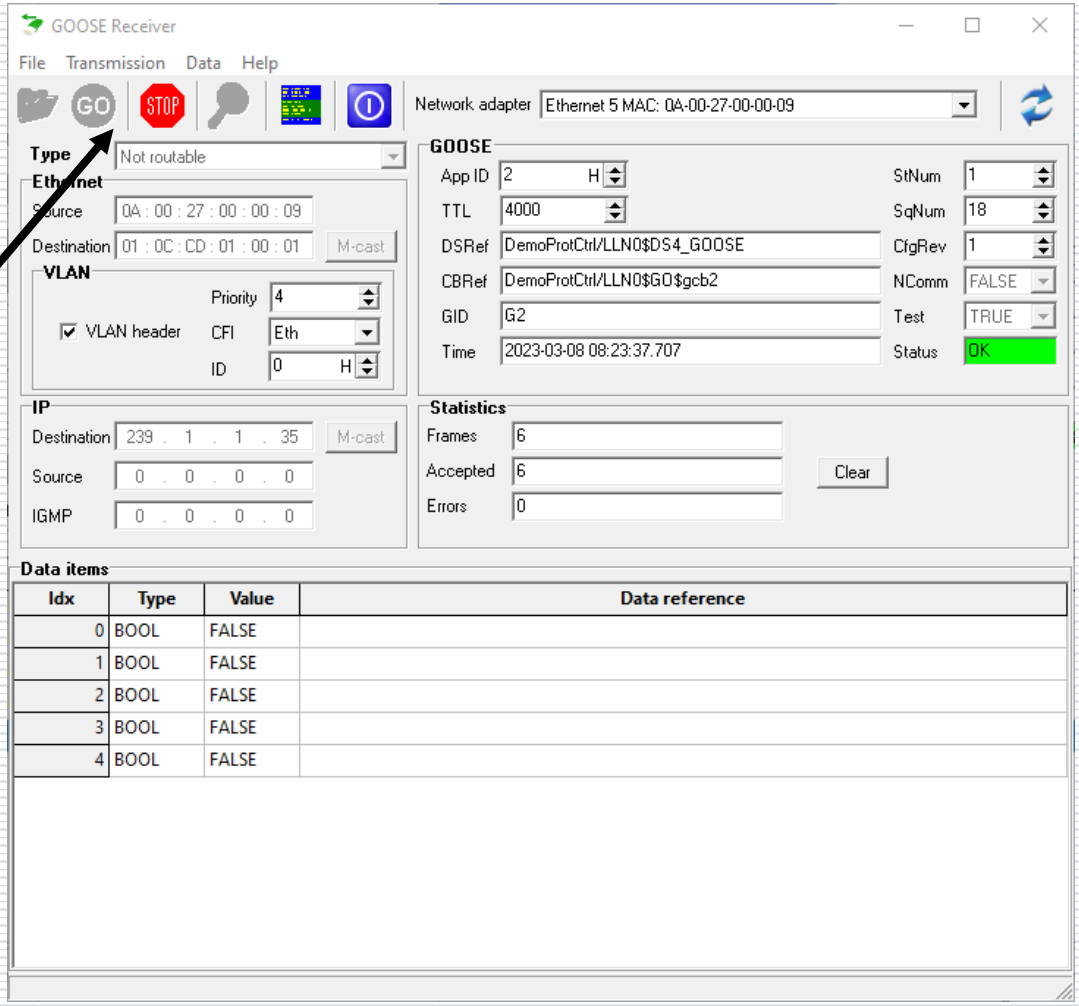
GOOSE toolset: GOOSE Receiver – configurable subscriber

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

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



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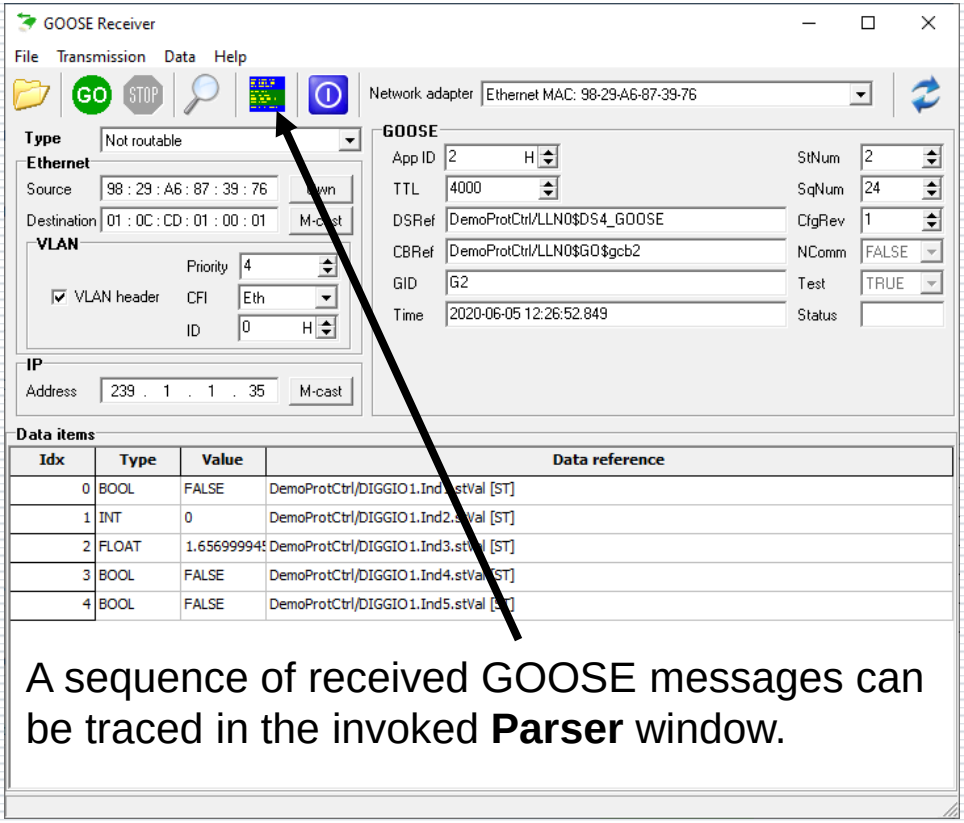
GOOSE Receiver – monitoring the selected message stream

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.

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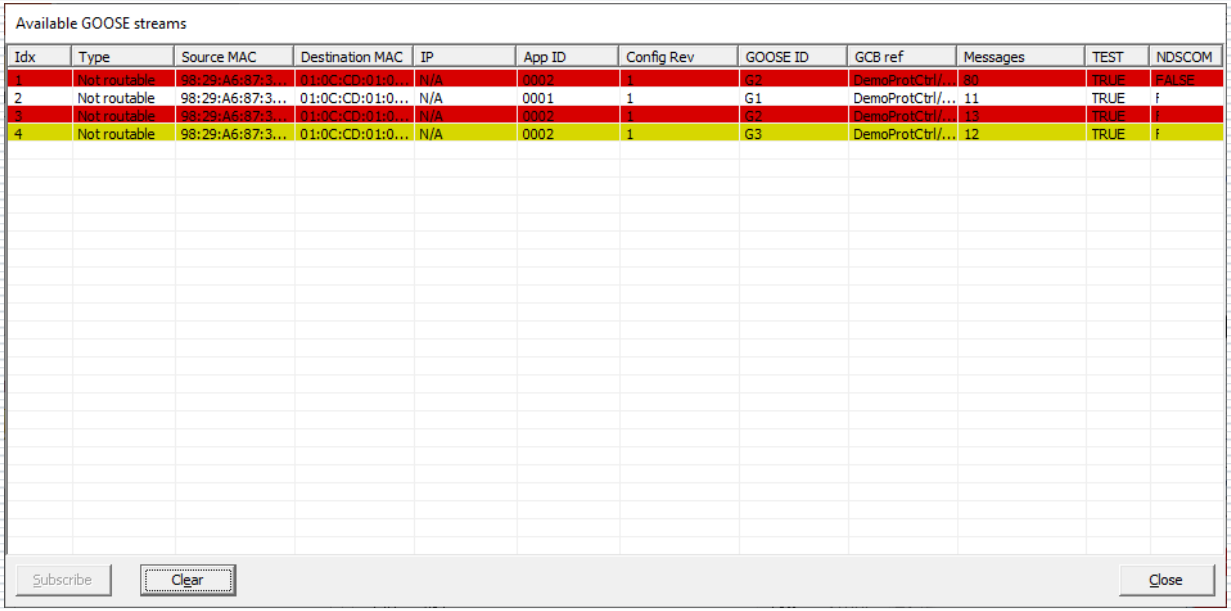
GOOSE Receiver – detecting errors in configuration of message streams

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.



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.

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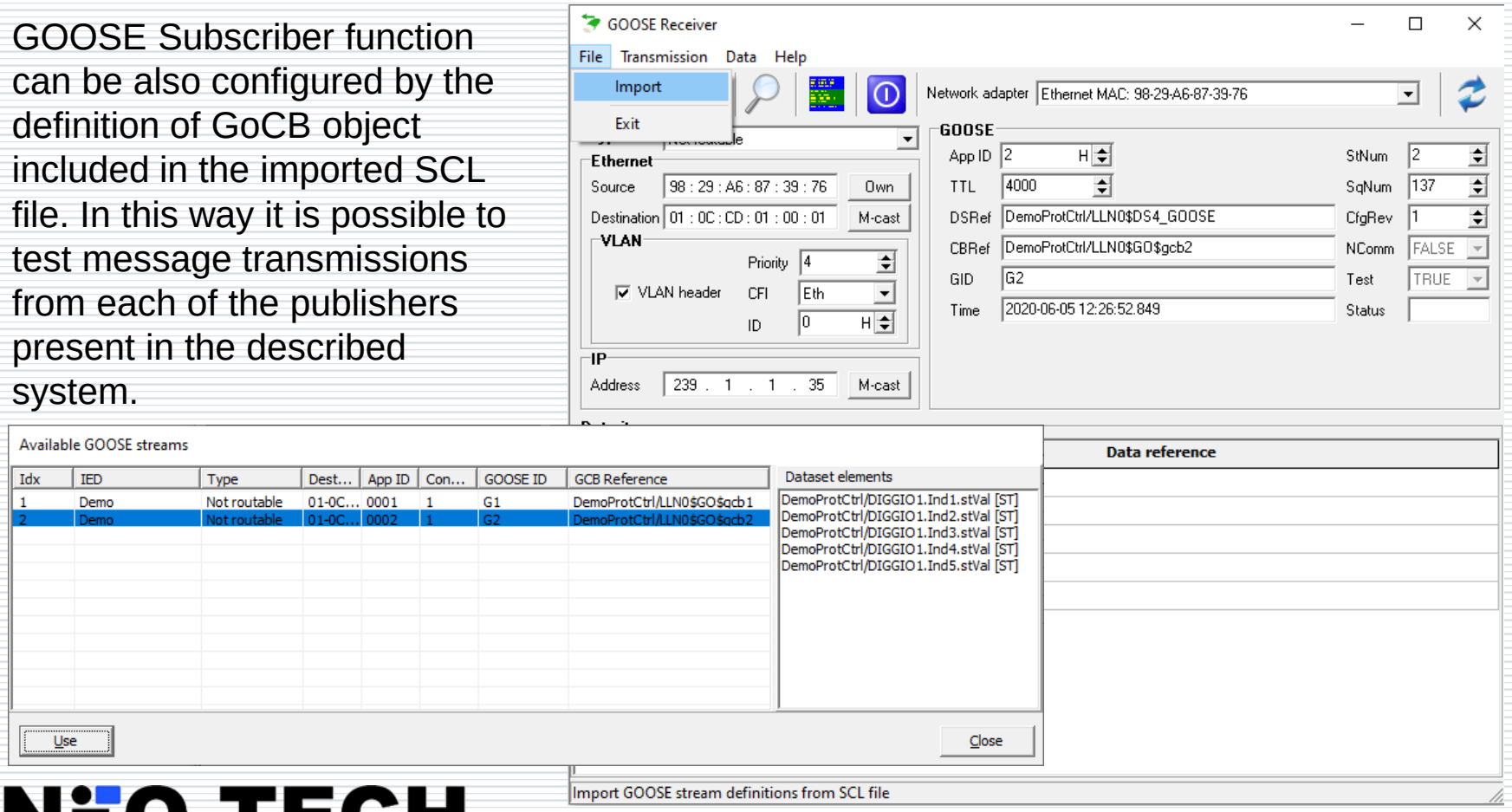
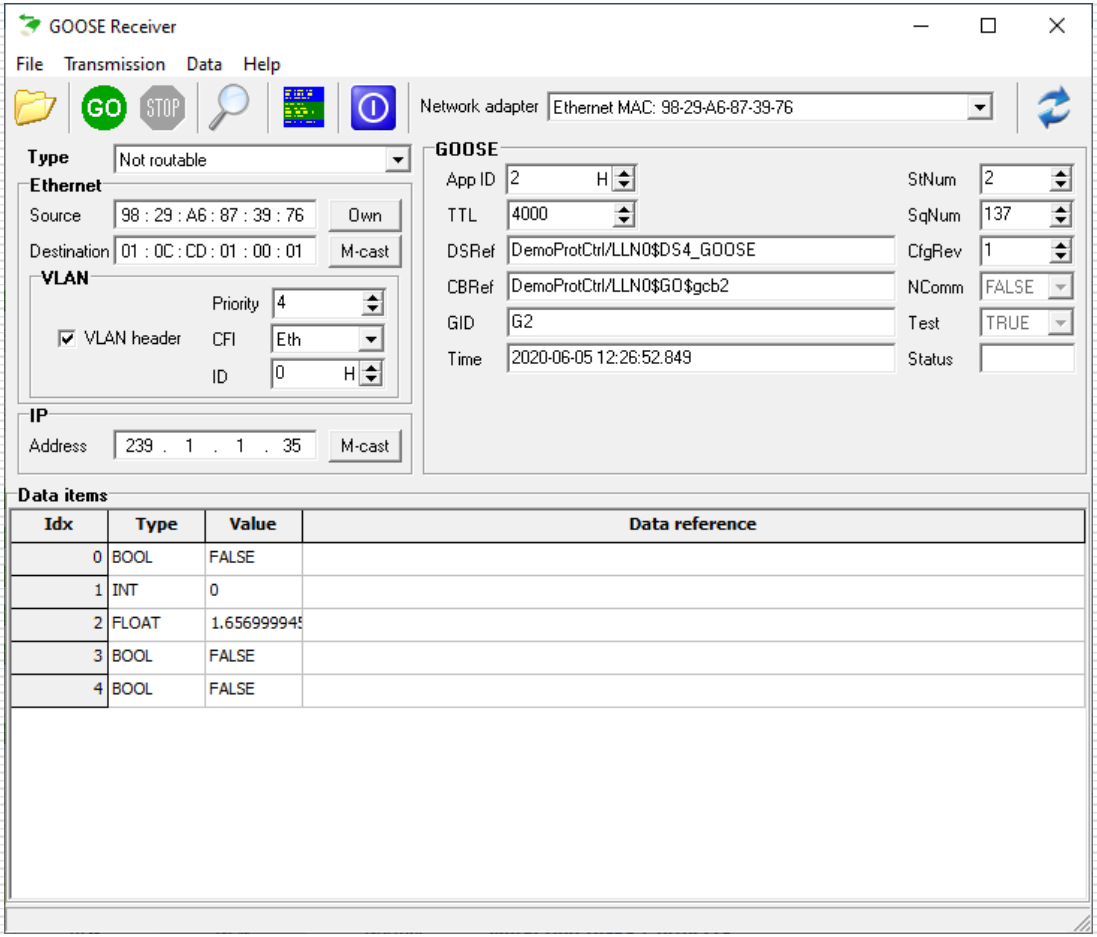
GOOSE Receiver – configuration from imported SCL file

