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Conformance Test Procedures for Server Devices with IEC 61850-8-1 Edition 2 Amendment 1 interface

Revision Rev1.1

On request of the UCA International Users Group

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1.0	Initial version
1.1 DRAFT01	Processed Ed2 redmine issues (from TP2.0.5): • #616 sCnf11 • #644 clause 3.2 - All configuration file and data model tests have been successfully performed for the product variants • #659 sCtl7 Processed Amd1 redmine issues • #635 sTm7 mandatory • #637 sFt4 • #639 Boolean ASN.1 encoding 0x02 for MMS • #640 sMdl6 • #642 sCtl29 removed • #645 SV publish/subscribe testing; PTP and PPS are conditional • ~~#665 sGop3 (TISSUE #1679)~~ • ~~#669 sSg13 (TISSUE #1681)~~ • ~~#670 sMdl22 (TISSUE #1702)~~ • #674 sCtl5 • #678 sCtl28 (#668, #638) • #748 sGos9 • #1793 sGos22 • #3079 sSvp13 conditional
DRAFT02	Removed/undo the TISSUE related issues • Removed sSg13, sMdl22, undo sGop3 changes, empty TICS template Processed Amd1 redmine issue • #666 sGos23 and sSvs15; subscription of test signals Added “with” to the certificate template
DRAFT03	TPWG Aug 24 • sSvp14: Fixed step 5 expected result; MsvID 1 char • #3090 sTm7 • #3103 sCnf121 and new sSvp23 • Added test tool limitation to clause 5.1 and certificate template instructions • Updated certificate template and table A.4.2

Note: the detailed change history is not part of this report but is archived by UCAIug.

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1 INTRODUCTION

1.1 Identifications

The following table gives the exact identification of tested equipment and test environment used for this conformance test.

DUT	<complete description of the device under test, type, hardware / software version>
SV PUBLISH VARIANTS	<F4000S1I4U4, F4800S1I4U4, F4800S2I4U4,..>
SV SUBSCRIBE VARIANTS	<F4000S1I4U4, F4800S1I4U4, F4800S2I4U4,..>
MANUFACTURER	<name, location of the manufacturer of the DUT>
PICS	<complete reference description of the PICS>
MICS	<complete reference description of the MICS>
TICS	<complete reference description of the TICS>
PIXIT	<complete reference description of the PIXIT>
IED tool	<name and version of the IED configuration tool>
ICD/IID	<complete reference description of the ICD/IID file> Note: ICD or IID is required by IEC 61850-6
SCD	Generated by the TEST FACILITY
TEST INITIATOR	<the initiator of the test, name, address, contact person>
TEST FACILITY	<test facility name> <accredited/recognized to issue Level A/B Certificates>
TEST ENGINEER	<name and e-mail address of test engineer>
TEST SESSION	<date and location(s) of the test session>
CLIENT SIMULATOR	<conformance test simulator name, version X.Y with reference test suite, version X.Y>
ANALYSER	<analyzer name, version X.Y>
EQUIPMENT SIMULATOR	<equipment simulator name, version X.Y>
TIME MASTER	SNTP: <name of SNTP time master> PTP: <name of PTP time master> PPS: <name of PPS time master>
DUT variants partly tested	<variant name and description>
ICD/IID variants	<variant ICD/IID reference>

NOTE; the TEST FACILITY or MANUFACTURER can provide the documents in digital or printed format

1.2 Background

<OPTIONAL, short description of *DUT*>

The *TEST FACILITY*'s assignment was to answer the following question:

"Does the protocol implementation of the DUT conform to the Edition 2 of the IEC 61850 standard and the PICS, MICS, PIXIT and ICD specifications as configured with SCD?"

To answer this question, *TEST FACILITY* has performed a **conformance test** of the IEC 61850 implementation in the *DUT*. This test has been performed according procedures and conditions set forth in IEC 61850 part 10 and UCAIUG Quality Assurance Program. *TEST FACILITY* is accredited/recognized by the UCAIUG to perform formal conformance tests and issue the Level A/B UCAIUG certificate.

1.3 Purpose of this document

The purpose of this document is to describe the conformance test procedure and results of the *TEST SESSION* concerning the IEC 61850-8-1 server implementation in the *DUT*.

The test results are the basis of the conformance statement.

1.4 Contents of this document

Chapter 2 shows the list of relevant normative and other references, used to provide input for the conformance test.

Chapter 3 describes the various relevant components for the conformance test and their configuration as used in the conformance test, including the DUT. This chapter also gives an overview and introduction to the various test groups that together constitute the conformance test.

Chapter 4 and 5 give an overview and summary of the test results, the conclusion(s) and recommendations.

Annex A specifies the detailed test procedures and their outcome. Annex B contains detailed comments on test results, for instance when a defect is detected, including the actual message flow if appropriate. Annex C provides a template for TICS documents. This template also specifies the mandatory technical issues. Annex D and E provide templates for the PIXIT document and UCAIUG IEC 61850 Server certificate.

1.5 Glossary

DUT	Device Under Test
ICD	IED configuration description in SCL format
IED	Intelligent Electronic Device
IID	Instantiated IED description file in SCL format
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
TICS	Technical Issues Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PPS	Pulse Per Second
PTP	Precision Time Protocol as specified in IEC/IEEE 61850-9-3
SCD	System configuration description in SCL format
SCL	System Configuration Language
SICS	SCL Implementation Conformance Statement
SNTP	Simple Network Time Protocol
TISSUE	Technical issue
UCAIUG	UCA International Users Group

2 REFERENCES

2.1 Normative

The tests defined in this document are based on the following IEC 61850 documents.

IEC 61850-4, *Communication networks and systems for power utility automation – Part 4: System and project management; Edition 2.0; 2011-04 and Amendment 1; 2020-11*

IEC 61850-6, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs; Edition 2.0; 2009-12 and Amendment 1; 2018-06*

IEC 61850-7-1, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models; Edition 2.0; 2011-07 and Amendment 1; 2020-08*

IEC 61850-7-2, *Communication networks and systems for power utility automation – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI); Edition 2.0; 2010-08 and Amendment 1; 2020-02*

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes; Edition 2.0; 2010-12 and Amendment 1; 2020-02*

IEC 61850-7-4, *Communication networks and systems for power utility automation – Part 7-4: Basic communication structure – Compatible logical node classes and data object classes; Edition 2.0; 2010-03 and Amendment 1; 2020-02*

IEC 61850-8-1, *Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3; Edition 2.0; 2011-06 and Amendment 1; 2020-02*

IEC 61850-9-2, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3; Edition 2.0; 2011-09 and Amendment 1; 2020-02*

IEC 61850-10, *Communication networks and systems for power utility automation – Part 10: Conformance testing; Edition 2.0; 2012-12*

IEC 61869-9, *Instrument transformers – Part 9: Digital interface for instrument transformers; Edition 1.0; 2016-04*

2.2 **Other**

IS 9646 – OSI – Conformance testing methodology and framework

UCA International User Group: Conformance Test Procedures for Server Devices with IEC 61850-8-1 Edition 2 Amendment 1 Interface Revision 1.0, <date of publication>

UCA International User Group: Quality Assurance Program for IEC Device Implementation Testing and Test System Accreditation and Recognition, Version 2.0, 17 June, 2006

UCA International User Group: Quality Assurance Program Addendum for IEC 61850 Specific Product Testing, Version 1.0, March 8, 2006

Edition 2 Amendment 1 technical Issues with category “in force” as published on https://iec61850.tissue-db.com/

Version 2007B3 of the name space definition (nsd) for IEC 61850 7-2, 7-3, 7-4, 8-1 and 9-2 and the SCL schema version 2007B4 as published on http://www.iec.ch/tc57/supportdocuments/

3 THE CONFORMANCE TEST

3.1 Components in the test environment

The test environment consists of the following components:

- DUT with ICT
- CLIENT SIMULATOR
- ANALYSER
- EQUIPMENT SIMULATOR
- SCT SIMULATOR
- Ethernet Switch
- TIME MASTER

In particular for the sampled values part of the test, the equipment simulator, time master and analyzer shall be accurate enough to perform the test.

