

IEC 61850 Conformance Test Service

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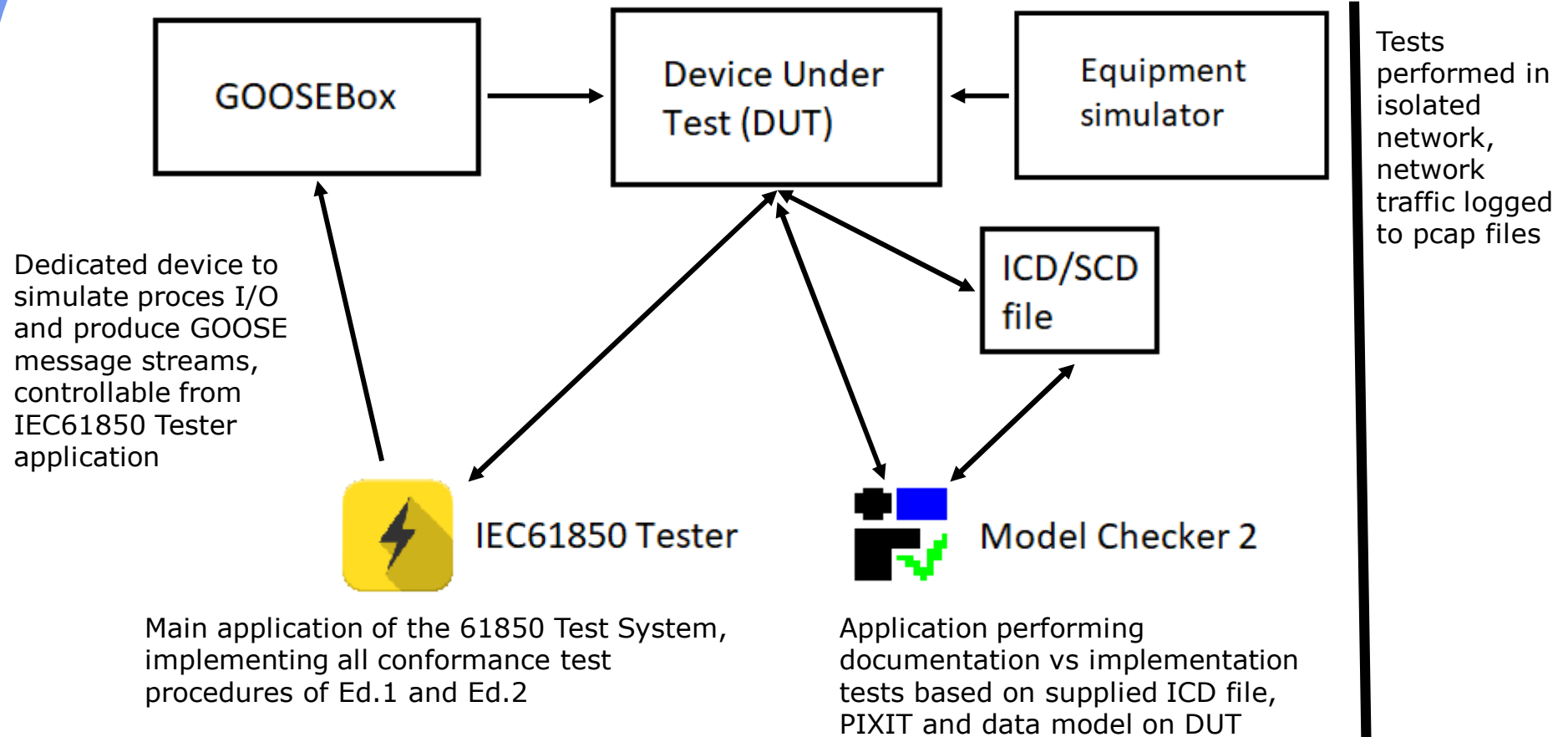
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INFO TECH offers

- ❑ **IEC 61850 conformance testing of server IEDs**
- ❑ Full coverage for all conformance test cases of **Edition 1** and **Edition 2**
- ❑ Automated testing environment – INFO TECH **61850 Tester System**
- ❑ Detailed test report with communication log for each test case
- ❑ Test service based on our experience in:
 - implementing the IEC 61850 source code library,
 - implementing communication interfaces in over 20 devices with confirmed conformance to the standard,
 - technical assistance to deploy IEC 61850 communication in tens of substation installations.
- ❑ Over 10 devices tested during the last 2 years
- ❑ **INFO TECH certificate issued after passing the test**

INFO TECH 61850 Tester System – testing environment



61850 Tester – Basic features

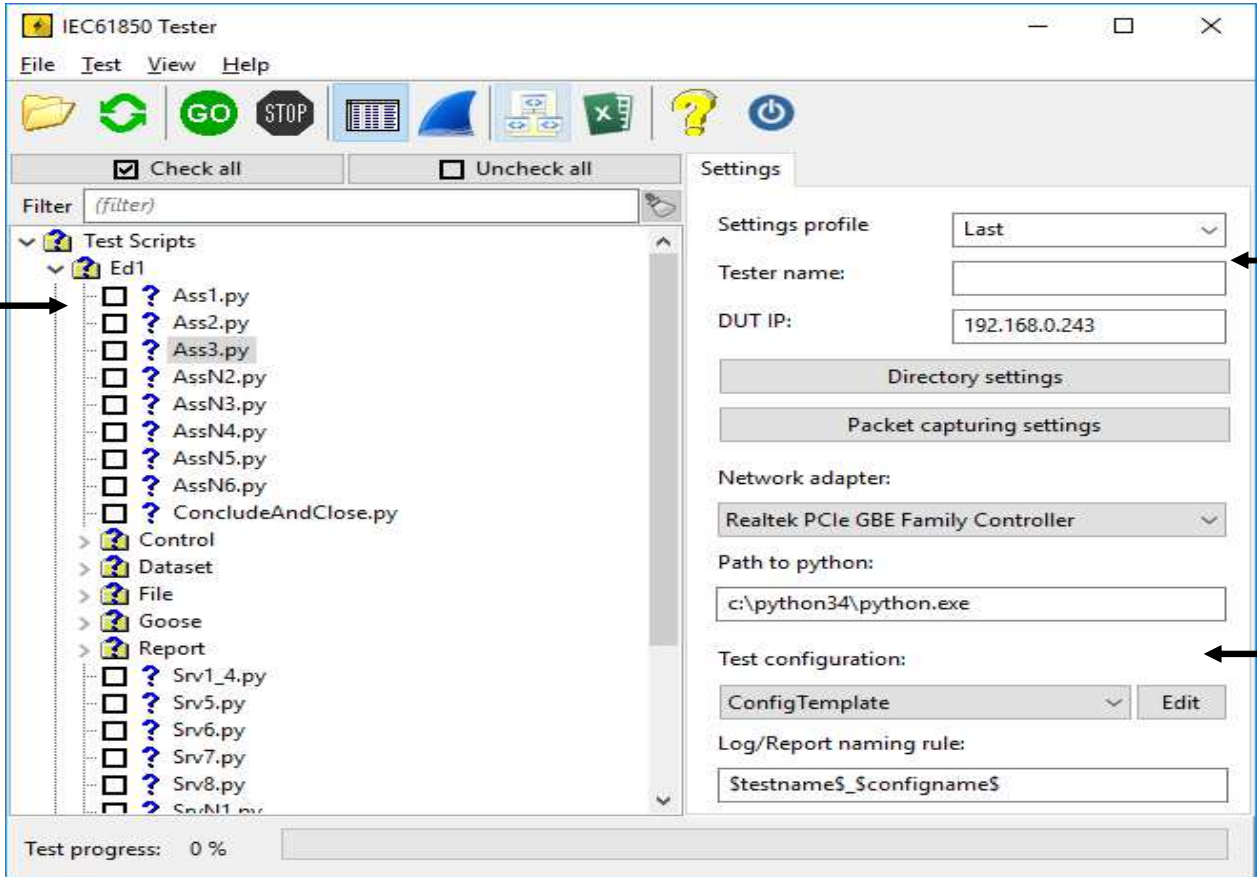
- Automated testing
- Full coverage of IEC 61850 conformance test procedures defined for Edition 1 and for Edition 2 of the standard
- Each test case is represented by a script written in Python
- Editor for creating and modifying test scripts
- Logging of communications with DUT
 - Packet capture to .pcap file
 - Errors and warnings to text file
- Easily configurable for different DUTs