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.



GOOSE Receiver – dataset elements of both simple and structured types

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



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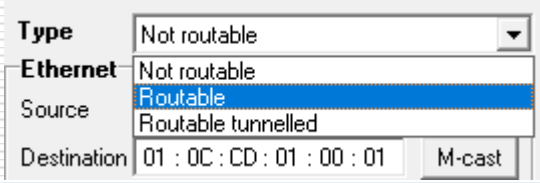
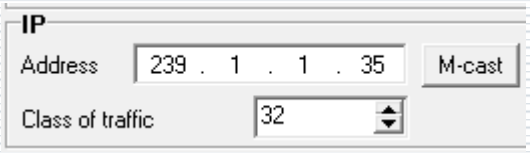
GOOSE Sender and GOOSE Receiver support also routable messages

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

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

Routable GOOSE: differences between types of routing

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

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

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

Sampled Values Toolset

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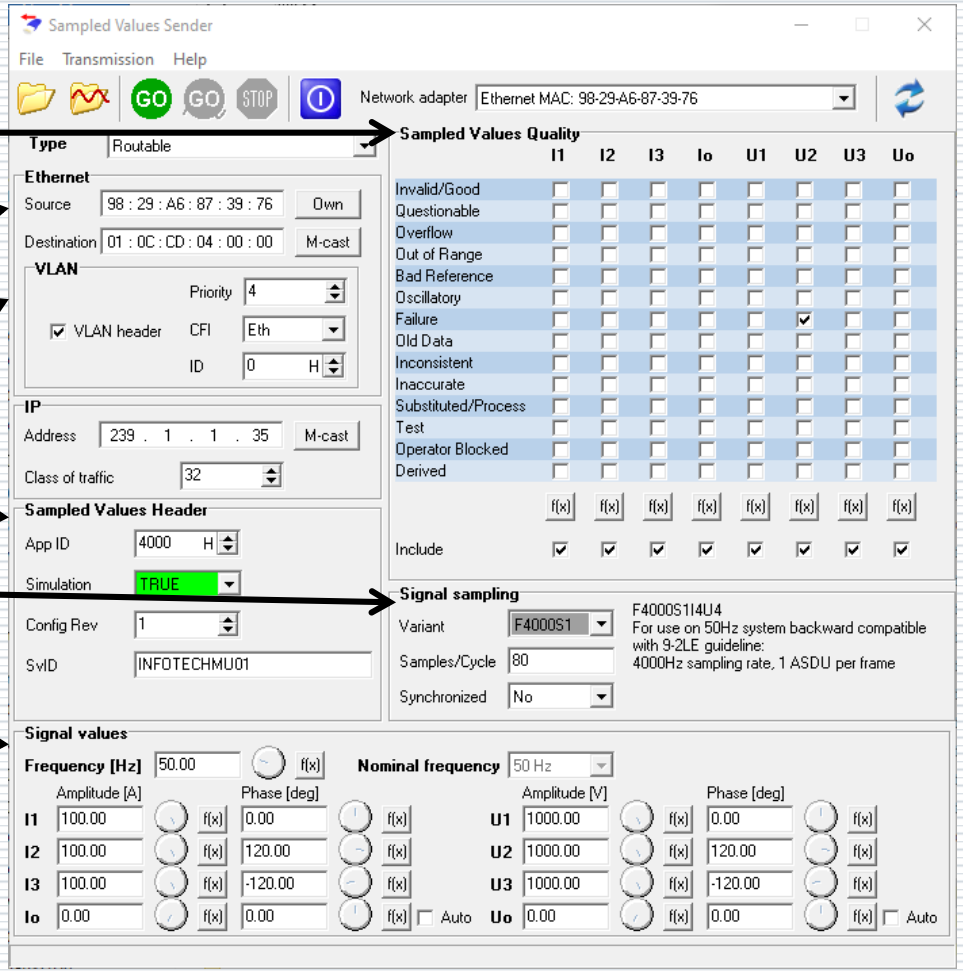
SV toolset: SAV Sender – working area

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

Ethernet header showing source and destination MAC address of the message
VLAN header showing VLAN part of the message (if present)
Sampled Values header used to set Sampled Values header part of the message
Signal sampling properties showing all options of the sampling rate and ASDU packing in accordance with the IEC 61869-9
Signal quality bits allowing to set quality bits for each sampled signal
Signal values allowing to set amplitude and phase of each simulated signal



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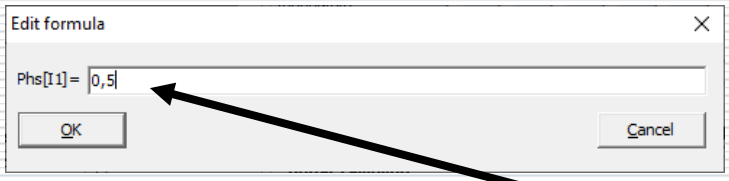
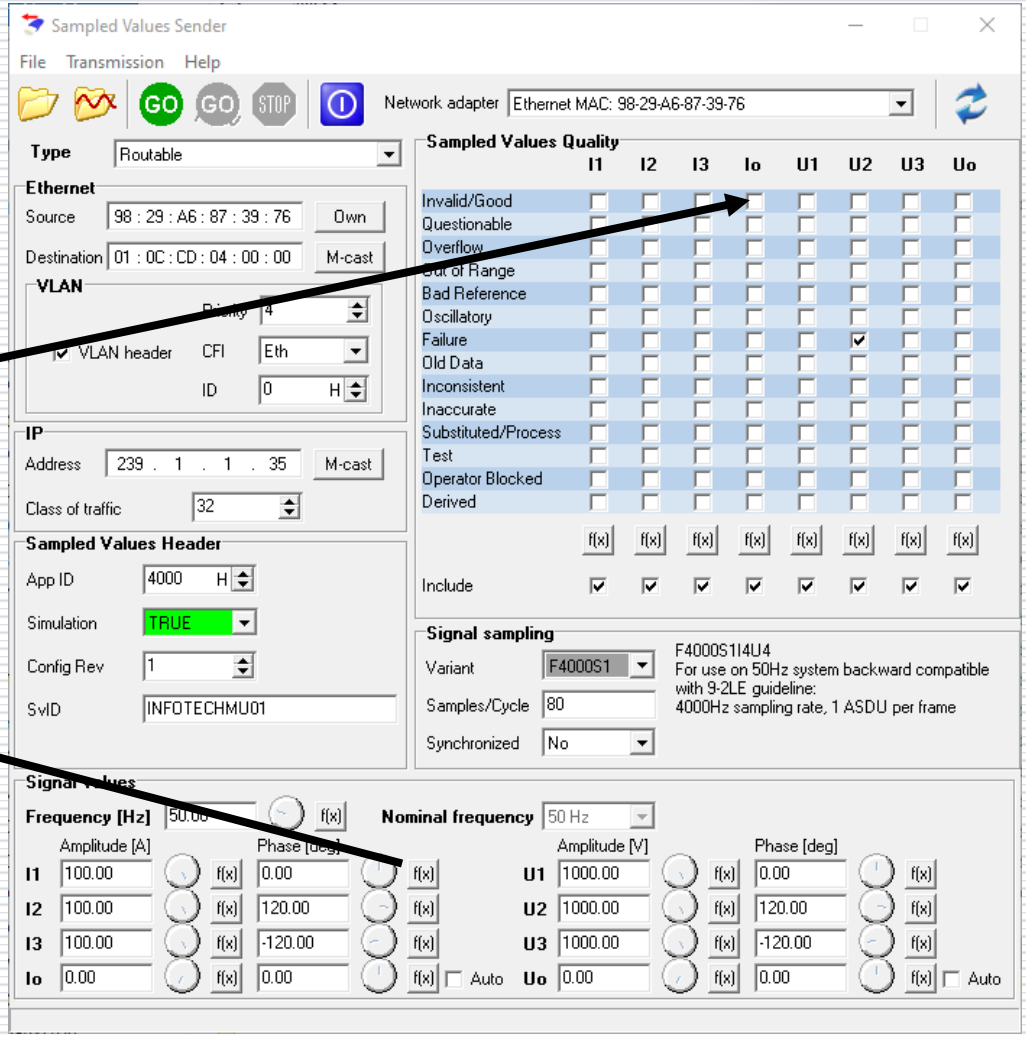
SV toolset: SAV Sender - simulator of Merging Unit

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.



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



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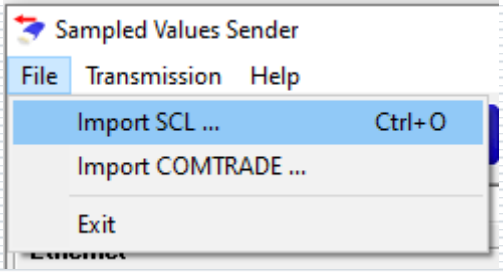
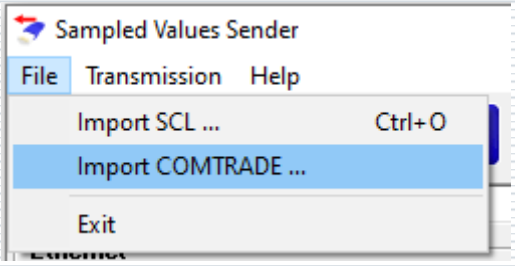
SV toolset: SAV Sender - configuration from files

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.