The equipment simulator shall be able to simulate analogue & digital status signals and analogue & digital measurement signals to perform the applicable test cases.

Figure 3.1 is conceptual. Alternate setup with conventional test set accompanied with a stand-alone digital bridge or a built-in time master are allowed.

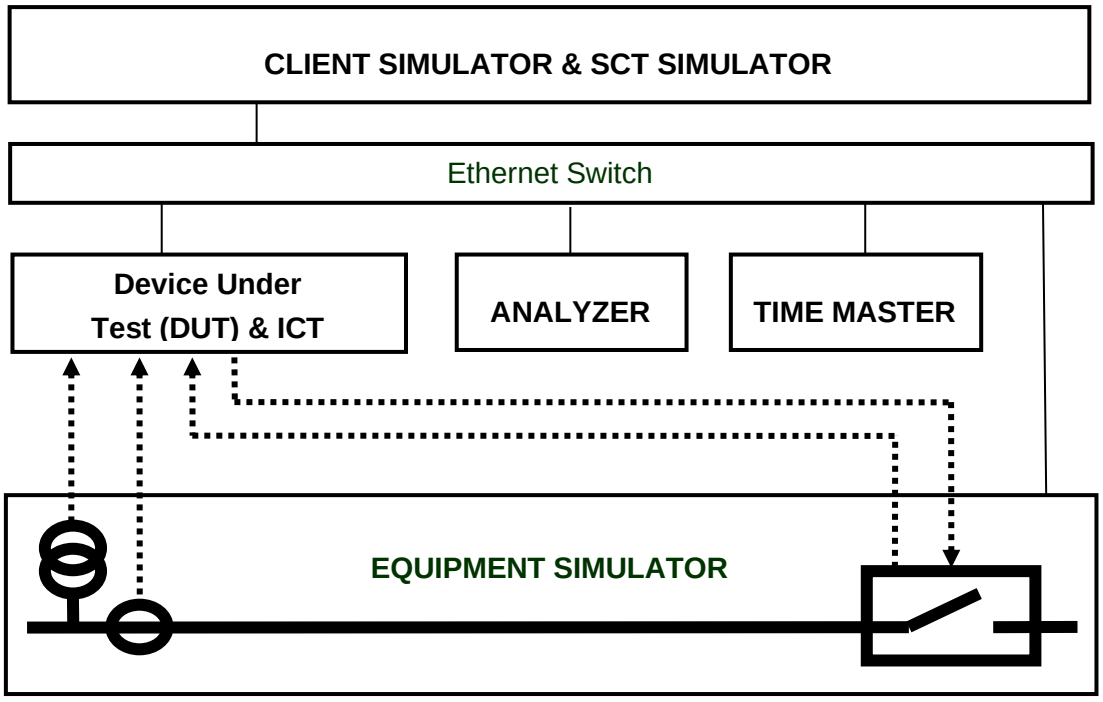


Figure 3.1 The test environment

3.2 Overview of the test suite

The server test cases are structured as follows:

- Documentation and version control (IEC 61850-4)
- Configuration file (IEC 61850-6)
- Data model (IEC 61850-7-3 and IEC 61850-7-4)
- Mapping of ACSI models and services (IEC 61850-7-2, IEC 61850-8-1, IEC 61850-9-2 and IEC 61869-9)
    - Application association
    - Server & Logical Device & Logical Node & Data
    - Data set
    - Service tracking
    - Substitution
    - Setting group
    - Reporting
    - Logging
    - Generic object oriented substation events (GOOSE)
    - Sampled Values

- Control
- Time and time synchronization
- File transfer

The *PICS* is used to select the applicable test procedures to be included in the test.

All configuration file and data model tests have been successfully performed for the product variants.

3.3 General instruction for executing the test suite

The client simulator tool shall use the ASN.1 encoding for boolean using the hexadecimal value 0x02. This verifies that the server inspects the entire octet and not the least significant nor most significant bit.

4 TEST RESULTS

Tables 4.1 and 4.2 in this Chapter give an overview of the conformance test results. References shown in the table columns refer to the individual test procedures in Annex A.

Table 4.1 Overview of applicable server test cases passed for *DUT*

Conformance Block	Mandatory tests	Conditional tests
1a: Basic Exchange		
1b: Associate with IPv6		
2: Data Sets		
2+: Data Set Definition		
3: Substitution		
4: Setting Group Selection		
4+: Setting Group Definition		
5: Unbuffered Reporting		
6: Buffered Reporting		
7: Logging		
9a: GOOSE publish		
9b: GOOSE subscribe		
11a: SV publish		
11b: SV subscribe		
12a: Direct control		
12b: SBO control		
12c: Enhanced Direct Control		
12d: Enhanced SBO control		

Conformance Block	Mandatory tests	Conditional tests
13a: Time sync with SNTP		
13b: Time synch with PTP		
14: File transfer		
15: Service Tracking		

Table 4.2 Overview of applicable test cases failed, inconclusive or comments for *DUT*

Conformance Block	Inconclusive	Failed	Comment
<block>	<testcase>	<testcase>	<testcase>

5 CONCLUSIONS

Based on the test results described in this report, *TEST FACILITY* declares the tested IEC 61850 Edition 2 implementation in the *DUT* has **been shown/not been shown to be non-conforming** to IEC 61850 Edition 2 Amendment 1 part 6, 7-1, 7-2, 7-3, 7-4, 8-1 [and 9-2 and IEC 61869-9 First Edition] as specified in the PICS, MICS, PIXIT, TICS and ICD and configured according to the SCD.

5.1 Comments following from the test

The following comments apply for the *DUT*:
<Comments from *TEST FACILITY*>

Test tool limitations: <testcase> <limitation> or None

ANNEX A – Detailed Test procedures and results

A1 Documentation (IEC 61850-4)

Test case	Test case description	Verdict
sDoc1	Check if the major/minor software version in the PICS documentation and the DUT do match (IEC61850-4). PICS shall contain the ACSI conformance statement according to IEC 61850-7-2 Annex A with applicable extensions from IEC 61850-9-3 and IEC 61869-9	☐ Passed ☐ Failed ☐ Inconclusive
sDoc2	Check if the major/minor software version in the PIXIT documentation and software version of the DUT does match (IEC61850-4). PIXIT shall indicate the required information as requested in the applicable test cases PIXIT shall keep the entry identifiers from the PIXIT template	☐ Passed ☐ Failed ☐ Inconclusive
sDoc3	Check if the major/minor software version in the MICS documentation and software version of the DUT does match (IEC61850-4). MICS shall indicate the semantics of all private/extended Logical Nodes, Data Objects and enumerations. MICS may contain other items in additional sections of the MICS.	☐ Passed ☐ Failed ☐ Inconclusive
sDoc4	Check if the major/minor software version in the TICS documentation and software version of the DUT does match (IEC61850-4). TICS shall indicate that the mandatory and applicable technical issues are implemented	☐ Passed ☐ Failed ☐ Inconclusive