61850 Tester – Basic features

- ❑ IEC 61850 client based on INFO TECH Library (DirectMMS part) with Python wrapper
- ❑ GOOSE communication library written in C++ with Python wrapper
- ❑ Time synchronization test cases written in Python
- ❑ The power and flexibility of Python applied to build test scripts

```
lst = list(map(list, itertools.product([0, 1], repeat=9)))  
lst = [[0]+x for x in lst]  
lst = list(filter(lambda x: Util_FilterSupported(x, suppLst), lst))  
  
DirectMMSWrapper_ClearReports(1)  
print('sBr2.1 Client configures an available BRCB using SetBRCBValues
```

61850 Tester – Initial View



The screenshot displays the IEC61850 Tester application window. The interface includes a menu bar (File, Test, View, Help), a toolbar with icons for file operations and execution (GO, STOP), and a main workspace. On the left, a tree view shows a list of test scripts under 'Test Scripts' and 'Ed1', with checkboxes and status indicators for each file. On the right, a 'Settings' panel is visible, containing fields for 'Settings profile' (Last), 'Tester name', 'DUT IP' (192.168.0.243), 'Network adapter' (Realtek PCIe GBE Family Controller), 'Path to python' (c:\python34\python.exe), and 'Test configuration' (ConfigTemplate). A progress bar at the bottom indicates 'Test progress: 0 %'.

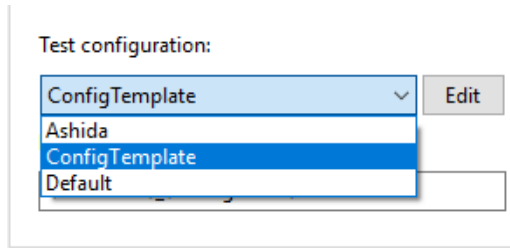
List of all test cases with clear status indication

Easily configurable main settings

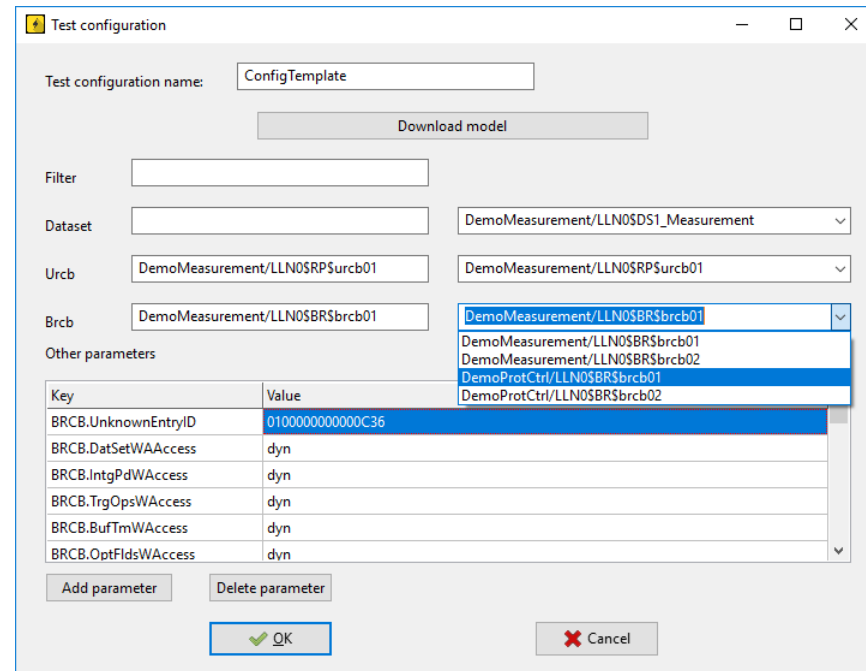
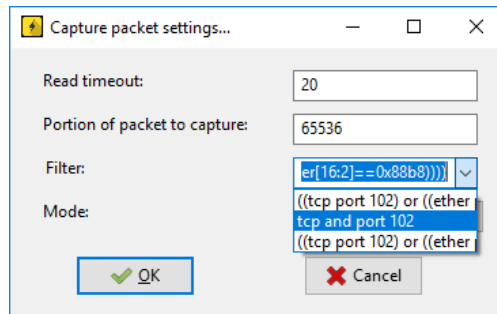
Dedicated test configuration for each DUT.

61850 Tester – Configuration

Selection of test configuration for DUT



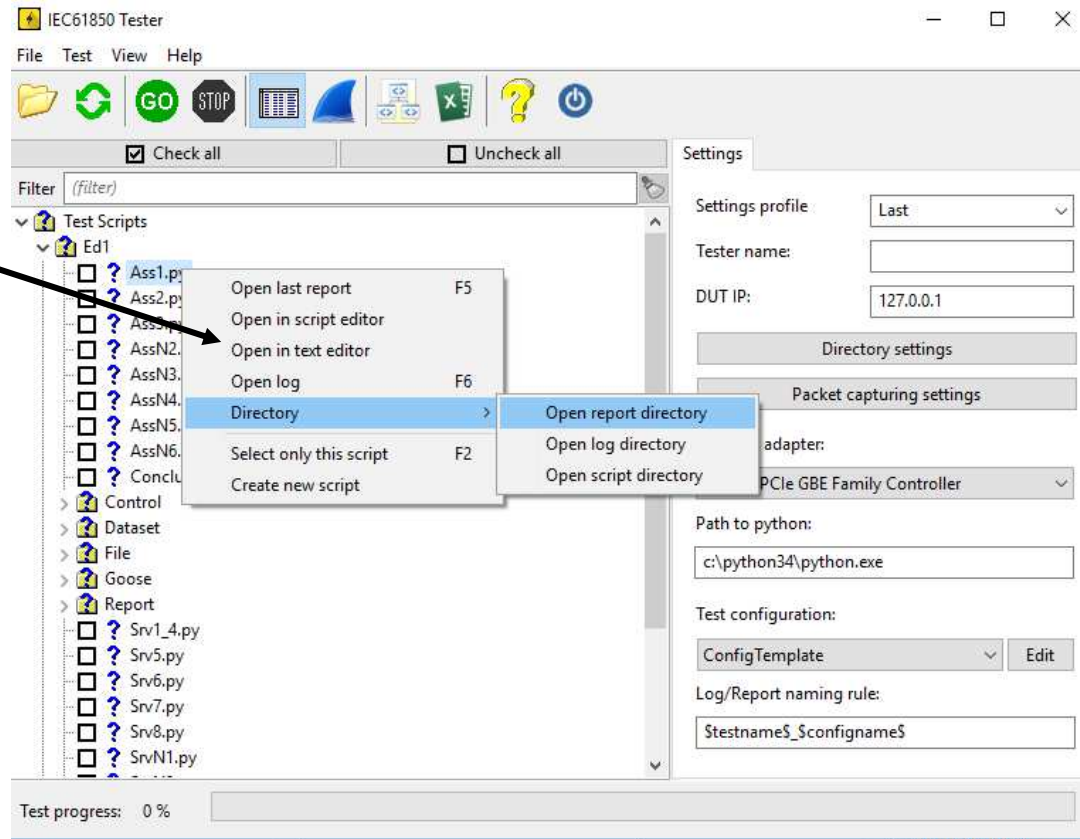
Packet capture settings with lists of capture filters



Editable configuration files. DUT data model can be imported and used for test configuration.