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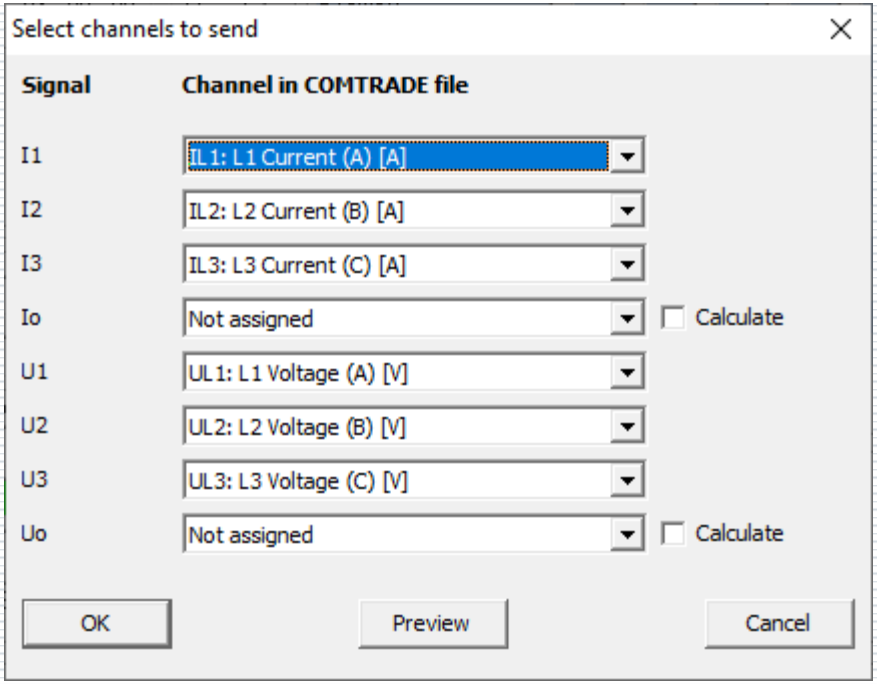
SV toolset: SAV Sender – COMTRADE channels selection

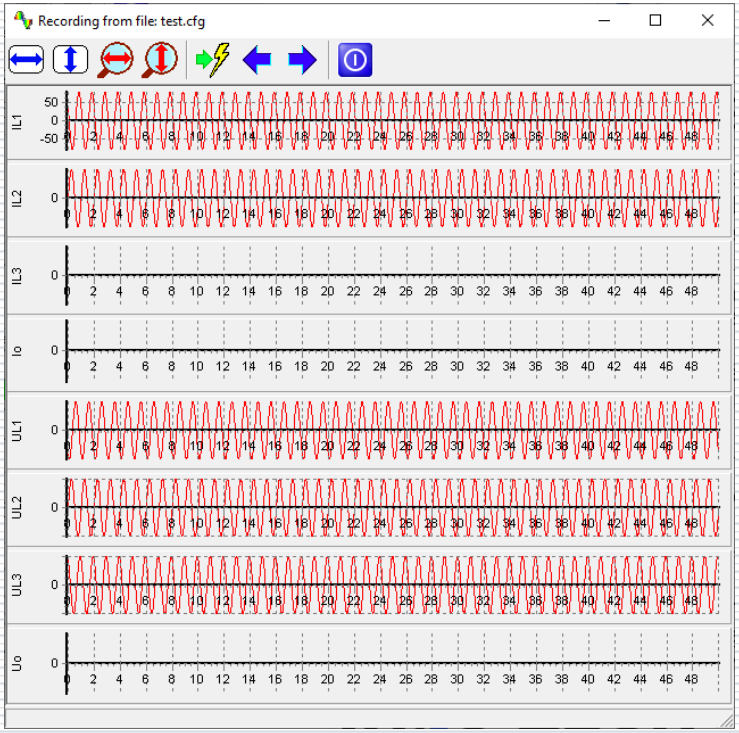
This window allows to select signals from an imported COMTRADE file and assign them to channels defined in the IEC 61850-9-2LE specification. Io and Uo signals can be artificially calculated from phase signals if needed (in such a case the DERIVED bit in quality attribute will be set for those signals). 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.



SV toolset: SAV Sender – COMTRADE recording preview

Preview buttom 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

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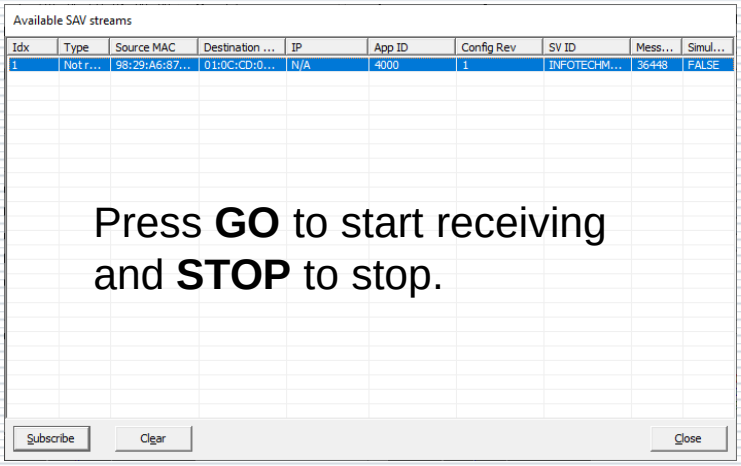
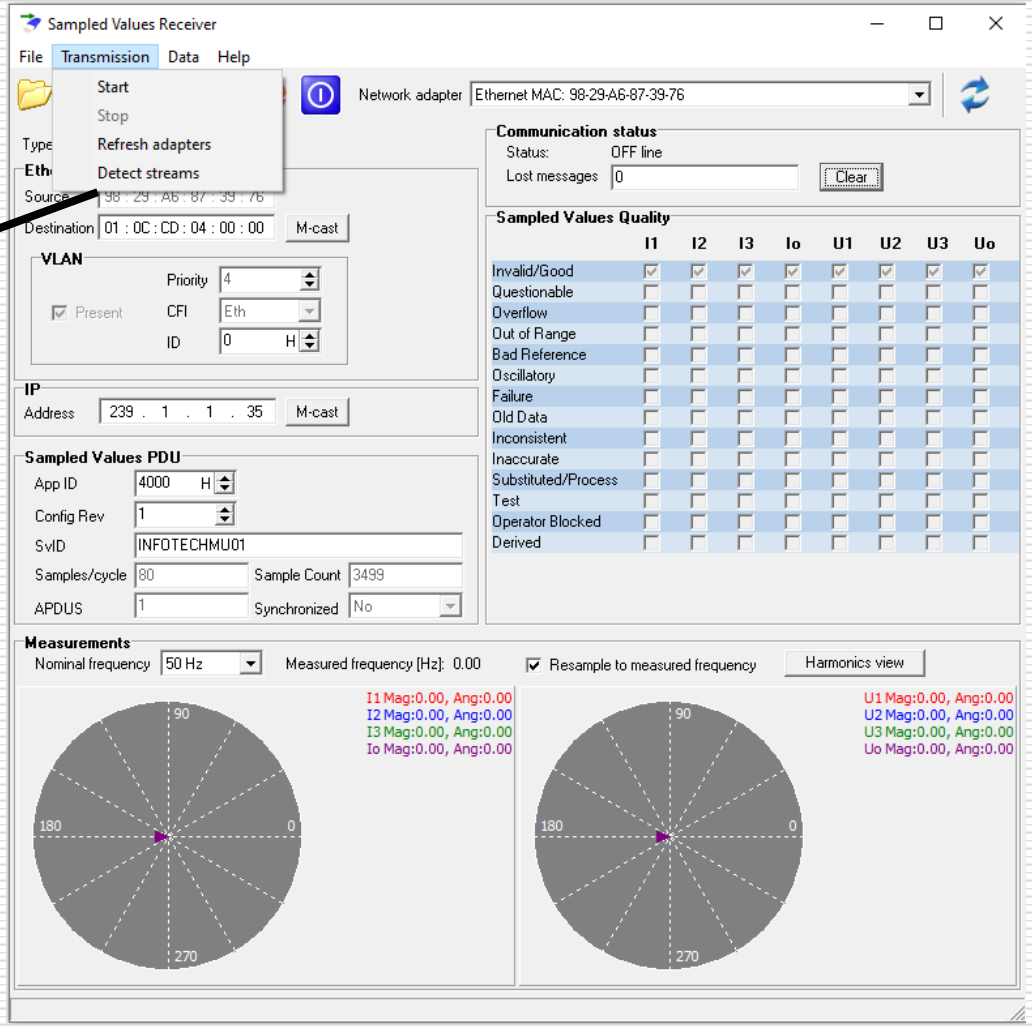
SV toolset: SAV Receiver - signal processing from received samples

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.



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



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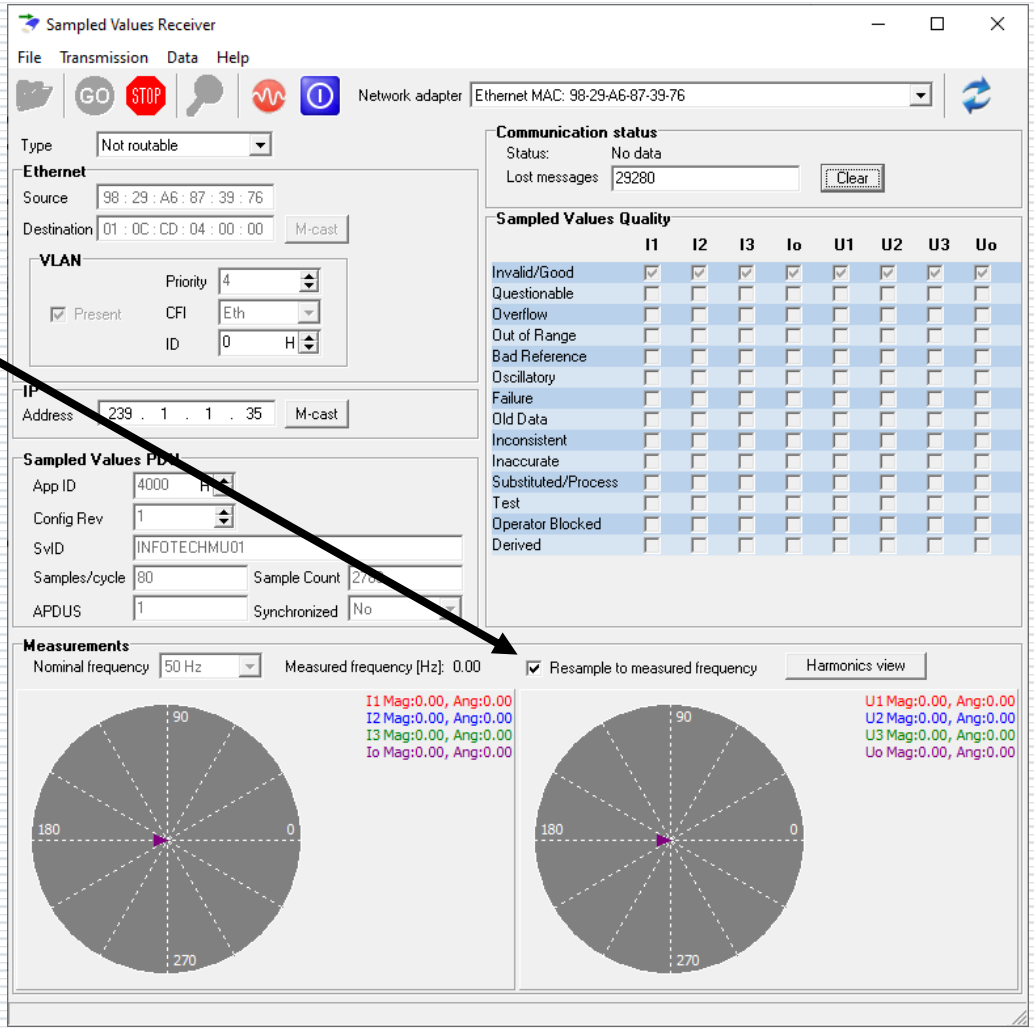
SV toolset: SAV Receiver – computation of signal characteristics

Signal characterictics 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.



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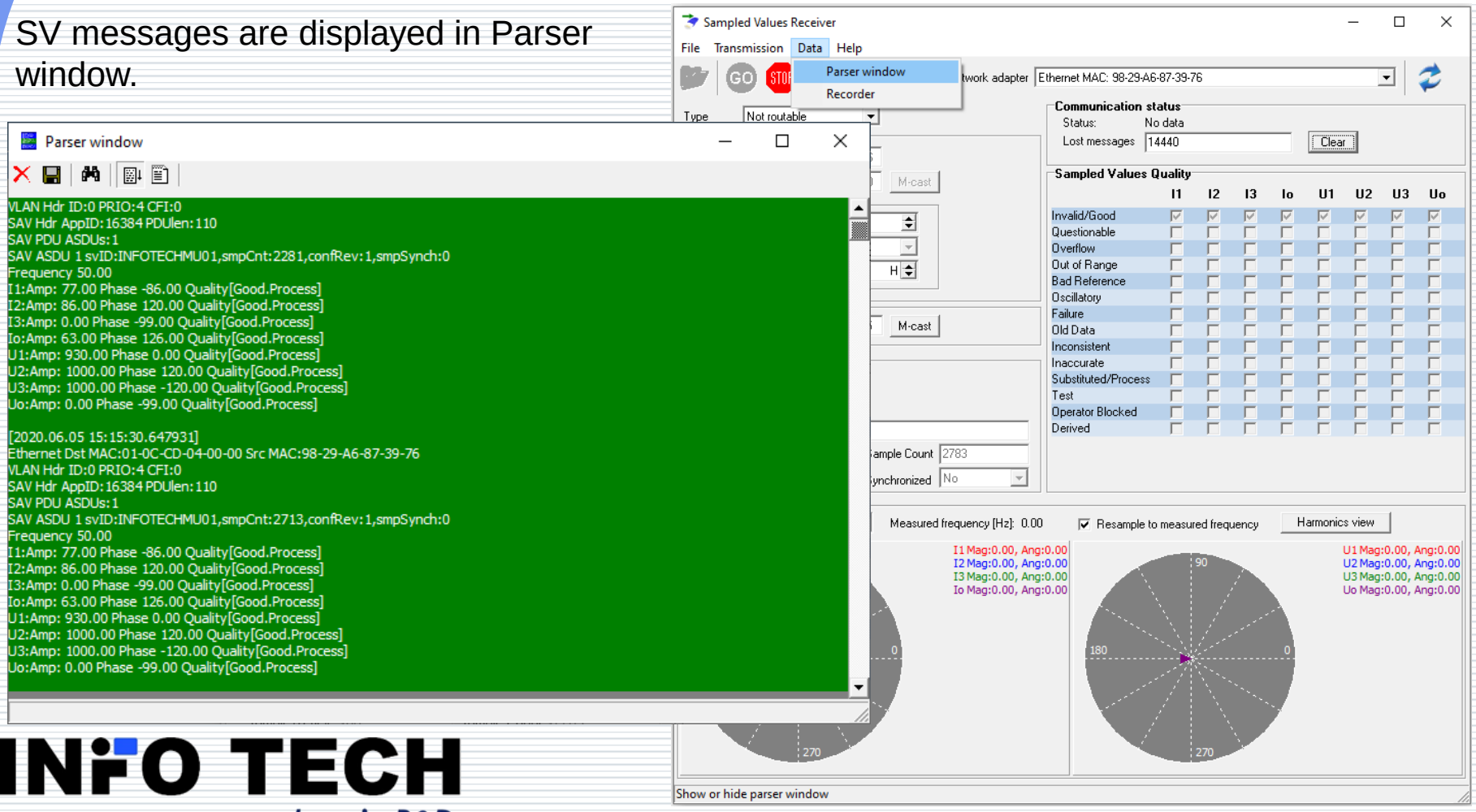
SV toolset: SAV Receiver - tracing SV message stream