Test case	Test case description	Verdict
sDoc5	Check the ICD if the server capabilities in the IED “services” section(s) do correspond with the ACSI services specified in the PICS SCL Services — PICS DynAssociation max — S2 SettingGroups — S18 || S23 SettingGroups/SGEdit — S19 || S20 || S21 || S22 SettingGroups/ConfSG — no condition in PICS GetDirectory — S1 || S5 || S6 GetDataObjectDefinition — S11 DataObjectDirectory — S10 GetDataSetValue — S12 SetDataSetValues — S13 DataSetDirectory — S16 ConfDataSet max — S12 DynDataSet max — S14, S15 ReadWrite — S8 || S9 || S17 || S54 TimerActivatedControl — S56 GetCBValues — S23 || S25 || S28 || S30 || S38 || S46 || S49 ConfReportControl maxBuf — S25 || S28 ReportSettings resvTms=true — S26 || S29 ConfLogControl — S30 LogSettings — S31 GOOSE goose — S35 publisher GOOSE rGOOSE — PICS 8-1 T8 GSESettings — S39 || S44 GSEDir — S36 || S37 SMVsc sv — S45 || S48 SMVsc rSV — PICS 8-1 T9 SMVSettings synchSrcID, nofASDU — S47 || S50 FileHandling — S57, S60, S61 ConfLNs — no condition in PICS ClientServices goose — S35 subscriber ClientServices rGOOSE — S35 subscriber ClientServices supportsLdName — S35 subscriber ClientServices sv — S45 subscriber ClientServices rSV — S45 subscriber ClientServices TimeSyncProt iec61850_9_3 — T1, T2 T3 ConfLdName — no condition in PICS SupSubscription — no condition in PICS ConfSigRef — no condition in PICS ValueHandling — no condition in PICS RedProt — no condition in PICS CommProt — no condition in PICS	☐ Passed ☐ Failed ☐ Inconclusive
sDoc100	Check if the PICS specifies the conformance class a, b, c or d (when IEC 61869-9 publisher is supported)	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sDoc101	Check if the PICS includes the IEC 61850-9-3 PICS when supported	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

A2 Configuration file (IEC 61850-6)

IEC 61850-6 clause 7 states: “An IED which is claimed to implement a server/publisher or client/subscriber according to the IEC 61850 standard shall be accompanied by an ICD file, respectively by a tool capable of generating an ICD file, or a project specific IID file, respectively a tool capable of generating a project specific IID file for this IED, and shall be able to consume an SCD file or be accompanied by a tool which can consume the SCD file to configure the communication part of the IED from this SCD file, within the limits declared in the ICD file or the IID file produced previously by the IED tool”.

The configuration file test cases are performed on both the *ICD* and *IID* as specified in clause 1.1 unless the test case explicitly specifies otherwise. In case the ICD and/or IID are generated by the IED tool it is not allowed to change these SCL files with external general purpose tools such as for example a general XML editor.

A2.1 SCL Header section

Test case	Test case description	Verdict
sCnf1	Verify the SCL version = “2007”, revision = “B”, release = “4”	☐ Passed ☐ Failed ☐ Inconclusive
sCnf2	Verify the XML encoding is UTF-8 or utf-8; <?xml version=”1.0” encoding=”UTF-8”?>	☐ Passed ☐ Failed ☐ Inconclusive
sCnf3	Verify that the ICD validates according to SCL schema: version 2007, revision B, release 4	☐ Passed ☐ Failed ☐ Inconclusive
sCnf4	Use the ICT tool to export an ICD file. When ICD is not supported export IID file. Use this file for the remaining tests. It is not allowed to change this SCL file with general purpose tools such as an XML editor. Condition: when the ICD is not fixed	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf5	Import the ICD or IID file from sCnf4 into SCT SIMULATOR and generate SCD file with updated IED name, IP/MAC address, datasets, report/GOOSE/SV control block and data flows from other IED’s when supported. Import the SCD file into the ICT tool and select the IED to be handled from IED’s named in the SCD file by IED name	☐ Passed ☐ Failed ☐ Inconclusive

A2.2 SCL Substation section

Test case	Test case description	Verdict
sCnf10	Verify the ICD has at most one Substation or Line or Process exists at SCL level and the attribute “name” is “TEMPLATE”. Condition: when Substation or Line or Process section is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf11	Verify the ICD has none of the LNode bound to an IED different from “TEMPLATE” or “none” Condition: when Substation section is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

A2.3 SCL Communication section

Test case	Test case description	Verdict
sCnf20	Verify that the “Communication” element exists: • IED/Services/DynAssociation or IED/AccessPoint/Services/DynAssociation is declared) and IED/AccessPoint/ Server is declared or • LN0/GSEControl element exist or • LN0/SampledValueControl element exist	☐ Passed ☐ Failed ☐ Inconclusive
sCnf21	For each ConnectedAP/Address element: Verify that exactly one “P” element with attribute type=”OSI-PSEL” with a valid value (non-empty, even number of characters, maximum 16 characters 0-9,A-F) Verify that exactly one “P” element with attribute type=”OSI-SSEL” with a valid value (non-empty, even number of characters, maximum 16 characters 0-9,A-F) Verify that exactly one “P” element with attribute type=”OSI-TSEL” with a valid value (non-empty, even number of characters, maximum 8 characters 0-9,A-F) (Note that if xsi:type mechanism is used then schema validator can automatically verify the type) Condition: IED/Services/DynAssociation is declared	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf22	Verify that for each accesspoint no more than one “P” element with attribute type=”OSI-AP-Title” and “OSI-AE-Qualifier and ”IP” and “IP-SUBNET”, “IP-GATEWAY”, OSI-NSAP, OSI-AP-Invoke, OSI-AE-Invoke and DNSName exists. For each of these that exist: Verify OSI-AP-Title value contains only decimal digits and non-repeating commas Verify OSI-AE-Qualifier value is decimal representation from 0-65535 Verify IP and IP-SUBNET and IP-GATEWAY contain a “standard dotted-decimal” for IPv4 Verify IPv6 and IPv6-SUBNET and IPv6-GATEWAY contain a RFC 4291 address with leading zeros for IPv6 Verify OSI-AP-Invoke and OSI-AE-Invoke values are between 0 and 65535.	☐ Passed ☐ Failed ☐ Inconclusive
sCnf23	For each GSE element: Address/P[type=MAC-Address] right digit of first octet is odd (1,3,5,7,9,B,D,F) (multicast). Address/P[type=VLAN-ID] present Address/P[type=PRIORITY] present Address/P[type=APPID] = 0000-3FFF or 8000-BFFF Condition: when GSE element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sCnf24	For each SMV element referencing a SampledValueControl whose attribute multicast=true or missing, verify Address/P[type=MAC-Address] right digit of first octet is odd (1,3,5,7,9,B,D,F) (multicast) For each SMV element referencing a SampledValueControl whose attribute multicast=false, verify Address/P[type=MAC-Address] right digit of first octet is even (0,2,4,6,8,A,C,E) (unicast) For each SMV element in the ICD: • Address/P[type=VLAN-ID] present • Address/P[type=PRIORITY] = present • Address/P[type=APPID] = 4000-7FFF Condition: when SMV element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf25	Verify the ICD that each Subnetwork/ConnectedAP@iedName is “TEMPLATE”	☐ Passed ☐ Failed ☐ Inconclusive
sCnf26	Verify each Subnetwork/ConnectedAP@apName matches one of IED/AccessPoint@name	☐ Passed ☐ Failed ☐ Inconclusive
sCnf27	Verify for each GSE element, the GSE@cbName points to a GSEControl within the AccessPoint pointed to by GSE//@apName and GSE@ldInst. Condition: when GSE element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf28	Verify for each SMV element, the SMV@cbName points to a SampledValueControl within the AccessPoint pointed to by SMV//@apName and SMV@ldInst. Condition: when SMV element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf29	Verify that at least one SubNetwork type has value “8-MMS” when type is present or type is absent	☐ Passed ☐ Failed ☐ Inconclusive