61850 Tester – Files

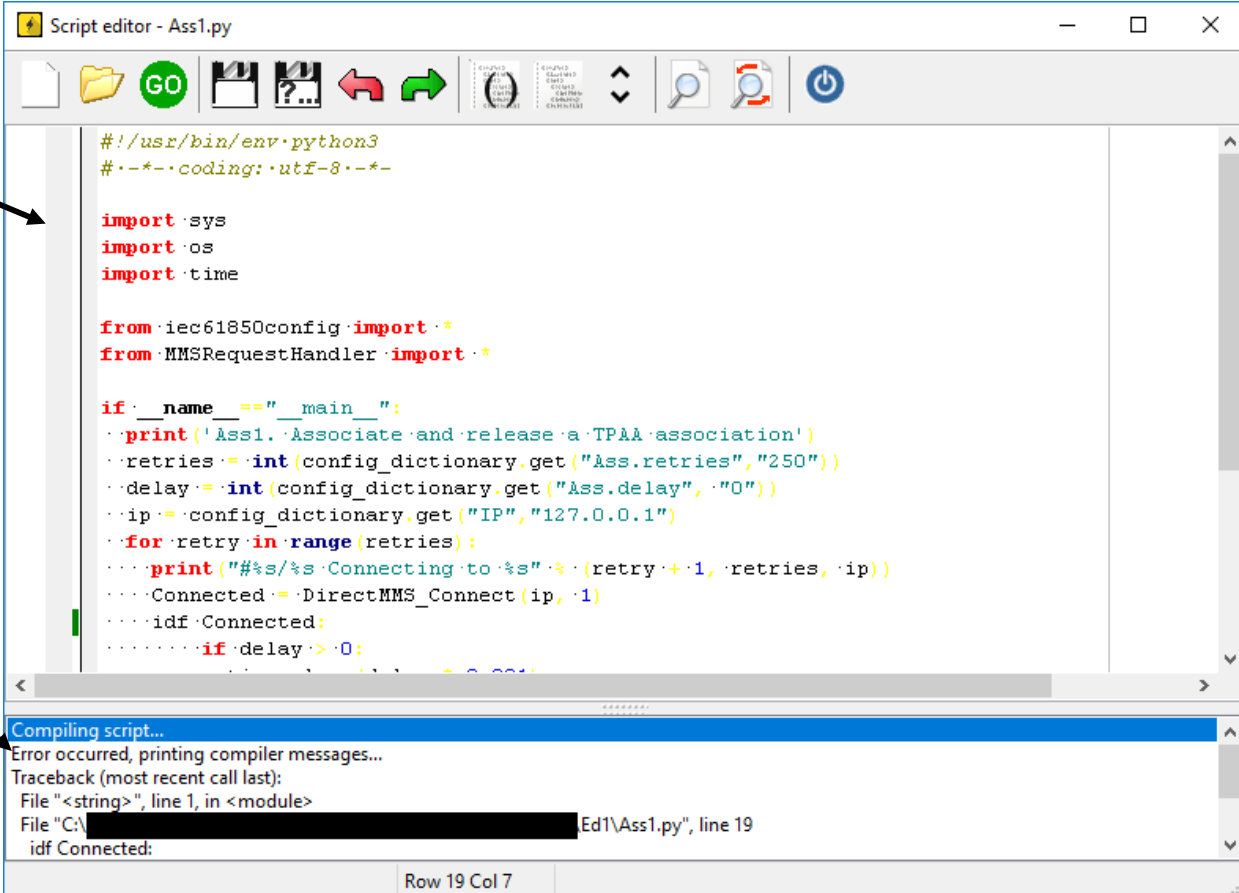
Test case implementation in script file.
Test case results in log file and report file.



61850 Tester – Test case script editor

Built-in editor
with syntax
highlighting

Syntax validator and
error detector



```
#!/usr/bin/env python3
# -*- coding: utf-8 -*-

import sys
import os
import time

from iec61850config import *
from MMSRequestHandler import *

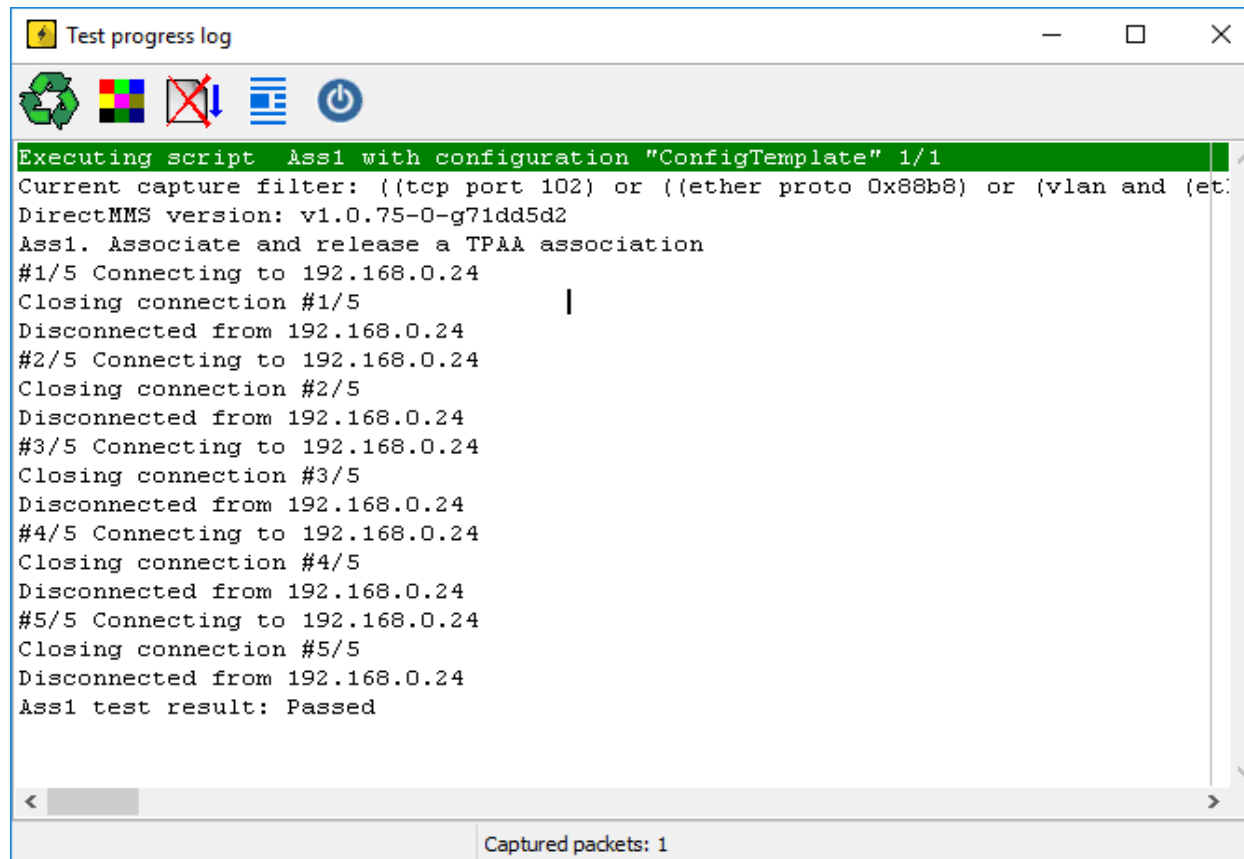
if __name__ == "__main__":
    print('Ass1: Associate and release a TPAA association')
    retries = int(config_dictionary.get("Ass.retries", "250"))
    delay = int(config_dictionary.get("Ass.delay", "0"))
    ip = config_dictionary.get("IP", "127.0.0.1")
    for retry in range(retries):
        print("#%s/%s Connecting to %s" % (retry + 1, retries, ip))
        Connected = DirectMMS_Connect(ip, 1)
        if Connected:
            if delay > 0:
```