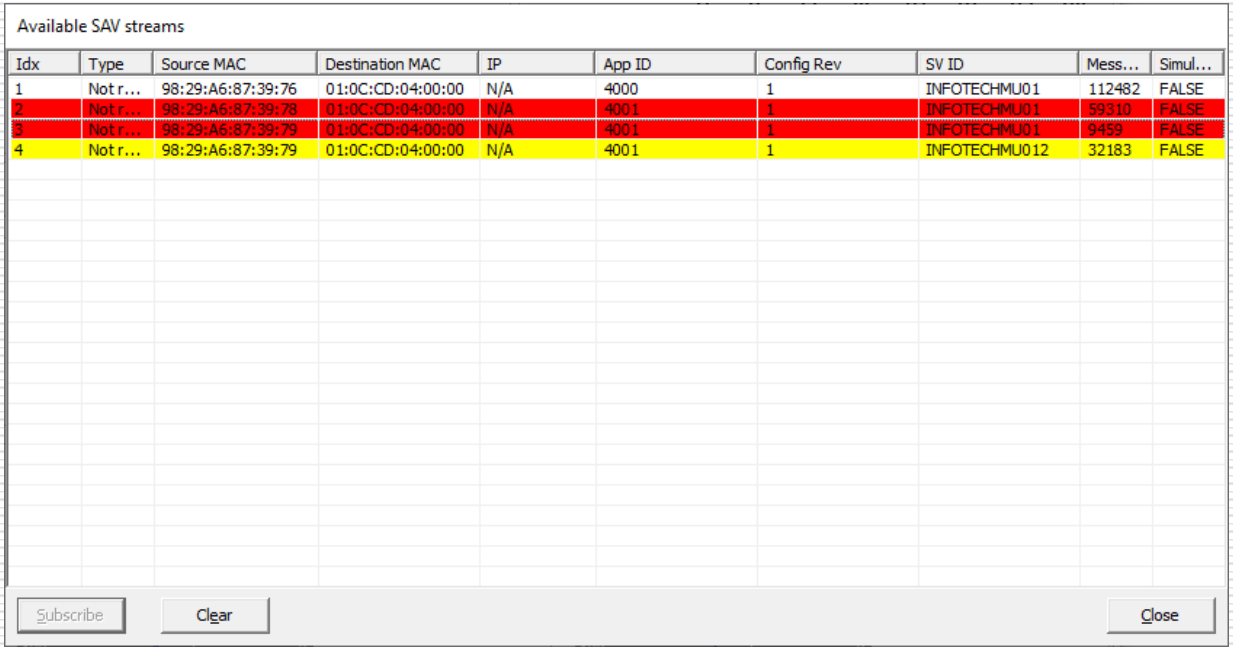
SV messages are displayed in Parser window.



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



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

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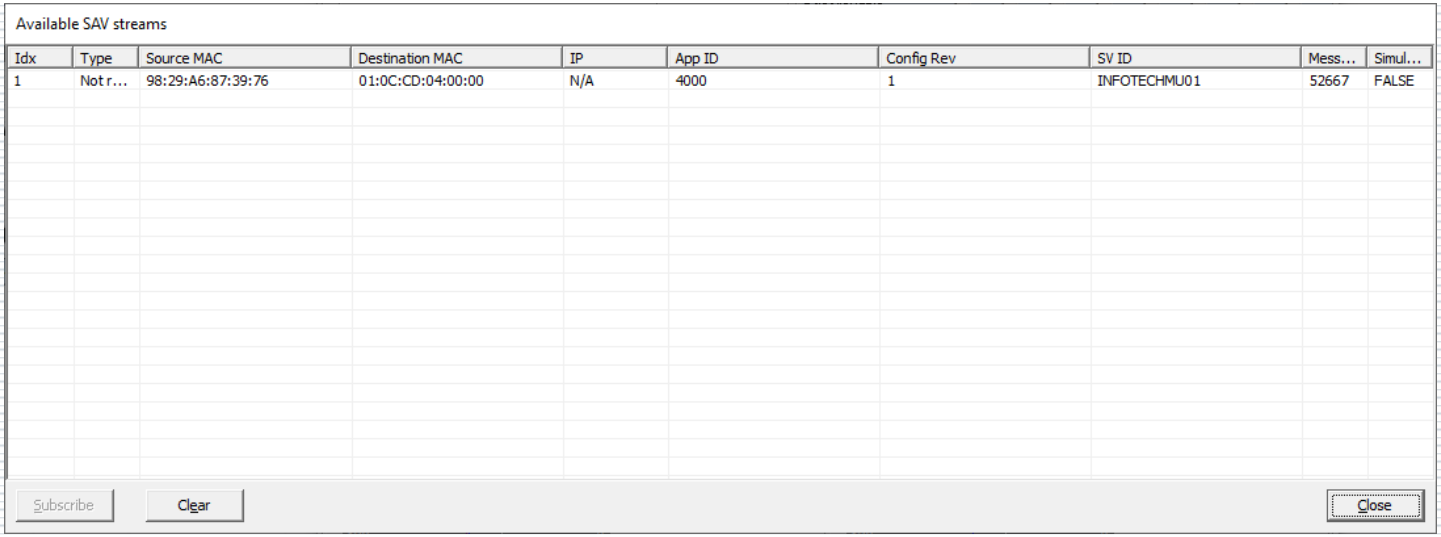
SAV Receiver – importing streams definitions from SCL

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.



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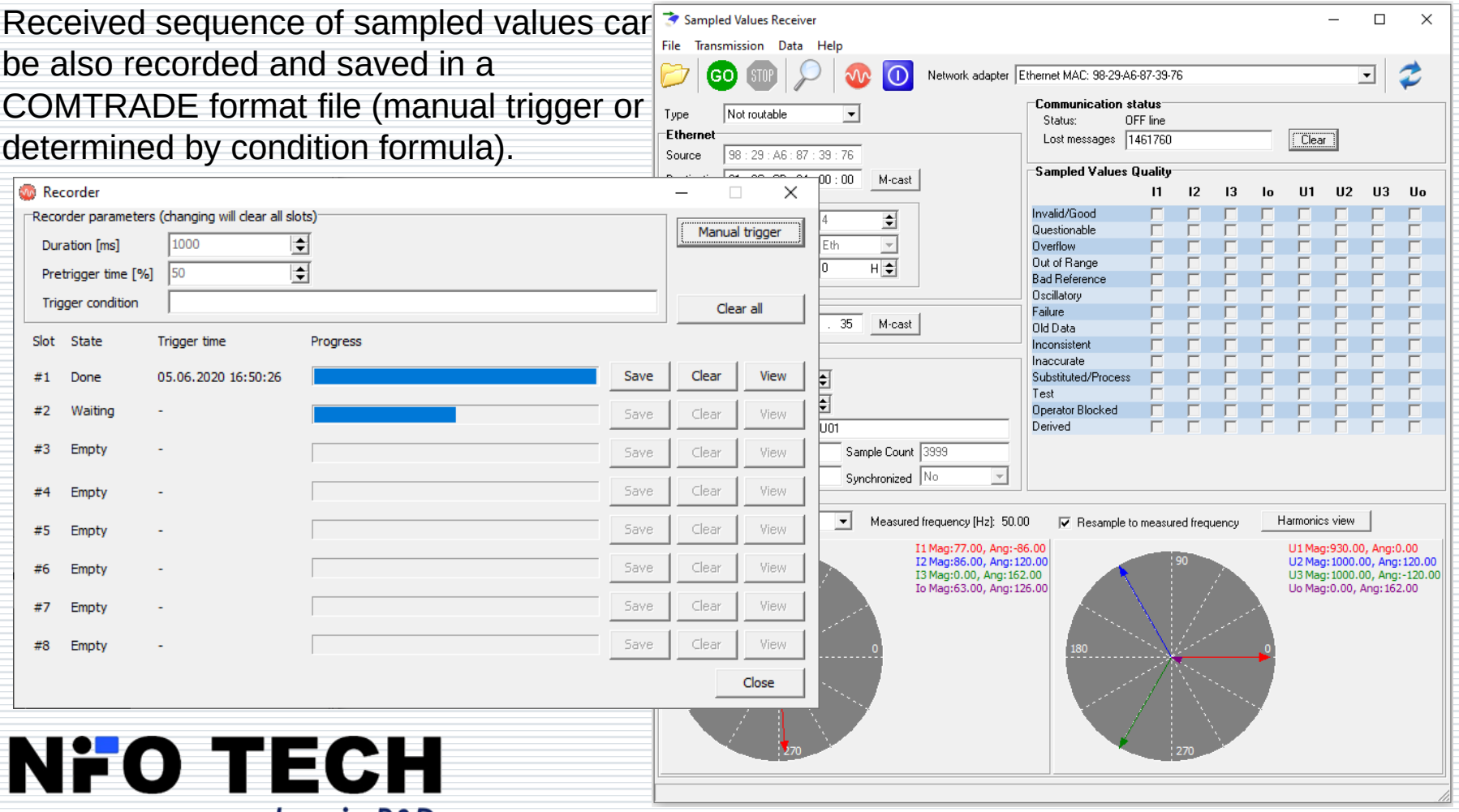
SAV Receiver – recording samples in COMTRADE file

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



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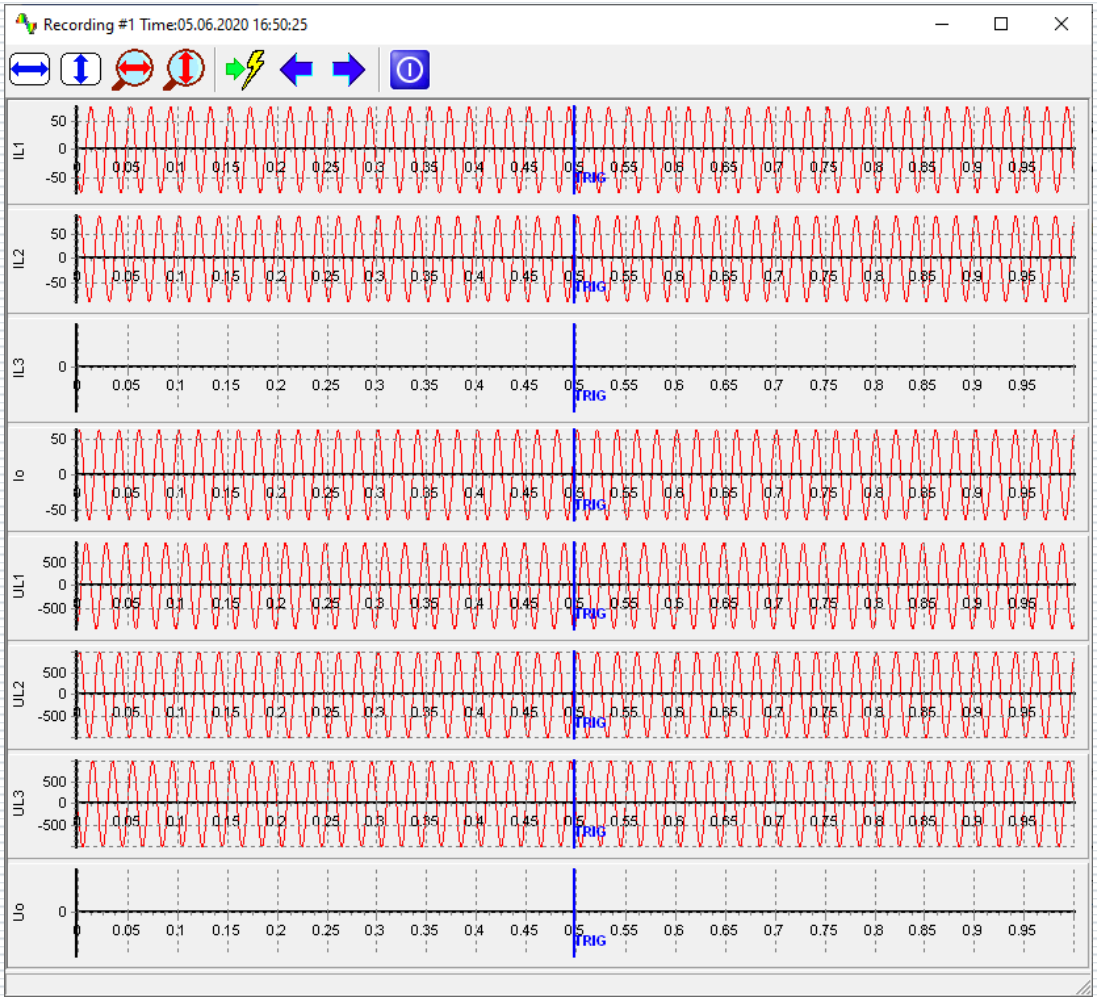
SV toolset: SAV Receiver – viewing recorded COMTRADE file