A2.4 SCL IED section

Test case	Test case description	Verdict
sCnf40	Verify the ICD has exactly one IED element and that the attribute “name” of the element is “TEMPLATE”	☐ Passed ☐ Failed ☐ Inconclusive
sCnf41	Verify all FCDA elements reference existing data and that doName and (optional) daName contain correct references. (ref 61850-6 §9.3.7 Table 22). • Verify attributes ldInst, lnClass, doName, and fc are declared. • Verify attribute lnInst is declared if lnClass is not “LLN0”. • Verify first component of doName references a DO@name and second component (if any) references a SDO@name within DO referenced by first component • Verify first component of daName (if present) references a DA@name and other component (if any) references a BDA@name within structure hierarchy of the DA referenced by first component • Verify that at most one component of doName/daName contains an index and that ix attribute is identical to this index (see 61850-6 Table 22). Valid example:<FCDA ldInst=”LD0” lnClass=”MHAI” lnInst=”1” fc=”MX” doName=”HA.phsAHar**(0)**” daName=”cVal.mag.f” ix=”0” />	☐ Passed ☐ Failed ☐ Inconclusive
sCnf42	Verify DOI/SDI/DAI structures match DataTypeTemplates (DOI@name is valid DO in LD/LN and DAI@name is a leaf within that DO and SDI@name form hierarchy between DOI and DAI)	☐ Passed ☐ Failed ☐ Inconclusive
sCnf43	Verify that the ICD has none of the ExtRef references IEDs different from TEMPLATE or “@” Condition: when ExtRef iedName attribute is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf44	Verify that the ICD has no ClientLN elements exist within ReportControl and no IEDName elements within GSEControl and SampledValueControl	☐ Passed ☐ Failed ☐ Inconclusive
sCnf45	Verify all GSEControl/SampledValueControl/ReportControl have confRev>0 when datSet is not empty	☐ Passed ☐ Failed ☐ Inconclusive
sCnf46	Verify IED@originalSclVersion, IED@originalSclRevision and IED@originalSclRelease attributes match corresponding attributes of SCL element (SCL@version, SCL@revision and SCL@release)	☐ Passed ☐ Failed ☐ Inconclusive
sCnf47	Verify multiple identically named DOI/SDI/DAI elements at the same level differ by “ix” attribute (either different “ix” or “ix” attribute not present). Condition: when DOI/SDI/DAI ix attribute is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sCnf48	Verify multiple LLN0.SGCB do not appear in the same logical device hierarchy (defined by LLN0.GrRef which references the parent logical device) Condition: when multiple SGCB are present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf49	Verify element “Log” exists only in LLN0 Condition: when Log is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf50	Verify that the name length of IED, Logical Devices, Logical Nodes, data objects, data attributes, data sets and control blocks do not exceed the maximum length as specified in IEC 61850-7-2 clause 22.2 and SCSM	☐ Passed ☐ Failed ☐ Inconclusive
sCnf51	Verify that logical node LPHD is present in each root logical device (IEC 61850-7-1 clause 8.2.5)	☐ Passed ☐ Failed ☐ Inconclusive
sCnf52	Verify that DUT/tool can import file with GSEControl in multiple LN0 Add one GSEControl to first and last LN0 in the configuration of the device Condition: Services/GSESettings attribute cbName is not “fix” or absent and multiple Logical Devices exist and GOOSE max > 1	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

A2.5 SCL IED Services section

Test case	Test case description	Verdict
sCnf60	Verify that the attribute nameLength=”64” exists in the IED/Services element	☐ Passed ☐ Failed ☐ Inconclusive
sCnf61	Verify that the Services section must not contradict existing control block and data sets; • Nr of DataSet elements <= ConfDataSet.max (if provided). • Nr of ReportControl instances <= ConfReportControl.max (if provided) • Nr of Buffered ReportControl instances <= ConfReportControl.maxBuf (if provided) • Nr of GSEControl <= GOOSE.max (if provided) • Nr of SMVControl <= SMVsc.max (if provided) • Nr of LogControl <= ConfLogControl.max (if provided) • Nr of LGOS instances <= SupSubscription.maxGo (if provided) • Nr of LSVS instances <= SupSubscription.maxSv (if provided)	☐ Passed ☐ Failed ☐ Inconclusive
sCnf62	Verify the AccessPoint/Services element does not contain the attribute nameLength Condition: when AccessPoint Services element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sCnf63	Verify AccessPoint/Services element does not contain any of the elements ConfLNs, and ConfLdName Condition: when AccessPoint Services element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf64	Verify that in case SupSubscription is claimed to be supported at least one instance of LGOS or LSVS must be in the ICD. Condition: when SupSubscription element is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf65	Verify that if serviceType=GOOSE is specified for ExtRef the ClientServices.goose=true or ClientServices rGOOSE=true. For serviceType=SMV the ClientServices.sv=true or ClientServices.rSV=true Condition: when serviceType=GOOSE or serviceType=SMV is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

A2.6 SCL DataTypeTemplate section

Test case	Test case description	Verdict
sCnf70	Verify for each DAType/BDA or DOType/DA with attribute “bType”=Struct has attribute “type” whose value matches DAType@id; does not declare valKind and does not contain a <Val> element	☐ Passed ☐ Failed ☐ Inconclusive
sCnf71	Verify for each DAType/BDA or DOType/DA with attribute “bType”=Enum has attribute “type” whose value matches EnumType@id	☐ Passed ☐ Failed ☐ Inconclusive
sCnf72	Verify type names do not exceed 255 characters, contain no “whitespace” characters and contain only characters from Basic-Latin and Latin-1-Supplement	☐ Passed ☐ Failed ☐ Inconclusive
sCnf73	Verify that each DOType element contains at least one SDO or DA element	☐ Passed ☐ Failed ☐ Inconclusive
sCnf74	Verify for each DA with FC=”CO” (except “SBO”) that the associated DAType contains the element <ProtNs type=”8-MMS”>IEC 61850-8-1:2003</ProtNs> Verify for each DA name=”SBO” (FC=”CO”) contains the ProtNS element Note: type default value is 8-MMS so it’s optional	☐ Passed ☐ Failed ☐ Inconclusive

sCnf75	Verify for each (instance of) DOType/DA[name=ctlModel] whose associated EnumType contains direct-with-normal-security has in the DOType a DA named “Oper”. If ctlModel has valKind=RO and valImport=missing/false then use the configured ctlModel value instead of EnumType. Similar for sbo-with-normal-security, Oper, Cancel and SBO Similar for direct-with-enhanced-security, Oper Similar for sbo-with-enhanced-security, Oper, Cancel and SBOw	☐ Passed ☐ Failed ☐ Inconclusive
sCnf76	Deprecated same as sMdl18	

A2.7 SCL Common IED and DataTypeTemplate section

Test case	Test case description	Verdict
sCnf80	Verify that <Val> element values actually match a value in the corresponding EnumType, “ord” shall not be used, only EnumVal element values. Ref IEC 61850-6 Table 45.	☐ Passed ☐ Failed ☐ Inconclusive
sCnf81	Verify that <Val> elements values match IEC 61850-6 Table “Data type mapping” (if no table rows then Val element is not allowed at all)	☐ Passed ☐ Failed ☐ Inconclusive
sCnf82	Verify for each LLN0 that if LLN0.NamPlt.lnNs is present it shall have value IEC 61850-7-4:2007B (and ldNs is valid domain name space), otherwise LLN0.NamPlt.ldNs shall have value IEC 61850-7-4:2007B.	☐ Passed ☐ Failed ☐ Inconclusive
sCnf83	Verify each ctlModel has an associated <Val> element	☐ Passed ☐ Failed ☐ Inconclusive
sCnf84	Verify CDC=ORG references use the ACSI format (with “.”, no “$” and no functional constraint) and that the reference does exist Condition: when a data object with CDC=ORG is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf85	Verify for each Logical Device whose LLN0 does not contain GrRef, the existence of Data Object LLN0.NamPlt Verify for each LLN0 which contains the DO NamPlt, the existence and non-null value for Data Attribute LLN0.NamPlt.configRev	☐ Passed ☐ Failed ☐ Inconclusive

A2.8 IEC 61869 specific SCL tests

The following tests are applicable when IEC 61869 SV subscribe is supported.