Compiling script...
Error occurred, printing compiler messages...
Traceback (most recent call last):
File "<string>", line 1, in <module>
File "C:\[redacted]Ed1\Ass1.py", line 19
idf Connected:

Row 19 Col 7

61850 Tester – Test log

All messages generated by the test script are displayed in a separate window and logged to text file



```
Test progress log
Executing script Ass1 with configuration "ConfigTemplate" 1/1
Current capture filter: ((tcp port 102) or ((ether proto 0x88b8) or (vlan and (et:
DirectMMS version: v1.0.75-0-g71dd5d2
Ass1. Associate and release a TPAA association
#1/5 Connecting to 192.168.0.24
Closing connection #1/5
Disconnected from 192.168.0.24
#2/5 Connecting to 192.168.0.24
Closing connection #2/5
Disconnected from 192.168.0.24
#3/5 Connecting to 192.168.0.24
Closing connection #3/5
Disconnected from 192.168.0.24
#4/5 Connecting to 192.168.0.24
Closing connection #4/5
Disconnected from 192.168.0.24
#5/5 Connecting to 192.168.0.24
Closing connection #5/5
Disconnected from 192.168.0.24
Ass1 test result: Passed
Captured packets: 1
```

Counter for live packet capture

61850 Tester – Test progress

Start/stop
of tests

Filter of
the test
case list

Selection
of test
cases to
run

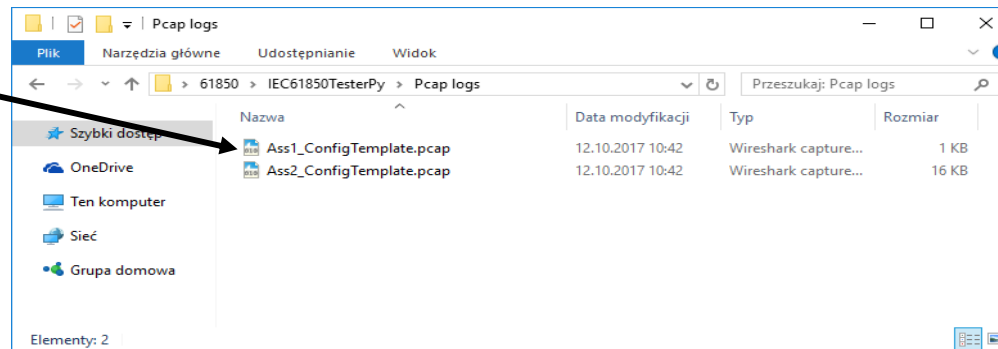
The screenshot displays the IEC61850 Tester application window. The main interface is divided into several sections: a menu bar (File, Test, View, Help), a toolbar with 'GO' and 'STOP' buttons, a 'Settings' panel on the right, and a central area for test scripts. The 'Test Scripts' section shows a tree view with 'Ed1' and 'Ed2' folders. Under 'Ed1', several test scripts are listed: Ass1.py, Ass2.py, Ass3.py, AssN2.py, AssN3.py, AssN4.py, AssN5.py, and AssN6.py. Checkmarks are visible next to Ass1.py and Ass2.py. A 'Test progress' bar at the bottom shows '2/2' completed, with a green bar indicating progress. To the right, a 'Test progress log' window displays the execution details for Ass1 and Ass2, including capture filters, DirectMMS version, and test results. The log for Ass1 shows 'Ass1 test result: Passed' and for Ass2 shows 'Ass2. Associate and client-abort TPAA association'.

Test progress bar

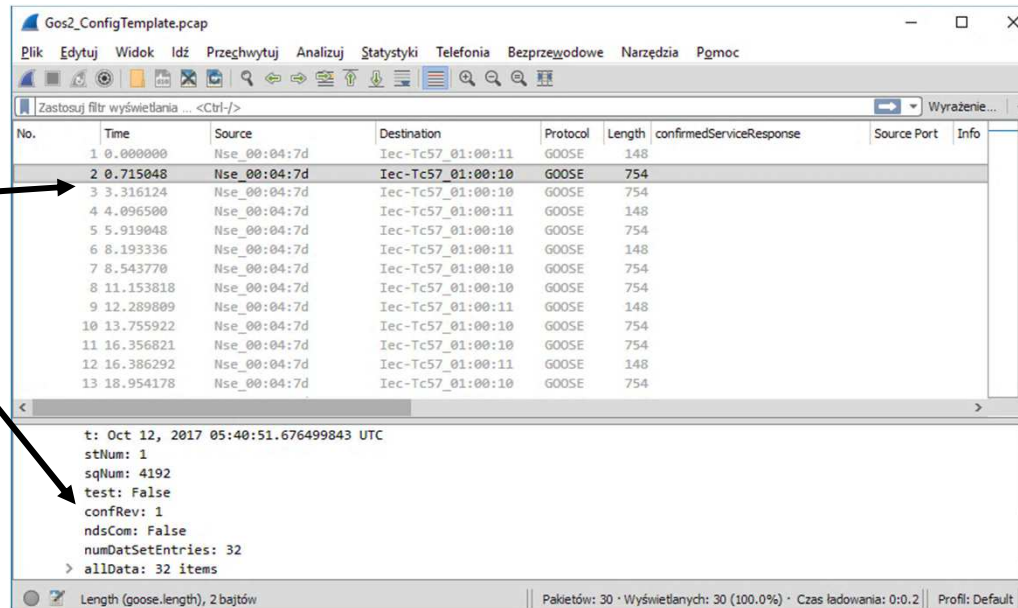
Test cases results
presented by icons
and by conclusions in
the test report view