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



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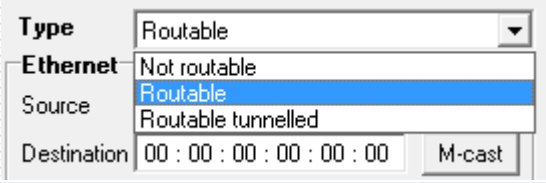
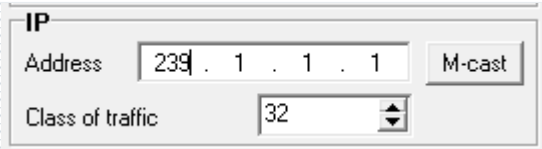
SAV Sender and SAV Receiver support also routable messages

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

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

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File Transfer Tool

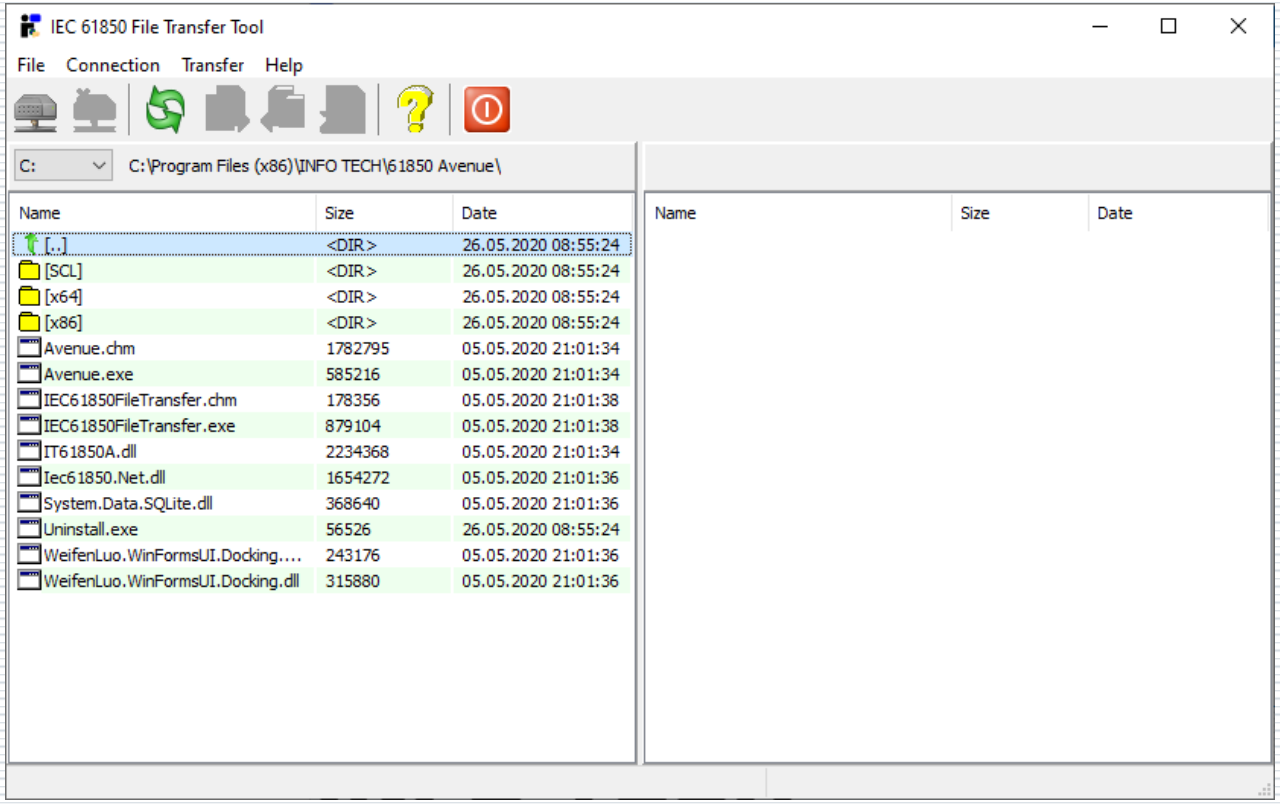
File Transfer Tool – to test access to files in server devices

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.



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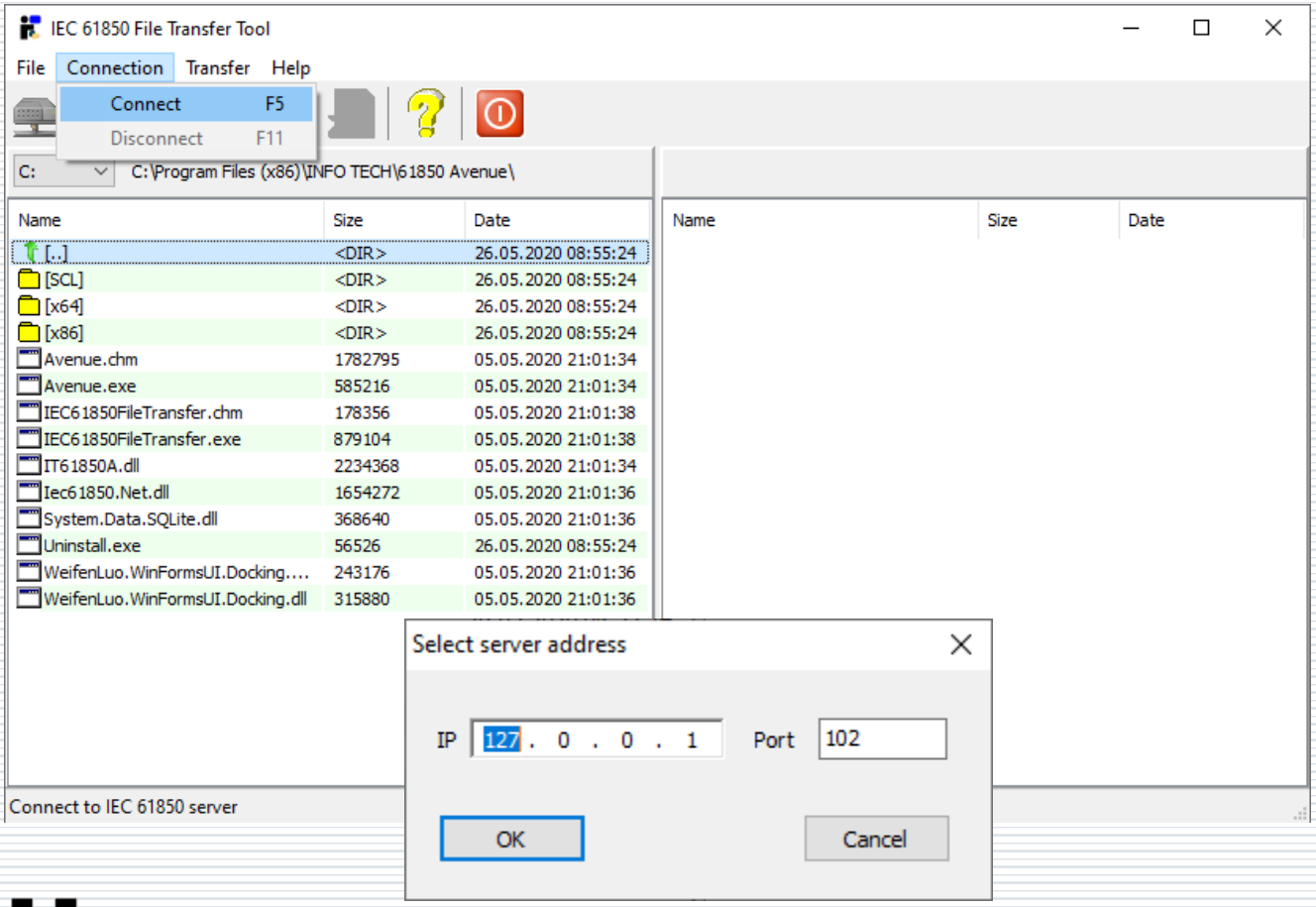
File Transfer Tool – connection to server device as a file server

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

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

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



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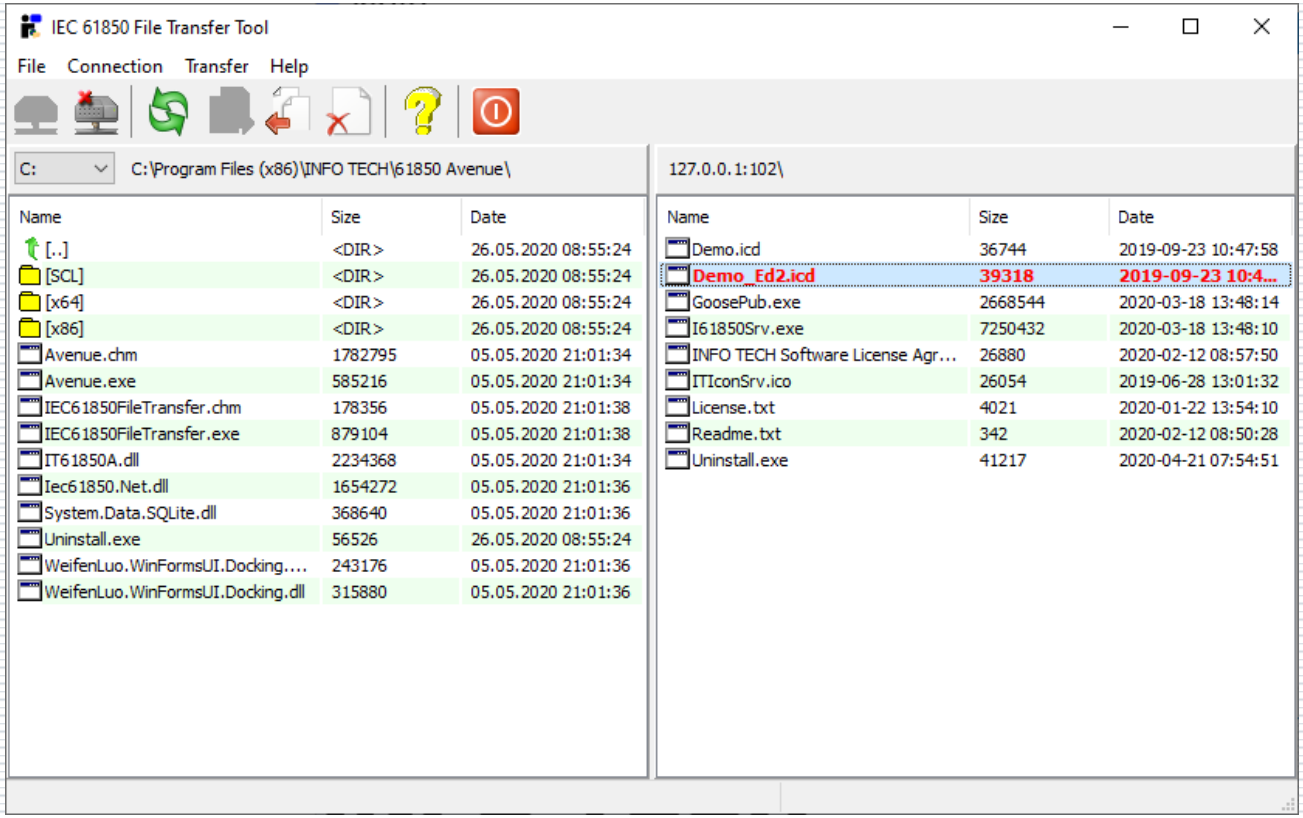
File Transfer Tool – view of the file system in the server device

Note:

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

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



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File Transfer Tool – file transfer operations

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

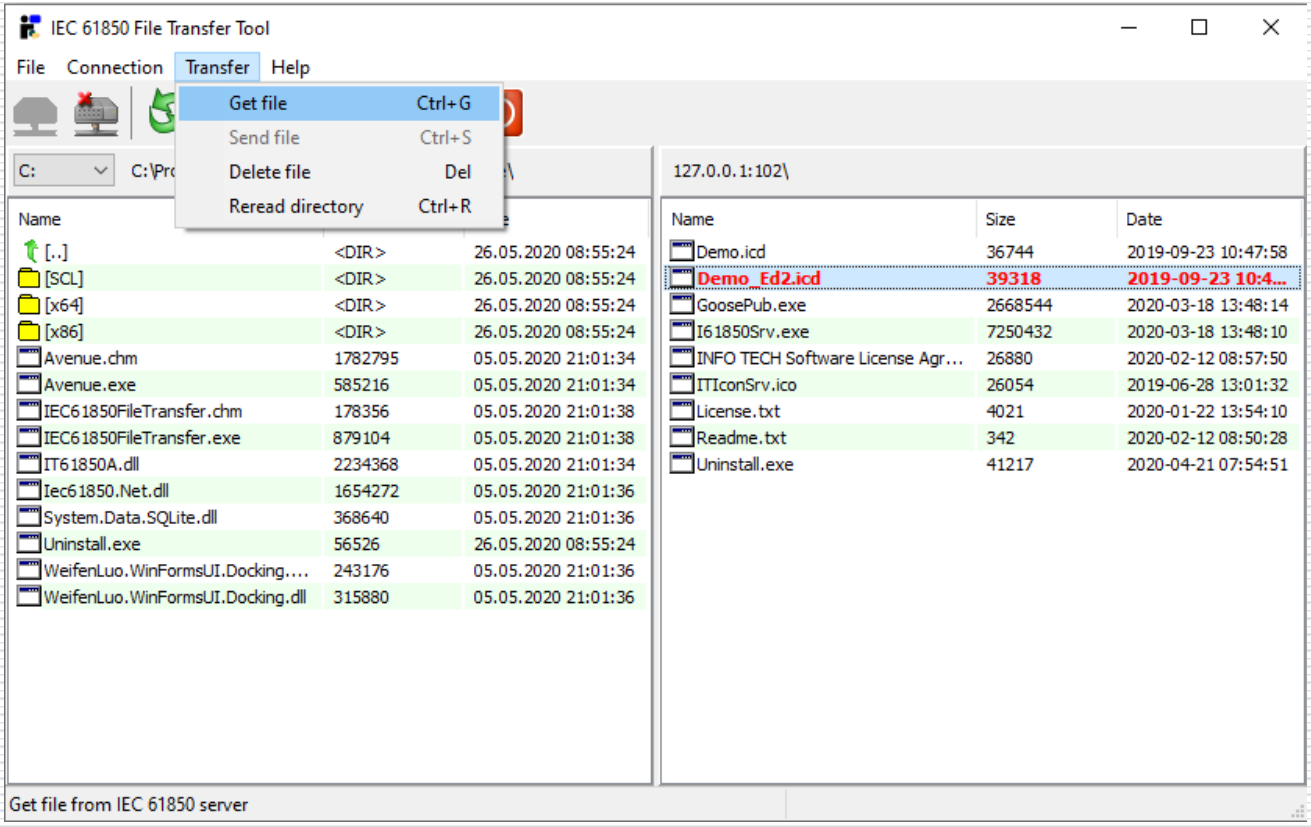
Possible operations in **Transfer** menu:

Get file – file reading from the server

Send file – file writing to the server

Delete file – file removal

Reread directory – refresh of the file list



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61850 ICD Editor

A tool to create and modify SCL files.