Test case	Test case description	Verdict
sCnf100	Check if the server "ClientServices" capabilities in the ICD “services” section do match with the IED capabilities: • sv=true • maxSMV = supported number of SV streams Condition: when IEC 61869 SV subscribe is supported	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

The following tests are applicable when IEC 61869 SV publish is supported.

Test case	Test case description	Verdict
sCnf120	Verify that all LDevice’s with an IEC 61869 MSVCB have inst=MUnn where nn are digits.	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf121	Verify the existence of LPHD extension Data Objects: NamVariant, NamHzRtg, NamAuxVRtg (optional), NamHoldRtg and NamMaxDlRtg (table 903) and MaxDl (part 7-4 Ed2 Amd1) Verify the existence of LPHD.PhyNam data attributes: vendor, model, serNum, hwRev, swRev and d and that these attributes have valKind read-only. The effective logical node namespace: lnNs = IEC 61869-9:2016[A]	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf122	Verify the existence of TCTR extension Data Objects: NamAccRtg, NamARtg, NamClipRtg (table 905) and Clip, HoldTmms (part 7-4 Ed2 Amd1) The effective logical node namespace: lnNs= IEC 61869-9:2016[A]	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf123	Verify the existence of TVTR extension Data Objects: NamAccRtg, NamVRtg, NamClipRtg (table 907) and Clip, HoldTmms (part 7-4 Ed2 Amd1) The effective logical node namespace: lnNs= IEC 61869-9:2016[A]	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf124	Verify for the logical nodes TCTR and TVTR naming; For the backwards compatible configuration: InnATCTR1, InnBTCTR2, InnCTCTR3, InnNTCTR4, UnnATVTR1, UnnBTVTR2, UnnCTVTR3, UnnNTVTR4 For the preferred rates: InnpTCTRn and UnnpTVTRn, where nn is a number and p is the phase (IEC 61869-9 Clause 6.903.7 and 6.903.8)	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sCnf125	Verify the sampled value control block: For backward compatible configuration: - If name is MSVCB01; SmpMod=SmpPerPeriod, smpRate=80, confRev=1, nofASDU=1, smvID=xxxxMUnn01 - If name is MSVCB02; SmpMod=SmpPerPeriod, smpRate=256, confRev=1, nofASDU=8, smvID=xxxxMUnn02 - Name = MSVCBxx SmpMod=SmpPerPeriod smpRate = 96 (the Japanese variant) where xx is not 01 nor 02 For preferred rates: - Name = MSVCBxx, SmpMod=SmpPerSec where xx is not 01 nor 02 Verify the SmvOpts (clause 6.903.11) - SmvOpt: sampleSynchronized="true" refreshTime="false" sampleRate="false" dataSet="false" security="false"	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf126	Verify the SV dataset naming and elements For backward compatible configuration: PhsMeas1 Dataset elements as specified in clause 6.903.10 For preferred rates: PhsMeas2..99 (clause 6.903.10) Dataset elements sequence shall be i/q/i/q… and current proceeds voltage if both are present. Where multiple current or multiple voltage members for a common measurement point exist, they shall be adjacent and in the sequence: A, AB, B, BC, C, CA, N. The number of current and voltage elements shall match the number in the variant code currently under test.	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf127	Verify the AmpSv units, offset and scaleFactor attribute values match 61869-9 table 904, read-only and not valImport=T Verify the VolSv units, offset and scaleFactor attribute values match 61869-9 table 906, read-only and not valImport=T	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sCnf128	Verify that if the device does not supply all samples for the backwards compatible rate(s), 'dummy' SAV data attributes might be referenced in the data set. To detect the difference between dummy and real samples in the SCL, the ICD shall have all LN's included but the ones that are not supported have the LN Mode preconfigured to "Off". Condition: a not supported channel	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sCnf129	Check if the server "SMVSettings" capabilities in the ICD “services” section does match: • SamplesPerSec is present • SmpRate is present • SecPerSamples is absent • kdaParticipant / McSecurity is false or absent • pdcTimeStamp is false or absent • synchSrcId is absent/false/true (IEC 61850-9-2 Ed2 Amd1)	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

A3 Data model (IEC 61850-7-3 and IEC 61850-7-4)

The reference for the data model test cases is the 2007B3 name space definition. This definition includes the applicable IEC 61850 Edition 2 Amendment 1 part 7-3 and part 7-4 tissue resolutions.

Test case	Test case description	Verdict
sMdl1	Verify presence of mandatory data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present	☐ Passed ☐ Failed ☐ Inconclusive
sMdl2	Verify presence of conditional presence true data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present	☐ Passed ☐ Failed ☐ Inconclusive
sMdl3	Verify non-presence of conditional presence false data objects for each LN type and data attributes for each DO type. Passed when these objects/attributes are not present	☐ Passed ☐ Failed ☐ Inconclusive
sMdl4	Verify data model mapping according to applicable SCSM concerning name length and object expansion. Passed when mapping is according to applicable SCSM	☐ Passed ☐ Failed ☐ Inconclusive
sMdl5	Verify data model mapping according to applicable SCSM concerning organisation of functional components.	Deprecated
sMdl6	Verify data model mapping according to applicable SCSM concerning naming of control blocks and logs. Passed when mapping is according to applicable SCSM.	See detail
sMdl7	Verify type of all data objects for each LN type and all data attributes for each DO type. Passed when type of all objects/attributes do match with the IEC 61850-7-3, IEC 61850-7-4 and the applicable SCSM	☐ Passed ☐ Failed ☐ Inconclusive
sMdl8	Verify that the enum types and values from the SCL and in the device are in specified range. Passed when all enum types and values match the 2007B.nsd.	See detail
sMdl9	Check if manufacturer specific data model extensions are implemented according to the extension rules in IEC 61850-7-1 clause 14.	See detail

Test case	Test case description	Verdict
sMdl10	Check if the order of the data attributes with the same functional constraint of the DO type match with IEC 61850-7-3. Passed when all attributes are in matching order	☐ Passed ☐ Failed ☐ Inconclusive
sMdl11	Moved to sCnf50	-
sMdl12	Check that the rules for multiple data object instantiation are kept (IEC 61850-7-1 clause 14.6, IEC 61850-7-4).	See detail
sMdl13	Moved to sCnf82	-
sMdl14	Check the correct use of name spaces for non-substation power utility applications like for example Hydro and DER. Condition: when non-substation name space is used	See detail
sMdl15	Check if the SCL configuration file used to configure the DUT corresponds with the actual data object references, data types, data sets and pre-configured data values (settings) exposed by the DUT on the network.	☐ Passed ☐ Failed ☐ Inconclusive
sMdl16	Change one parameter/setting with valImport=True of each configurable data type and FC (FC can be DC, CF or SP) using the SCT SIMULATOR Change one parameter/setting when valImport=False or absent of each configurable data type and FC (FC can be DC, CF or SP) using the supplied IED configuration tool Check the updated online parameter/setting values correspond with the configured values in the SCL. Document the tested parameters in the test report. Condition when a parameter/setting is configurable	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sMdl17	Check the “ldName” naming structure when supported. All online object references (including data sets, control block references and object references – CDC ORG) shall start with the “LDevice ldName” value instead of the “IED name” + “LDevice inst” Condition when Services ConfLdName is present	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
sMdl18	Verify that the indicated trigger option: <DA dchg, qchg, dupd > is conformant with the IEC 61850-7-3 standardized Trigger Option.	☐ Passed ☐ Failed ☐ Inconclusive
sMdl19	Configure IED attribute name in server resulting in a 64-character MMS domain name for the longest ldInst and verify online domain name agrees with configuration.	☐ Passed ☐ Failed ☐ Inconclusive
sMdl20	If ICD/IID file contains any valKind=Conf: Verify that online data model does not contain empty data structures as a result of all contained attributes being valKind=Conf	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Test case	Test case description	Verdict
sMdl21	Modify some LN prefix / instance number in the SCD file, reconfigure the IED and load onto the IED. Browse the IED data model and check that changes are in, ~~check that the IED functionality behind still works correctly~~. Condition: when Services ConfLNs fixPrefix=false or fixLnInst=false	☐ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable

Detailed data modelling test procedures

sMdl6	Naming of control blocks and logs	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-6 Subclause 9.3.8

Expected result

- Report control blocks may be indexed. The indexing of report control blocks depends on the presence and value of the SCL elements: RptEnabled, max and indexed. According to the SCL schema the default value of indexed=TRUE and max = 1, max = 0 is not allowed. The indexing shall be according to the following table. The SCL ReportControl name="rcbA"

RCBName (IED)	RptEnabled	max=	indexed
rcbA01			
rcbA01			TRUE
rcbA			FALSE
rcbA01	y	1	
rcbA01	y	1	TRUE
rcbA	y	1	FALSE
rcbA01, rcbA02	y	2	
rcbA01, rcbA02	y	2	TRUE
rcbA	y	2	FALSE (prohibited)

- An SCL ReportControl with RptEnabled max>1, buffered=TRUE and indexed=FALSE is prohibited
- The report control block attribute owner does match with the SCL IED Services ReportSettings attribute owner
- The SCL IED Services ReportSettings attribute resvTms shall be true
- The report control block attribute resvTms shall be present when the SCL ReportControl attribute buffered=true
- The setting group control block resvTms does match with the SCL IED Services SettingGroups SGEdit attribute resvTms
- Note: the presence of the optional GOOSE control block attributes: MinTime, MaxTime, FixedOffs have no SCL IED Services attributes

Test description

Verify the naming and attributes of all control blocks and logs in the DUT.

Comment

Note: Because URCB can be pre-assigned the max>1 and indexed=FALSE is not allowed anymore

sMdl8	**Enum type and values**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-6 Subclause 9.5.6 2007B.nsd		
Expected result 1. The positive ord values shall match the 2007B.nsd name space 2. Not supported enum values are removed for controllable data objects with common data class ENC. 3. All values are in range 4. All values are in range		
Test description 1. Verify that all data attributes with bType=ENUM reference valid EnumType values. (note: the EnumType itself can't be verified only the enum values) 2. Not supported enum values shall not be included in the ICD file for controllable data objects with common data class ENC 3. Verify that preconfigured enumerated data attribute values from the SCL are in specified range. 4. Verify that enumerated data attribute values from the device are in specified range.		
Comment		

sMdl9	**Data model extensions**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-1 Clause 14.2, Annex J 2007B.nsd		
Expected result Standard LN • Private DO (not defined in a standardized name space) shall have a dataNs referring to a private name space • Standardized LN may re-use DO's from another standard LN. The DO shall refer to a private dataNs; the re-used DO shall have the same CDC type as the original DO Private LN • Private LN shall have lnNs referring to a private name space • Only DO's inherited from the DomainLN class in a private LN may have a dataNs = IEC 61850-7-4:2007[A][B] • Private DO in a private LN may have a dataNs referring to a private name space Private DO • When a private DO has a name that exists in the 2007B.nsd it shall have the same CDC as in the name space Private CDC • Private CDC are not allowed, private extensions in existing CDC are not allowed • Private data attributes are not allowed • Only standardized data types are allowed Private ENUM • Private ENUM values in a standardized ENUM type shall have a negative ord value • Private ENUM types are only allowed for private DO and may use positive and negative ord values Control blocks • Extensions to control blocks are not allowed		
Test description Scan SCL file for extensions: private LN, private DO, private DA and private ENUMs. Browse DUT for extensions: control blocks		
Comment Note: part 7-1 allows Ed2 LN in Amd1 device		

sMdl12	**Check that the rules for multiple data object instantiation are kept**	☐ Passed ☐ Failed ☐ Inconclusive

Data objects as specified in name space definition 2007B
IEC 61850-7-1 Subclause 14.6

Expected result

- Standardized DO's ending with a number do have presCond="Omulti" in the 2007B.nsd (example GGIO.Ind4 is derived from GGIO.Ind with presCond="Omulti"; PSCH.RxPrm29 is derived from PSCH.RxPrm1) and are not member of the exception white list below
- Private DO's may end with a number
- Derived instances from TmAChr, TmVChr, TmTmpChr, VChr, VHzChr have instance number range between 33 and 48 (presCond="OmultiRange" presCondArgs="33, 48" in the 2007B.nsd)
- Standardized DO's ending without a number don't have the presCond="Omulti" in the 2007B.nsd (example Mod)
- All data object instances with presCond="Omulti" must have an instance number
- Instantiated data objects in the same LN shall have an unique number when leading zero's are removed, for example "1" and "01" is not allowed,

Test description
Scan SCL file for DO names

Comment
Exception white list of DOs that cannot be multiple instantiated: PDIS.X1, ZSMC.X0, ZSMC.X2, ZSMC.SatCffs10, ZSMC.SatCffs12Standardized DO = DO that have been standardized within a standardized LN.

sMdl14	**Non-substation data model extensions**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 clause 14

Expected result

In case the ldNs = IEC 61850-7-4:2007B then

- A domain specific LN shall have lnNs referring to the corresponding standard, for example FHB1.NamPlt.lnNs = IEC 61850-7-410:2013

Else in case the LLN0.NamPlt.ldNs refers to an inclusion name space then

- The LLN0.NamPlt.lnNs = IEC 61850-7-4:2007[A][B]
- LPHD will inherit the name space of LLN0
- A LN from another domain shall have lnNs referring to the corresponding standard, for example XCBR1.NamPlt.lnNs = IEC 61850-7-4:2007[A][B]

Test description
Scan SCL file for non-substation extensions like for example Hydro Power, Distributed Energy Resources and Wind Power

Comment
Note: for Ed2 Amd1 the inclusion name spaces are: IEC 61850-7-410 and IEC 61850-7-420, see part 7-1

A4 Mapping of ACSI models and services (IEC 61850-7-2 and applicable SCSM)

The following table specifies which ACSI services are mandatory / optional for each conformance block.