61850 Tester – Test output

Packet capture file (communication log) for each test case

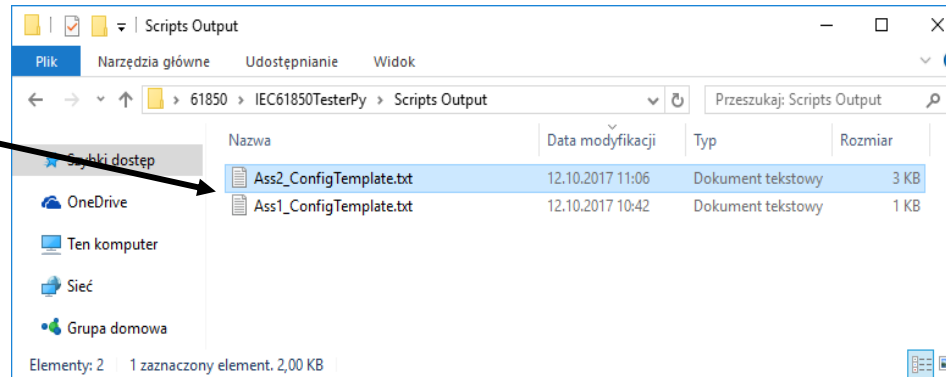


Detailed analysis of DUT behavior possible using e.g. WireShark analyzer



61850 Tester – Test output

Test report file for each test case



Test case conduct is tracable step by step

```
1
2
3 Status: Passed
4 Tester name:
5 Time and date: 10:42:04 12.10.2017r.
6 Filter: ((tcp port 102) or ((ether proto 0x88b8) or (vlan and (ether[16:2]==0x88b8))))
7
8 Selected IP: 127.0.0.1
9
10
11 Current capture filter: ((tcp port 102) or ((ether proto 0x88b8) or (vlan and (ether[16:2]==0x88b8))))
12 DirectMMS version: v1.0.75-0-g71dd5d2
13
14 Ass2. Associate and client-abort TPAA association
15
16 #1/250 Connected to 127.0.0.1
17
18 #1/250 Disconnected from 127.0.0.1
19
20 #2/250 Connected to 127.0.0.1
21
22 #2/250 Disconnected from 127.0.0.1
23
24 #3/250 Connected to 127.0.0.1
25
26 #3/250 Disconnected from 127.0.0.1
27
28 #4/250 Connected to 127.0.0.1
29
```

61850 Tester - GOOSEBox

- Process end simulator for DUT**
- Equipped with 4 controllable output relays to operate on DUT inputs
- Runs IEC 61850 server
- Outputs controllable through MMS or GOOSE communication
- Support for automated testing**

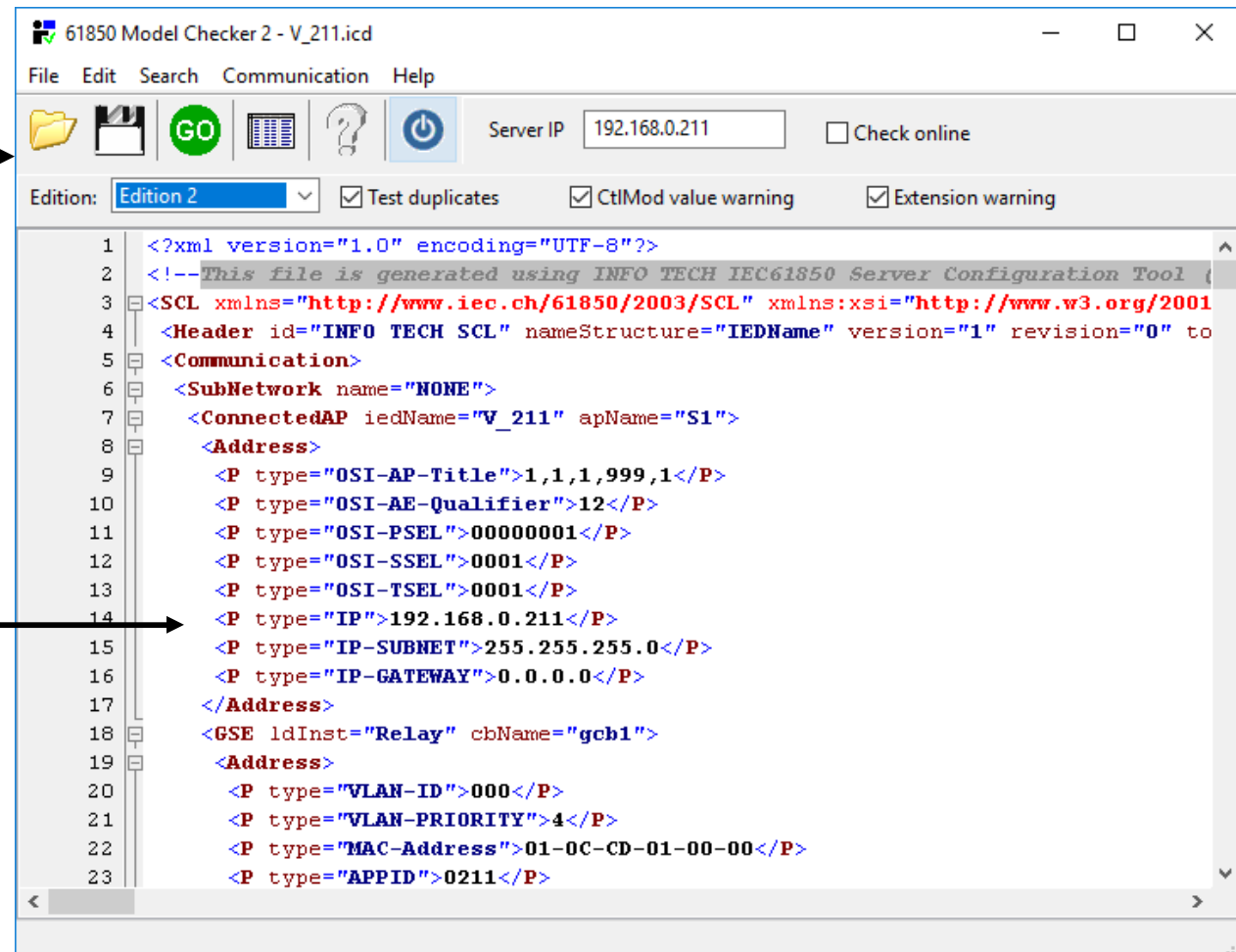
61850 Model Checker 2

- **ICD file check against SCL scheme**
- **Verification of ICD file against on-line exploration**
- Info Tech DirectMMS library used for communication with DUT
- Documentation tests include:
 - Comparing ICD with actual data names, data types, data-sets, pre-defined values exposed by DUT in the network,
 - Verification of proper initialization of control models,
 - Verification of presence of mandatory and conditional objects (true cases),
 - Verification of non-presence of conditional objects (false cases),
 - Verification of data model mapping according to applicable SCSM,
 - Verification of value ranges,
 - Verification of order of data objects,
 - Verification of data model extensions and compliance with the rules.

61850 Model Checker 2 – Initial View

Simple test configuration

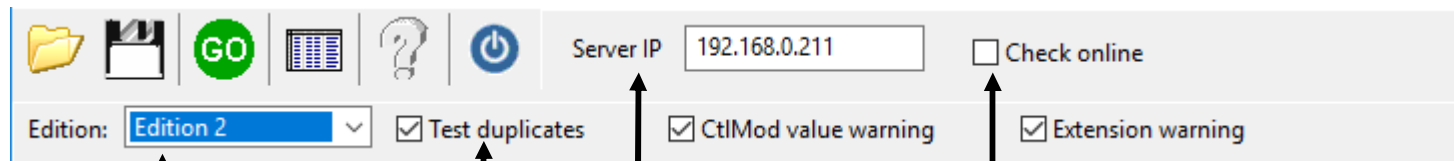
ICD viewer and editor



The screenshot shows the application window for '61850 Model Checker 2 - V_211.icd'. The interface includes a menu bar (File, Edit, Search, Communication, Help), a toolbar with icons for file operations and a 'GO' button, and a configuration area with a 'Server IP' field set to '192.168.0.211' and a 'Check online' checkbox. Below this is an 'Edition' dropdown set to 'Edition 2' and three checked checkboxes: 'Test duplicates', 'CtlMod value warning', and 'Extension warning'. The main area displays an XML configuration file with the following content:

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--This file is generated using INFO TECH IEC61850 Server Configuration Tool
3 <SCL xmlns="http://www.iec.ch/61850/2003/SCL" xmlns:xsi="http://www.w3.org/2001
4 <Header id="INFO TECH SCL" nameStructure="IEDName" version="1" revision="0" to
5 <Communication>
6 <SubNetwork name="NONE">
7 <ConnectedAP iedName="V_211" apName="S1">
8 <Address>
9 <P type="OSI-AP-Title">1,1,1,999,1</P>
10 <P type="OSI-AE-Qualifier">12</P>
11 <P type="OSI-PSEL">00000001</P>
12 <P type="OSI-SSEL">0001</P>
13 <P type="OSI-TSEL">0001</P>
14 <P type="IP">192.168.0.211</P>
15 <P type="IP-SUBNET">255.255.255.0</P>
16 <P type="IP-GATEWAY">0.0.0.0</P>
17 </Address>
18 <GSE ldInst="Relay" cbName="gcb1">
19 <Address>
20 <P type="VLAN-ID">000</P>
21 <P type="VLAN-PRIORITY">4</P>
22 <P type="MAC-Address">01-0C-CD-01-00-00</P>
23 <P type="APPID">0211</P>
```


61850 Model Checker 2 – Configuration



Standard edition is read from ICD file but another edition can be enforced if needed

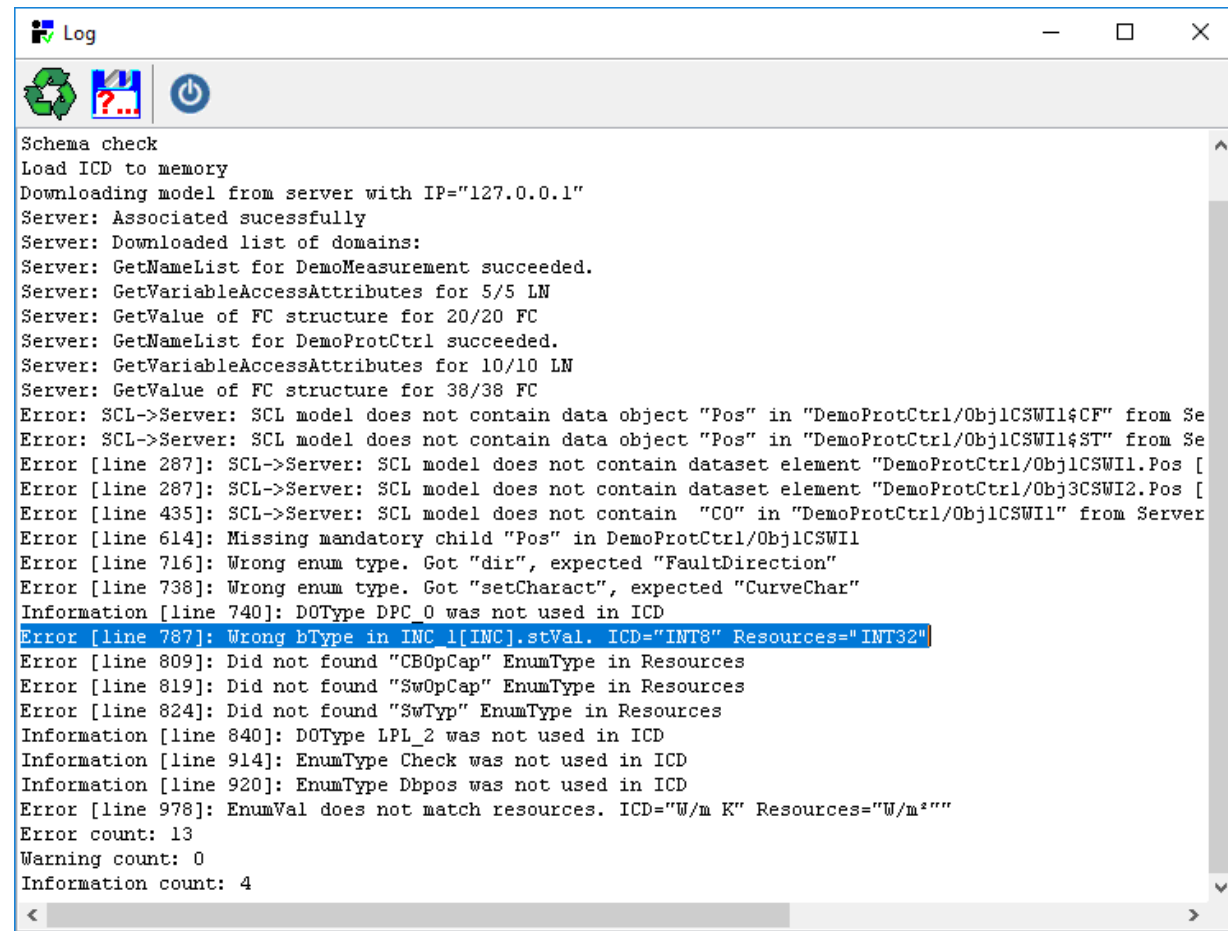
Non-critical warnings can be suppressed

Device IP address read from ICD file

Several test cases done with ICD file without connecting to DUT

61850 Model Checker 2 – Log

After the test completion all information is displayed in the log window and can be saved to a file



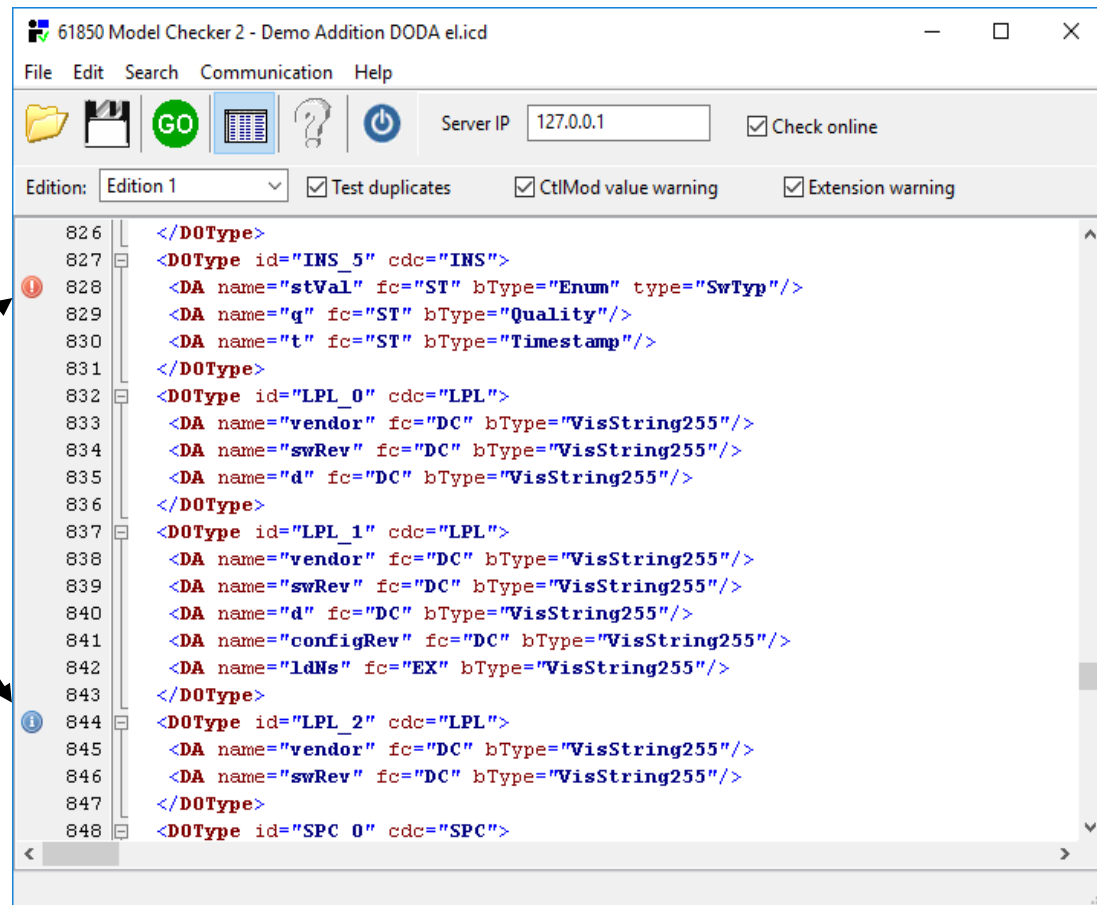
The screenshot shows a window titled "Log" with a toolbar containing icons for refresh, help, and power. The log content is as follows:

```
Schema check
Load ICD to memory
Downloading model from server with IP="127.0.0.1"
Server: Associated successfully
Server: Downloaded list of domains:
Server: GetNameList for DemoMeasurement succeeded.
Server: GetVariableAccessAttributes for 5/5 LN
Server: GetValue of FC structure for 20/20 FC
Server: GetNameList for DemoProtCtrl succeeded.
Server: GetVariableAccessAttributes for 10/10 LN
Server: GetValue of FC structure for 38/38 FC
Error: SCL->Server: SCL model does not contain data object "Pos" in "DemoProtCtrl/Obj1CSWI1$CF" from Se
Error: SCL->Server: SCL model does not contain data object "Pos" in "DemoProtCtrl/Obj1CSWI1$ST" from Se
Error [line 287]: SCL->Server: SCL model does not contain dataset element "DemoProtCtrl/Obj1CSWI1.Pos [
Error [line 287]: SCL->Server: SCL model does not contain dataset element "DemoProtCtrl/Obj3CSWI2.Pos [
Error [line 435]: SCL->Server: SCL model does not contain "CO" in "DemoProtCtrl/Obj1CSWI1" from Server
Error [line 614]: Missing mandatory child "Pos" in DemoProtCtrl/Obj1CSWI1
Error [line 716]: Wrong enum type. Got "dir", expected "FaultDirection"
Error [line 738]: Wrong enum type. Got "setCharact", expected "CurveChar"
Information [line 740]: DType DPC_0 was not used in ICD
Error [line 787]: Wrong bType in INC 1[INC].stVal. ICD="INT8" Resources="INT32"
Error [line 809]: Did not found "CBOpCap" EnumType in Resources
Error [line 819]: Did not found "SwOpCap" EnumType in Resources
Error [line 824]: Did not found "SwTyp" EnumType in Resources
Information [line 840]: DType LPL_2 was not used in ICD
Information [line 914]: EnumType Check was not used in ICD
Information [line 920]: EnumType Dbpos was not used in ICD
Error [line 978]: EnumVal does not match resources. ICD="W/m K" Resources="W/m^2"
Error count: 13
Warning count: 0
Information count: 4
```

61850 Model Checker 2

Built-in editor allows for quick corrections in the tested ICD file to repeat of the test

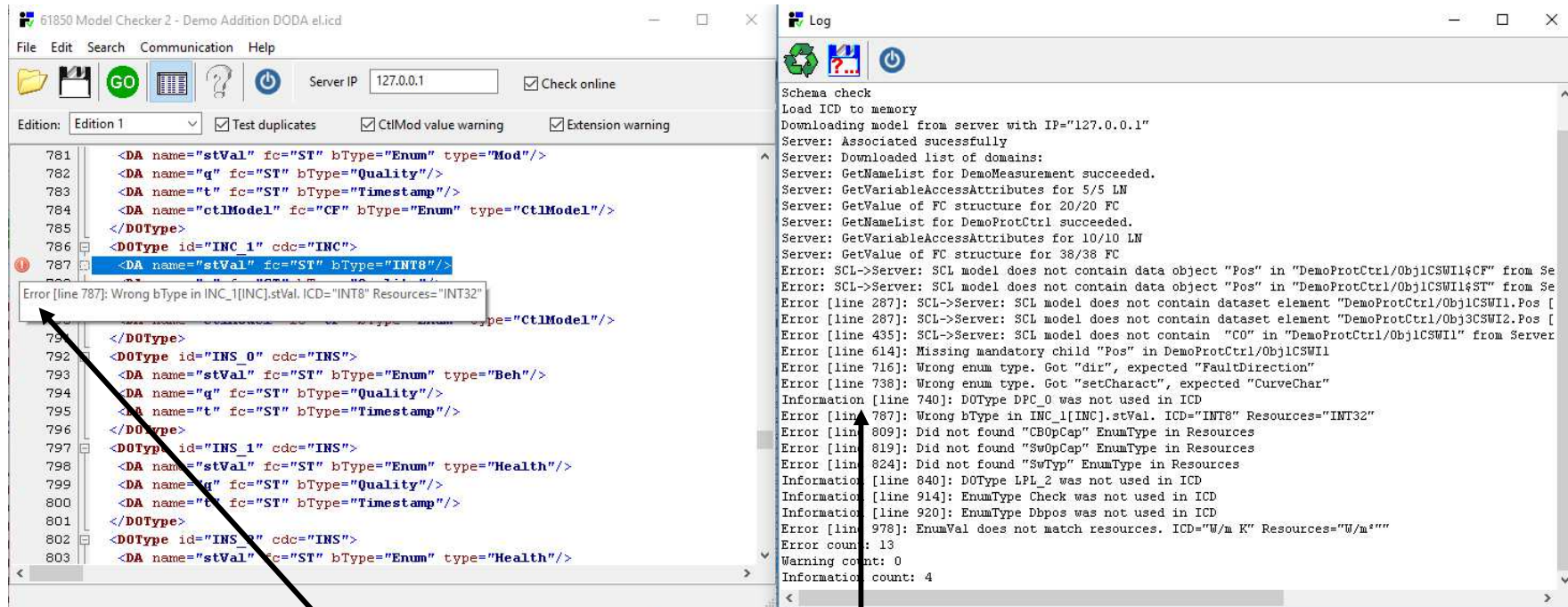
Gutter icons help to locate problems without referring to log window



The screenshot displays the 61850 Model Checker 2 interface. The window title is "61850 Model Checker 2 - Demo Addition DODA el.icd". The menu bar includes "File", "Edit", "Search", "Communication", and "Help". The toolbar contains icons for file operations, a "GO" button, a help icon, and a power icon. The "Server IP" field is set to "127.0.0.1" and the "Check online" checkbox is checked. Below the toolbar, there are checkboxes for "Edition 1", "Test duplicates", "CtlMod value warning", and "Extension warning". The main area shows XML code with line numbers from 826 to 848. Gutter icons are visible on the left side of the code editor, indicating errors or warnings. Two arrows point from the text "Gutter icons help to locate problems without referring to log window" to the gutter icons at lines 828 and 844.