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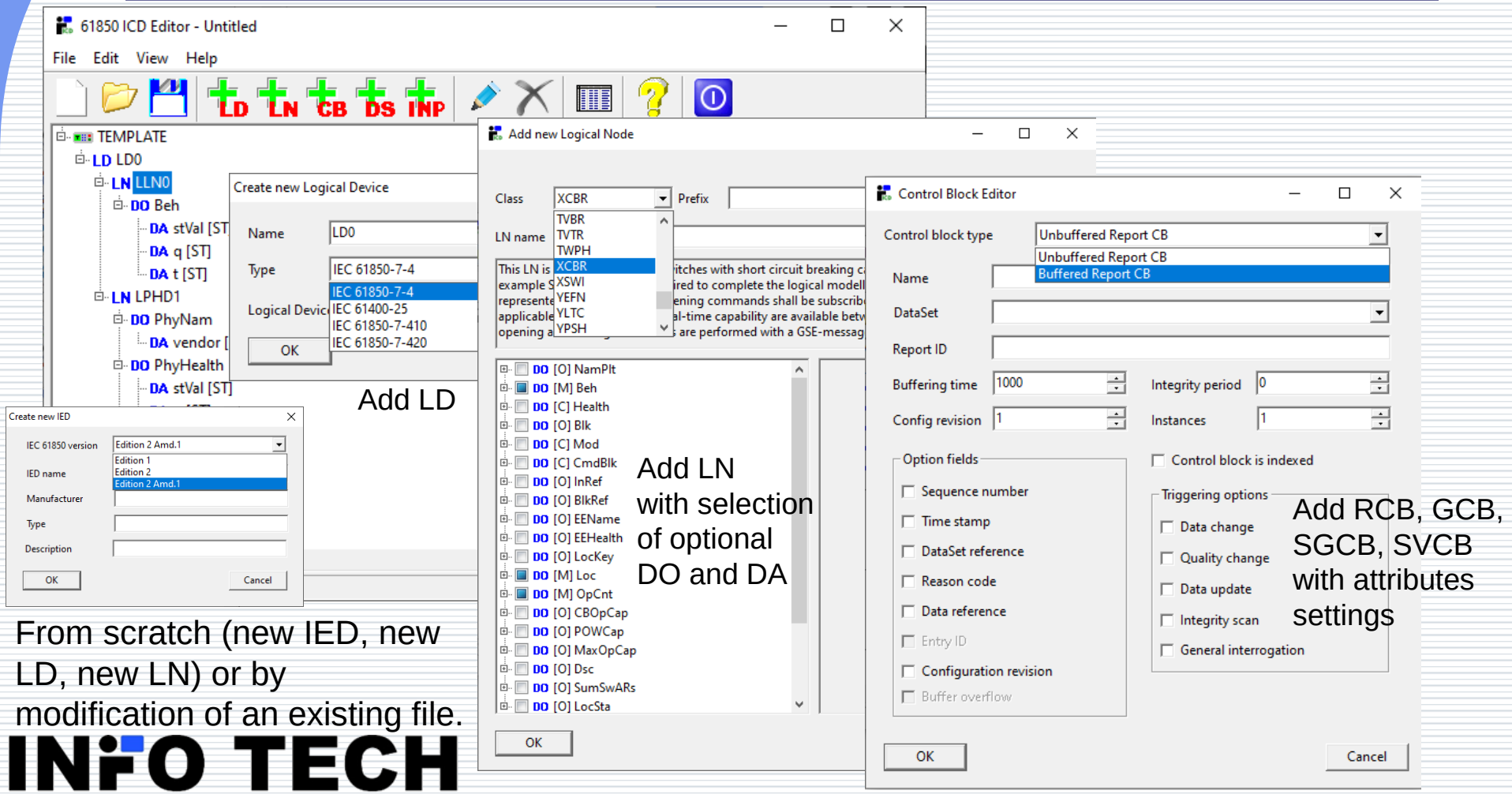
61850 ICD Editor allows to build an ICD file of the server device



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

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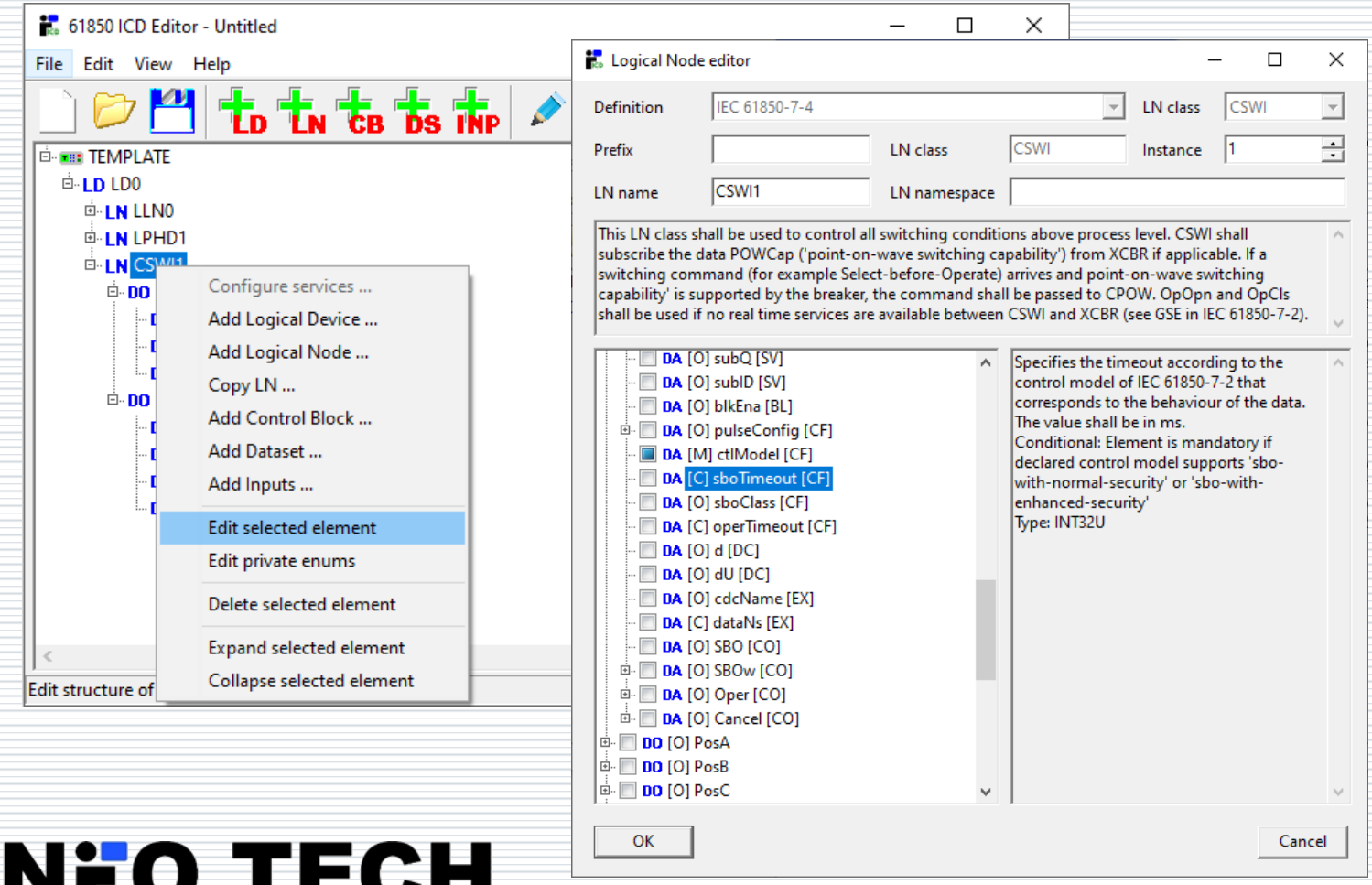
61850 ICD Editor - edting data model



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

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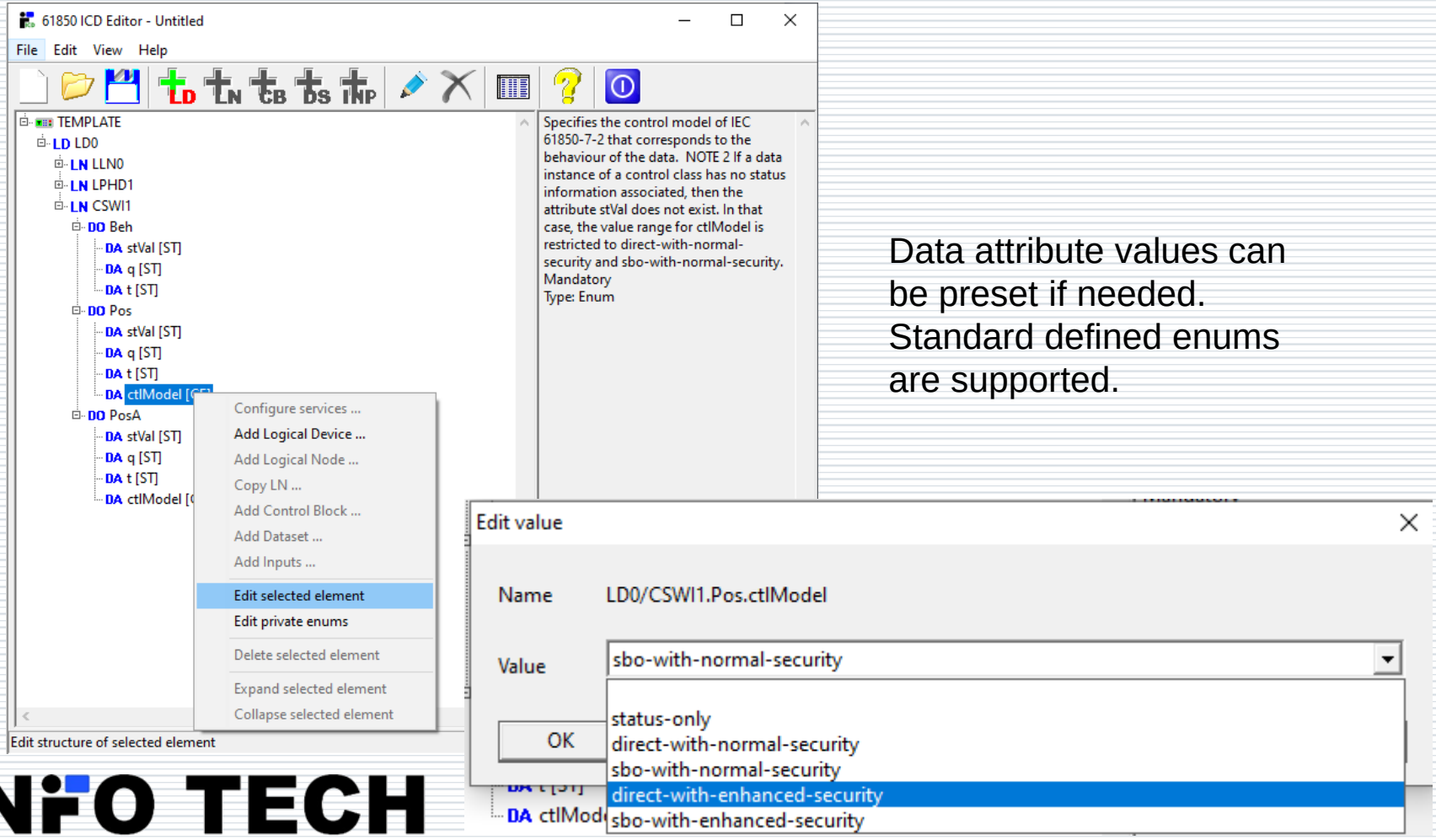
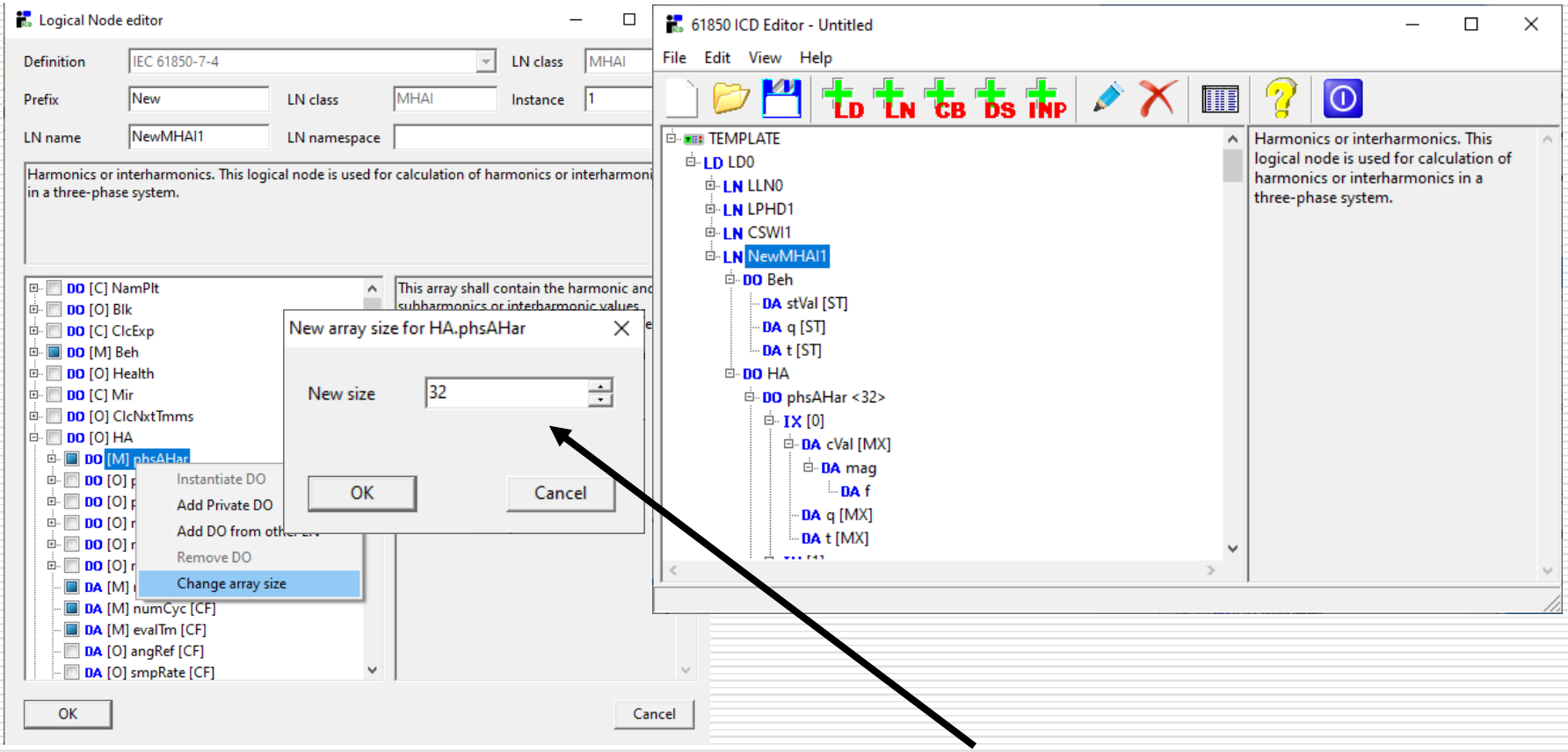
61850 ICD Editor - presetting DA values