Table A.4.1: ACSI services per conformance block

Conformance Block	Mandatory	Optional
1a: Basic Exchange	Associate, Abort, Release with IPv4 GetServerDirectory(LD) GetLogicalDeviceDirectory GetLogicalNodeDirectory (DATA) GetDataValues GetAllDataValues GetDataDirectory/GetDataDefinition	ServerAssociate_Req ServerRelease_Req SetDataValues
1b: Association with IPv6	Associate, Abort, Release with IPv6	ServerAssociate_Req ServerRelease_Req
2: Data Set	GetLogicalNodeDirectory (DATA-SET) GetDataSetValues GetDataSetDirectory	SetDataSetValues
2+: Data Set Definition	CreateDataSet DeleteDataSet	
3: Substitution	SetDataValues GetDataValues	
4: Setting Group Selection	SelectActiveSG GetSGCBValues	
4+: Setting Group Definition	SelectEditSG GetEditSGValue SetEditSGValue ConfirmEditSGValues	
5: Unbuffered Reporting	Report GetURCBValues SetURCBValues	
6: Buffered Reporting	Report GetBRCBValues SetBRCBValues	
7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	SetLCBValues

Conformance Block	**Mandatory**	**Optional**
9a: GOOSE publish	SendGOOSEMessage (publish)	GetGoCBValues SetGoCBValues
9b: GOOSE subscribe	SendGOOSEMessage (subscribe)	
9c: GOOSE management	GetGoReference GetGOOSEElementNumber	
11a: SV publish	SendSVMessage (publish)	GetMSVCBValues SetMSVCBValues
11b: SV subscribe	SendSVMessage (subscribe)	
12a: Direct control	Operate	TimeActivatedOperate
12b: SBO control	Select, Cancel, Operate	TimeActivatedOperate
12c: Enhanced Direct Control	Operate CommandTermination	TimeActivatedOperate
12d: Enhanced SBO control	SelectWithValue, Cancel, Operate CommandTermination	TimeActivatedOperate
13a: Time sync SNTP	TimeSynchronization with SNTP	
13b: Time sync PTP	TimeSynchronization with PTP	
14: File transfer	GetServerDirectory(FILE) GetFile GetFileAttributeValues	SetFile DeleteFile
15: Service Tracking	<no specific services>	<no specific services>

The following table specifies which test procedures are mandatory/conditional for each conformance block (defined in Quality Assurance Plan Addendum for IEC 61850). Conditions refer to the SCL, PICS, MICS or PIXIT.

Table A.4.2: Test procedures per conformance block

Conformance Block	**Mandatory**	**Conditional**
1a: Basic Exchange	sAss1, sAss2, sAss3, sAss4, sAssN2, sAssN3, sAssN4, sAssN5 sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrv8, sSrvN1abcdf, sSrvN4	PICS-ServerAssoc_Req: sAss5, sAssN7 SCL-DynAssociation max > 1: sAssN6 PICS-SetDataValues: sSrv6, sSrvN1e, sSrvN3 PIXIT-Sr2 detailed bits: sSrv9 PIXIT-Sr1 detailed bits: sSrv10 SCL-blkEna: sSrv11 SCL-Mode off/blocked/test: sSrv12 SCL-GrRef: sSrv13 SCL-WYE/DEL/SEQ used: sSrv15 SCL-Enum with FC=CF/DC/SP and valKind=Set: sSrvN2
1b: Associate with IPv6	sAss61, sAss62, sAss63, sAss64, sAss66, sAss6N2, sAss6N3, sAss6N4, sAss6N5	PICS-ServerAssoc_Req: sAss65, sAss6N7 SCL-DynAssociation max > 1: sAss6N6
2: Data Sets	sDs1, sDs10a, sDsN1ae	PICS-SetDataSetValues: sDs10b, sDsN1b, sDsN13 SCL-ConfDataSet: sDs15
2+: Data Set Definition	sDs2, sDs3, sDs4, sDs5, sDs6, sDs7, sDs8, sDs9, sDs13, sDs14, sDsN1cd sDsN2, sDsN3, sDsN4, sDsN5 sDsN6, sDsN7, sDsN8, sDsN9, sDsN10,	SCL-maxAttributes: sDs11, sDs12 SCL-Report.DatSet=dyn: sDsN11, sDsN12
3: Substitution	sSub1, sSub2, sSub3	
4: Setting Group Selection	sSg1, sSg3, sSgN1	SCL-SGCB.NumOfSG>1: sSg11
4+: Setting Group Definition	sSg2, sSg4, sSg6, sSg7, sSg8, sSg10, sSgN2, sSgN3, sSgN4, sSgN5	SCL-ResvTms: sSg5 SCL-SGCB.NumOfSG>1: sSg9
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp16, sRp23, sRpN1, sRpN2, sRpN3, sRpN4, sRpN5, sRpN7, sRpN8, sRpN9	SCL-DatSet=dyn: sRp6, sRp7 SCL-DatSet=conf/dyn: sRp10, sRp15 SCL-BufTm=conf/dyn: sRp8, sRp11, sRp12 SCL-Owner: sRp13 PIXIT-Rp15 db=0: sRp17

Conformance Block	Mandatory	Conditional
6: Buffered Reporting	sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr16, sBr20, sBr21, sBr22, sBr23, sBr24, sBr25. sBr26, sBr27, sBr28, sBr29 sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN7, sBrN8, sBrN9, sBrN10	SCL-DatSet=dyn: sBr6, sBr7 SCL-DatSet=conf/dyn: sBr10, sBr15 SCL-BufTm=conf/dyn: sBr8, sBr11, sBr12 SCL-Owner: sBr13 PIXIT-Rp15 db=0: sBr17
7: Logging	sLog2, sLog3, sLog4, sLog5, sLog6, sLog7, sLog8, sLog9, sLog11, sLog12, sLog13, sLogN1, sLogN2	SCL-GLOG: sLog10
9a: GOOSE publish	sGop2a, sGop3, sGop4, sGop9, sGop10, sGop11, sGop12	PICS-GetGoCBValues: sGop1 SCL-Services.GOOSE.FixedOffs=T: sGop2b PIXIT-Gp1 Simulation: sGop5 PICS-SetGoCBValues: sGop6 SCL-DynAssociation max>0: sGopN1 PIXIT-Gp9 Dataset too large: sGopN2
9b: GOOSE subscribe	sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGos8, sGos9, sGos10, sGos11, sGos12, sGos14, sGos15, sGos20, sGos21, sGos22, sGos23, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6, sGosN7	SCL-LGOS: sGos4 SCL-LPHD.Sim=T: sGos6b SCL-McSecurity not supported: sGos13
9c: GOOSE management	sGom1, sGom2, sGomN1	
11a: SV publish	sSvp1, sSvp2, sSvp3, sSvp4, sSvp5, sSvp6, sSvp7, sSvp8, sSvp14	PICS/PIXIT-Svp6 PTP: sSvp9, sSvp15 PIXIT-Svp6 PPS: sSvp10 PIXIT-As9 Not test equipment: sSvp11 PIXIT-Svp3 Simulation mode: sSvp12 PIXIT-Svp9 Quality invalid: sSvp13 PIXIT-Svp2 Test mode: sSvp16 PIXIT-Svp13 SAMU: sSvp17 PICS-GetMSVCBValues: sSvp20 PICS-SetMSVCBValues: sSvp21 SCL-DynAssociation max>0: sSvp22 PICS-GetDataValues: sSvp23