```
826 </DObjectType>
827 <DObjectType id="INS_5" cdc="INS">
828 <DA name="stVal" fc="ST" bType="Enum" type="SwTyp"/>
829 <DA name="q" fc="ST" bType="Quality"/>
830 <DA name="t" fc="ST" bType="Timestamp"/>
831 </DObjectType>
832 <DObjectType id="LPL_0" cdc="LPL">
833 <DA name="vendor" fc="DC" bType="VisString255"/>
834 <DA name="swRev" fc="DC" bType="VisString255"/>
835 <DA name="d" fc="DC" bType="VisString255"/>
836 </DObjectType>
837 <DObjectType id="LPL_1" cdc="LPL">
838 <DA name="vendor" fc="DC" bType="VisString255"/>
839 <DA name="swRev" fc="DC" bType="VisString255"/>
840 <DA name="d" fc="DC" bType="VisString255"/>
841 <DA name="configRev" fc="DC" bType="VisString255"/>
842 <DA name="ldNs" fc="EX" bType="VisString255"/>
843 </DObjectType>
844 <DObjectType id="LPL_2" cdc="LPL">
845 <DA name="vendor" fc="DC" bType="VisString255"/>
846 <DA name="swRev" fc="DC" bType="VisString255"/>
847 </DObjectType>
848 <DObjectType id="SPC_0" cdc="SPC">
```

61850 Model Checker 2

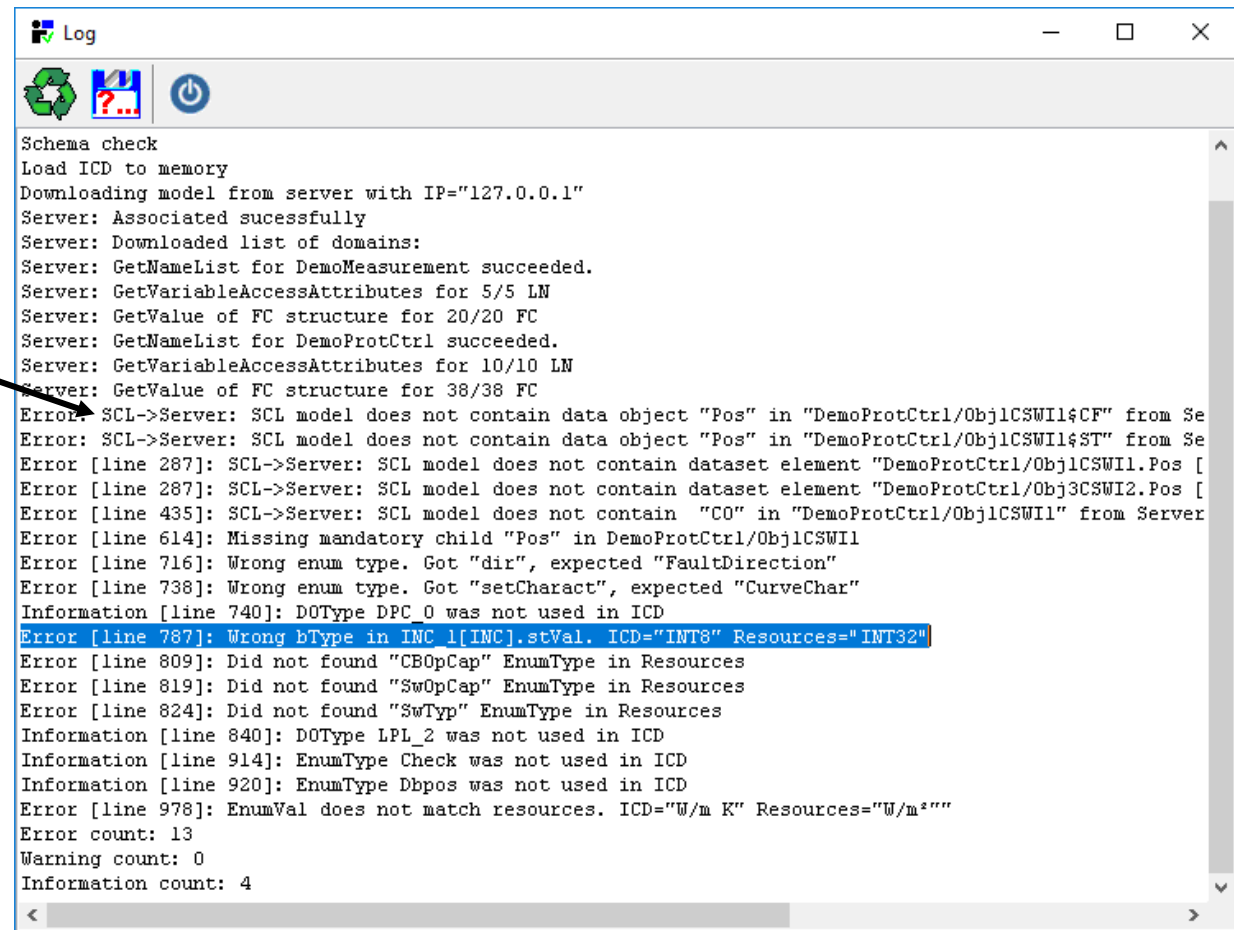


The editor gutter also shows additional information

Double click on error message in the log window moves the cursor to specific line in the editor window

61850 Model Checker 2 – On-line test

Explored data model is checked against ICD file



```
Log
Schema check
Load ICD to memory
Downloading model from server with IP="127.0.0.1"
Server: Associated successfully
Server: Downloaded list of domains:
Server: GetNameList for DemoMeasurement succeeded.
Server: GetVariableAccessAttributes for 5/5 LM
Server: GetValue of FC structure for 20/20 FC
Server: GetNameList for DemoProtCtrl succeeded.
Server: GetVariableAccessAttributes for 10/10 LN
Server: GetValue of FC structure for 38/38 FC
Error: SCL->Server: SCL model does not contain data object "Pos" in "DemoProtCtrl/Obj1CSWI1$CF" from Se
Error: SCL->Server: SCL model does not contain data object "Pos" in "DemoProtCtrl/Obj1CSWI1$ST" from Se
Error [line 287]: SCL->Server: SCL model does not contain dataset element "DemoProtCtrl/Obj1CSWI1.Pos [
Error [line 287]: SCL->Server: SCL model does not contain dataset element "DemoProtCtrl/Obj3CSWI2.Pos [
Error [line 435]: SCL->Server: SCL model does not contain "CO" in "DemoProtCtrl/Obj1CSWI1" from Server
Error [line 614]: Missing mandatory child "Pos" in DemoProtCtrl/Obj1CSWI1
Error [line 716]: Wrong enum type. Got "dir", expected "FaultDirection"
Error [line 738]: Wrong enum type. Got "setCharact", expected "CurveChar"
Information [line 740]: DOType DPC_0 was not used in ICD
Error [line 787]: Wrong bType in INC_1[INC].stVal. ICD="INT8" Resources="INT32"
Error [line 809]: Did not found "CB0pCap" EnumType in Resources
Error [line 819]: Did not found "Sw0pCap" EnumType in Resources
Error [line 824]: Did not found "SwTyp" EnumType in Resources
Information [line 840]: DOType LPL_2 was not used in ICD
Information [line 914]: EnumType Check was not used in ICD
Information [line 920]: EnumType Dbpos was not used in ICD
Error [line 978]: EnumVal does not match resources. ICD="W/m K" Resources="W/m^2"
Error count: 13
Warning count: 0
Information count: 4
```

To discuss and order test service please contact:

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