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

61850 ICD Editor - LNs with DOs containing array types



Array size can be set (default is 32).

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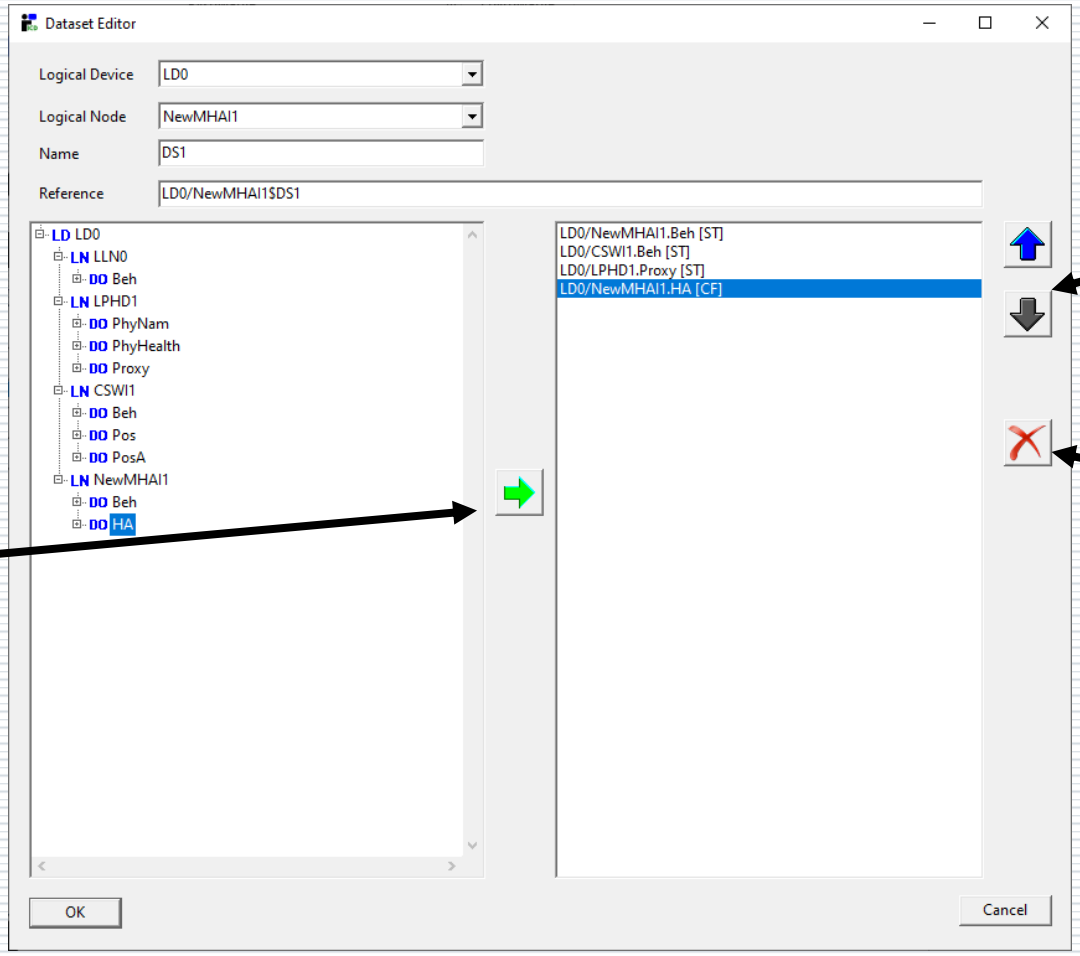
61850 ICD Editor - Dataset creation by selection of elements from the data model

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

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

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



Buttons for changing order of elements in dataset.

Button for removing element of dataset.

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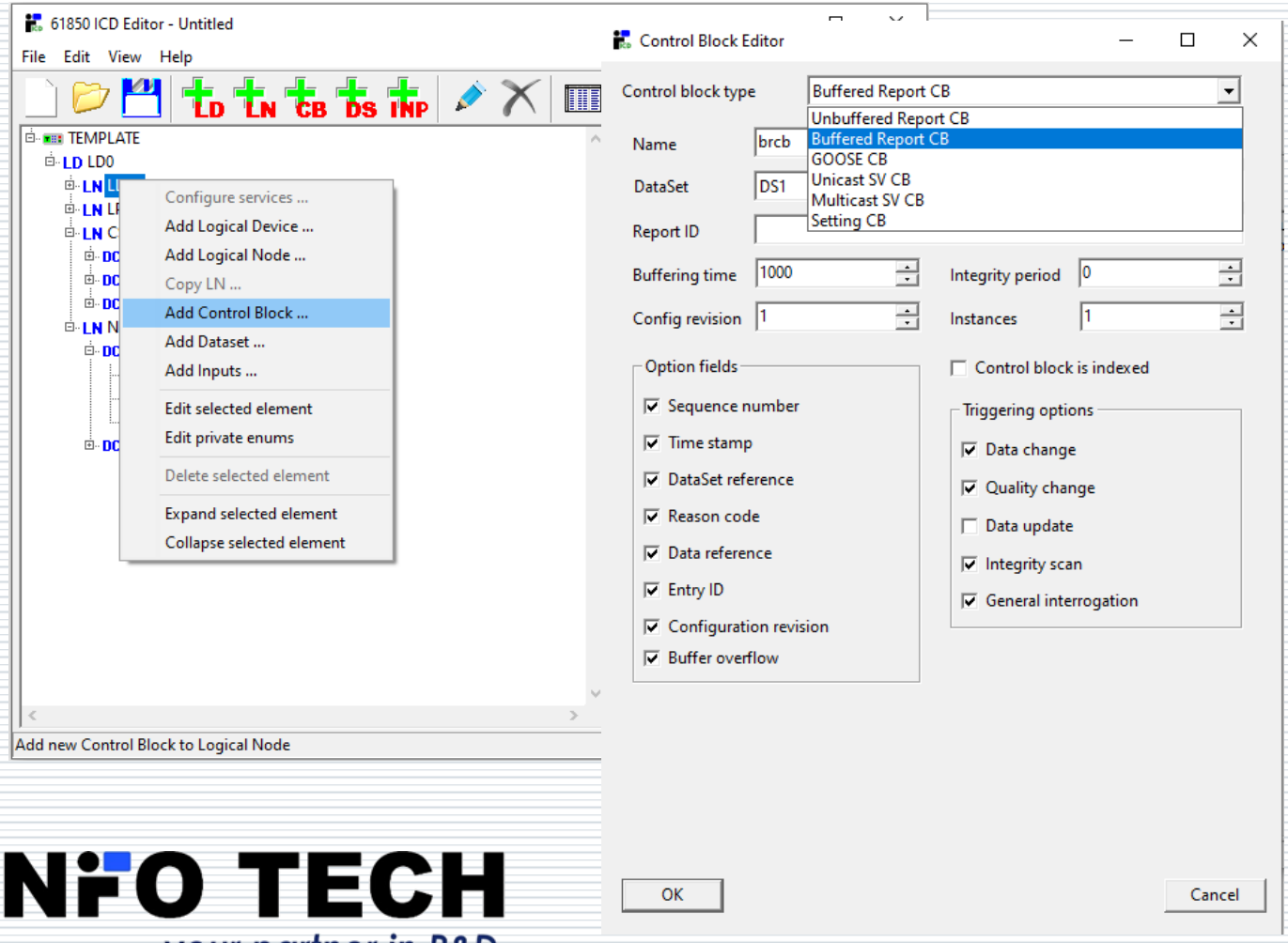
61850 ICD Editor - control blocks



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

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

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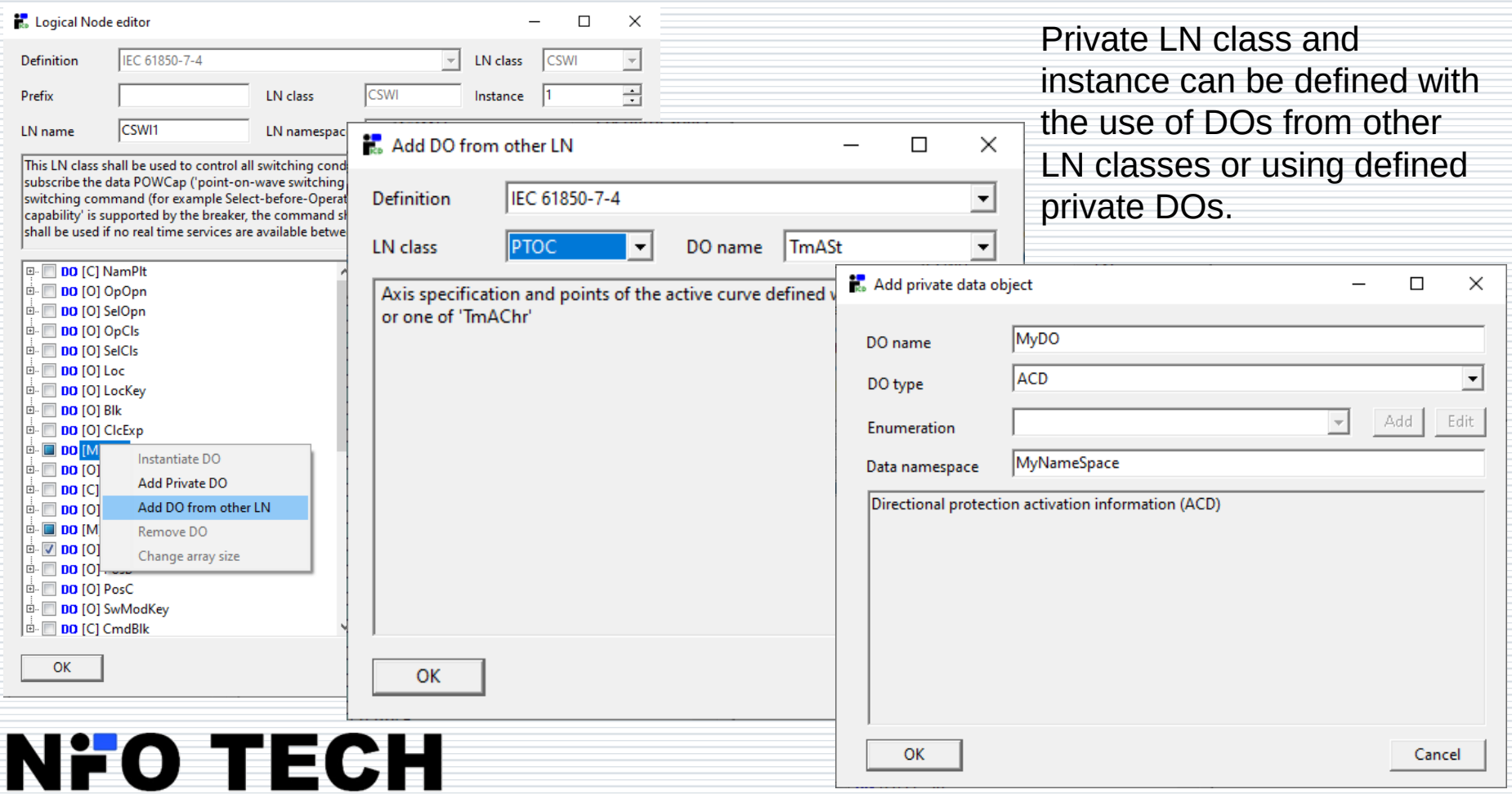
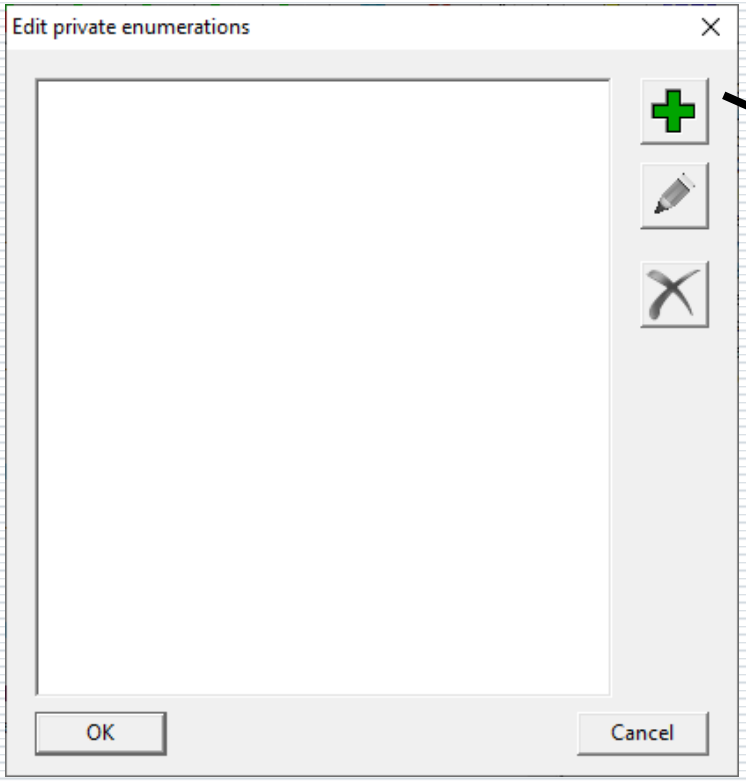
61850 ICD Editor - private Logical Nodes

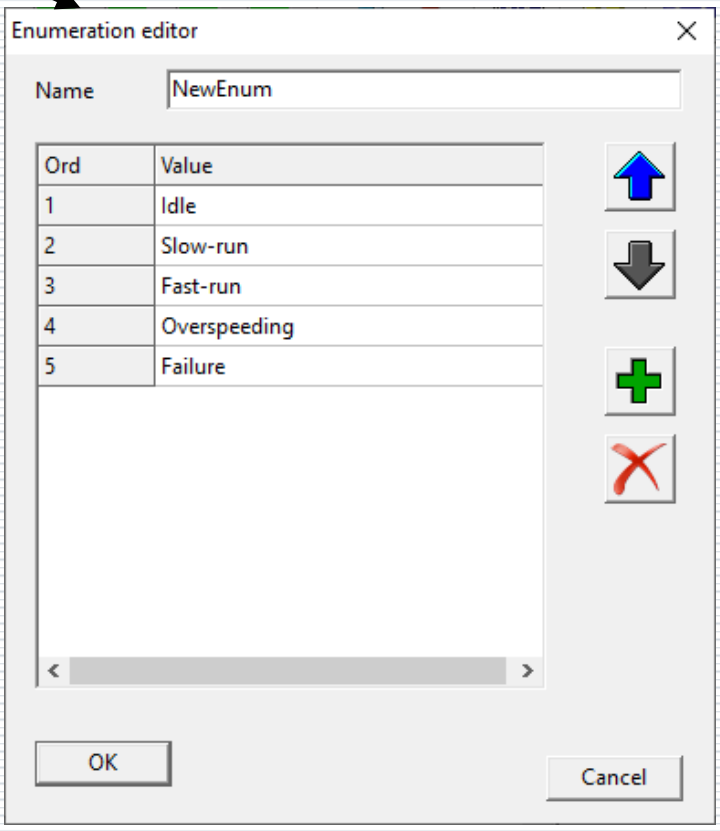


Private LN class and instance can be defined with the use of DOs from other LN classes or using defined private DOs.

61850 ICD Editor – private enums



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



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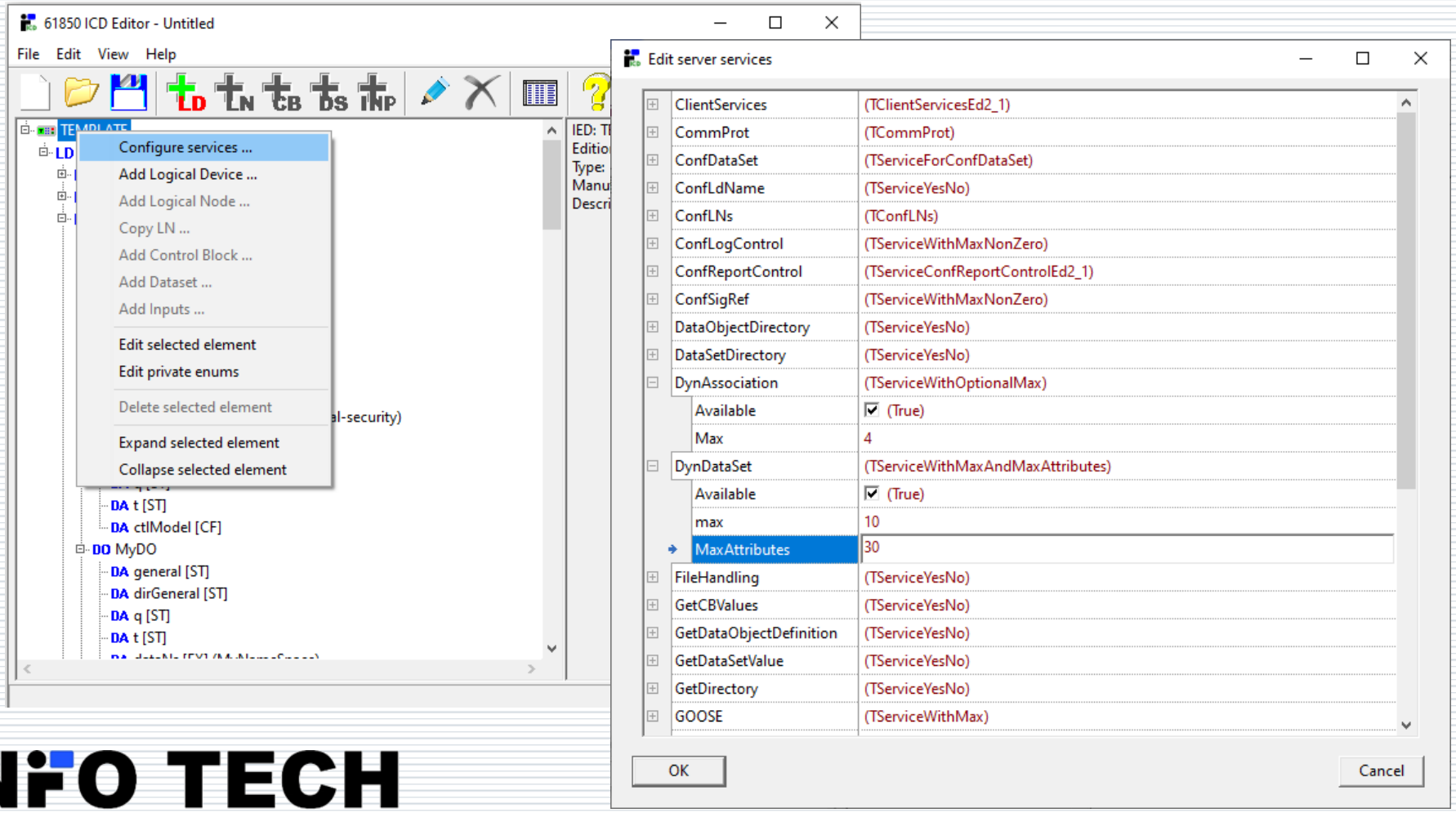
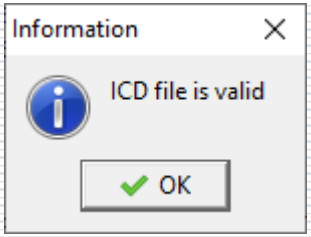
61850 ICD Editor - data model parameters setup

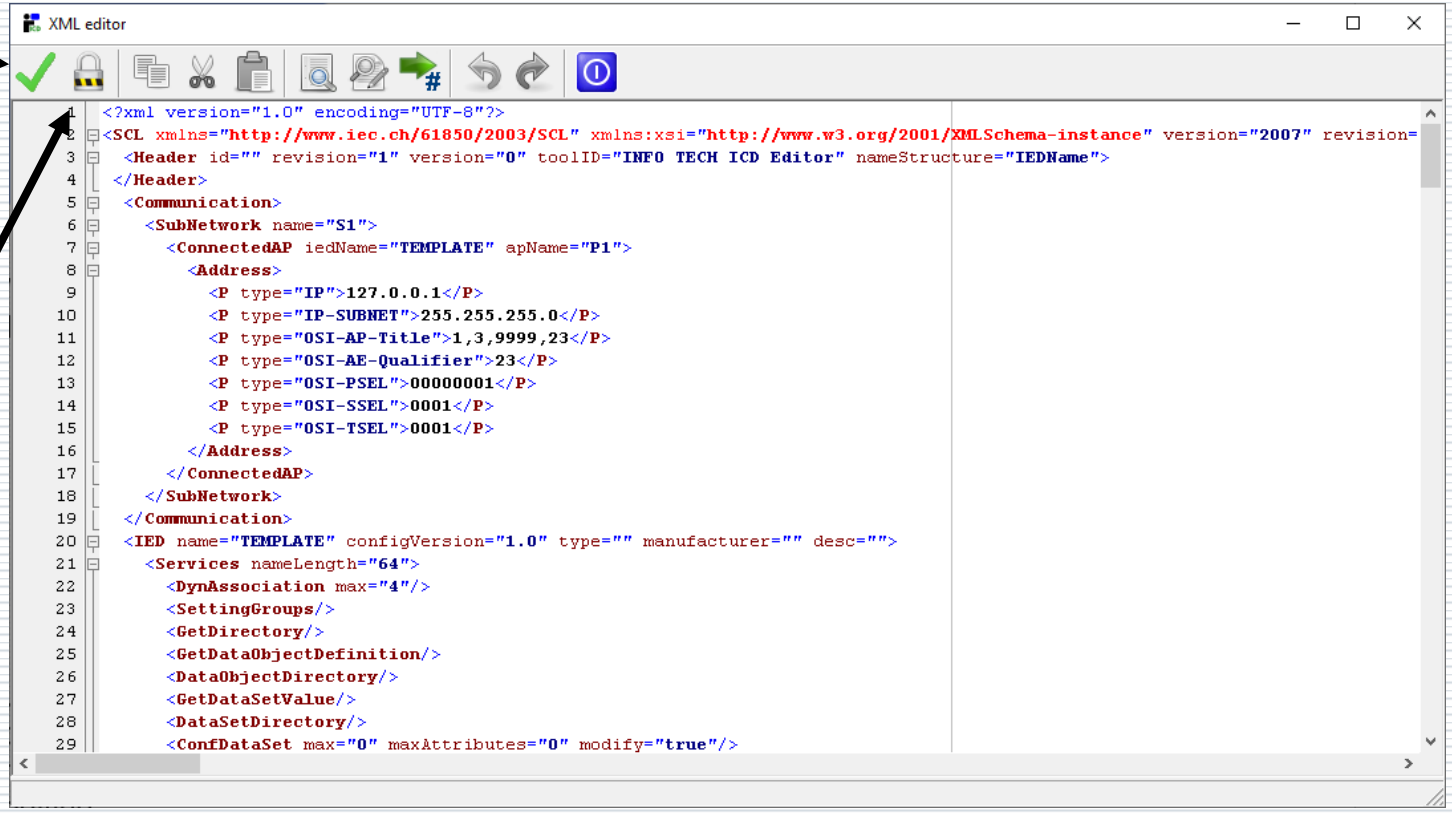


61850 ICD Editor - XML Editor and ICD file validation

Validation check button



Unlock/lock button for manual editing.



Possible applications of 61850 ICD Editor program

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

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