Conformance Block	Mandatory	Conditional
11b: SV subscribe	sSvs1, sSvs2, sSvs3, sSvs4, sSvs5, sSvs6, sSvs7, sSvs8, sSvs9, sSvs10, sSvs11, sSvs14, sSvs15, sSvsN1, sSvsN2, sSvsN3, sSvsN4, sSvsN5, sSvsN6	SCL-LSVS: sSvs12 SCL-McSecurity not supported: sSvs13
12: Control general	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25	SCL-Writable control model: sCtl2 PICS-TimOper: sCtl3 SCL-stSeld: sCtl4 SCL-multiple SBO: sCtl6 SCL-CILO: sCtl7 SCL-DO object has SBO/SBOw data attributes: sCtl13 SCL-Operate time reasonably large: sCtl14 PIXIT-Sr5 Behaviour=off: sCtl15 SCL-Loc: sCtl16 SCL-LocSta: sCtl17 SCL-CmdBlk: sCtl18 PIXIT-Ct9 AddCause: • Parameter-change-in-execution: sCtl20 • Step-limit: sCtl21 • Ended-with-overshoot: sCtl23 • Abortion-due-to-deviation: sCtl24 • Command-already-in-execution and operate time: sCtl26 SCL-SBO and SBOw: sCtl27 SCL-opOk or opRcvd: sCtl28
12a Direct control	sDOns1, sDOns2	PICS-TimOper: sDOns4, sDOns5
12b SBO control	sSBOns1, sSBOns2, sSBOns6	PICS-TimOper: sSBOns4, SBOns5 SCL-sboClass=Operate-Many: sSBOns7
12c Enhanced Direct Control	sDOes1, sDOes2	PICS-TimOper: sDOes4, DOes5
12d Enhanced SBO control	sSBOes1, sSBOes2, sSBOes6, sSBOes8	PICS-TimOper: sSBOes4, sSBOes5 SCL-sboClass=Operate-Many: sSBOes7
13a: Time sync SNTP	sTm1, sTm2, sTm7, sTmN1	PIXIT-Tm9 COMTRADE supported: sTm3 SCL-LTIM: sTm4 SCL-LTMS: sTm5 PIXIT-Tm1: ClockFailure: sTmN2
13b: Time sync PTP	sTmP1, sTmP2, sTmPN1	SCL-LTMS: sTmP5
14: File transfer	sFt1, sFt2ab, sFt4, sFt5, sFtN1ab	PICS-SetFile: sFt3 PICS-DeleteFile: sFt2c, sFtN1c

Conformance Block	Mandatory	Conditional
15: Service tracking		SCL-BrcbTrk: sTrk1 SCL-UrcbTrk: sTrk2 SCL-LocbTrk: sTrk3 SCL-GocbTrk: sTrk4 SCL-MsvcbTrk: sTrk5 SCL-UsvcbTrk: sTrk6 SCL-SgcbTrk: sTrk7 SCL-SpcTrk: sTrk8 SCL-DpcTrk: sTrk9 SCL-IncTrk: sTrk10 SCL-EncTrk: sTrk11 SCL-IscTrk: sTrk12 SCL-BscTrk: sTrk13 SCL-ApcFTrk: sTrk14 SCL-ApcITrk: sTrk15 SCL-BacTrk: sTrk16 SCL-GenTrk: sTrk17

Note1: sAssN1, sSrv7, sCtl12, sCtl22, sRpN6, sBrN6, sLog1, sGop7, sGop8, sDOns3, sSBOns3, sDOes3 and sSBOes3 are not applicable for IEC 61850-8-1 and not referenced in this table.
Note2: TimOper = TimeActivatedOperate

The following paragraphs describe the abstract test cases and corresponding detailed test procedures.

A4.1a Application association

Abstract test cases

Test case	Test case description
sAss1	Associate and client-release a TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss2	Associate and client-abort TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss3	Associate with maximum number of clients simultaneously (PIXIT)
sAss4	Verify the negotiation of MMS initiate parameters
sAss5	Verify the server initiates the Associate

Test case	Test case description
sAssN1	Check that with incorrect authentication parameters and authentication turned on at server the association fails, and with authentication turned off the server associates (IEC 61850-7-2 Subclause 8.3
sAssN2	Check that with incorrect association parameters at server or client the association fails (IEC 61850-7-2 Subclause 8.3, PIXIT)
sAssN3	Set up maximum+1 associations, verify the last associate is refused
sAssN4	Disconnect the communication interface, the DUT shall detect association lost within a specified period
sAssN5	Interrupt and restore the power supply, the DUT shall accept an association request when ready
sAssN6	Verify the re-use of dropped association resources
sAssN7	Server Associate with mismatching association parameters

Detailed test procedures

sAss1	**Associate and client-release a TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
Expected result 2. DUT sends Associate response+ 3. DUT sends Release response+		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client request Associate 3. Client request Release 4. Repeat steps 2 and 3 250 times		
Comment		

sAss2	**Associate and client-abort TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
Expected result 2. DUT sends Associate response+ 3. DUT sends Abort response+		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Client requests Abort 4. Repeat steps 2 and 3 250 times		
Comment		

sAss3	**Associate with maximum number of clients simultaneously**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2 SCL IED [AccessPoint] Services DynAssociation max		
Expected result 2. DUT sends Associate response+ for each client 3. DUT sends Release response+ for each client		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client 1 to max requests Associate 3. Client 1 to max requests Release 4. Repeat steps 2 and 3 250 times		
Comment Prerequisite for testing: the maximum number of clients shall be specified in the SCL - Services - DynAssociation max		

sAss4	**MMS Associate Support**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 8.3.2.2
IEC 61850-8-1 Subclause 10.2.2 and PICS
PIXIT: As7
ISO/IEC 9506-1:2003 and ISO/IEC 9506-2:2003

Expected result

1. DUT sends negotiatedLocalDetail less than proposed value (the maximum PDU size, PIXIT), NestingLevel=(see Note 1), negotiatedParameterCBB=(see Note 2), and servicesSupportedCalled according to PICS and ISO/IEC 9506
2. DUT sends negotiatedLocalDetail equal as proposed value, NestingLevel=(see Note 1), negotiatedParameterCBB same as step 1, and servicesSupportedCalled same as expected result step 1
3. DUT either refuses the connection or responds negotiatedParameterCBB same as step1 but without vnam and servicesSupportedCalled same as expected result step 1

Test description

1. Client sends MMS Initiate Request with localDetailCalling=100MB, NestingLevel=15, proposedParameterCBBs=(str1, str2, vnam, valt, vlis) and ServiceSupportCalling=(fileOpen, fileRead, fileClose, informationReport, conclude)
2. Client sends MMS Initiate Request with localDetailCalling=<minimum PDU size, (see PIXIT), NestingLevel=15, proposedParameterCBBs=(str1, str2, vnam, valt, vlis) and ServiceSupportCalling=(fileOpen, fileRead, fileClose, informationReport, conclude)
3. Client sends MMS Initiate Request with localDetailCalling=2000, NestingLevel=1, ProposedParameterCBBs=(str1, str2, valt, vlis), and ServiceSupportCalling=(fileOpen, fileRead, fileClose, informationReport, conclude)

Comment

Note 1: Nesting level must be >= 0
If PICS S8 (GetDataValues) is declared then nesting level must be >= 5
If data model contains and Data Objects with CDC CMV then nesting level must be >= 6

Note 2: The negotiatedParameterCBB shall be the intersection of the CBBs supported by the Server and those specified by the ProposedParameterCBB
negotiatedParameterCBB str1 is required if the server has arrays in the data model
negotiatedParameterCBB str2 and valt are required if PICS S8 (GetDataValues) is declared
negotiatedParameterCBB vnam is required if PICS S8 (GetDataValues) is declared and ProposedParameterCBB vnam is present
negotiatedParameterCBB vlis is required if PICS S16 (GetDataSetDirectory) is declared

sAss5	**Server Associate and Release/Abort a TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, Table 135		
Expected result 2. DUT sends Associate request, the servicesSupportedCalling in the MMS initiate respond shall correspond to IEC 61850-8-1 Table 111 and the PICS, Client sends Associate response+ 3. DUT sends Release request, Client sends Release or Abort response+ 5. DUT sends Associate request to each client. Each of Clients sends Associate response+ 6. DUT sends Release request to each client. Each of Clients sends Release or Abort response+		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. DUT request Associate 3. DUT request Release or Abort 4. Repeat steps 2 and 3 10 times 5. DUT requests Associate to maximum number of Clients 6. DUT requests Release or Abort to maximum number of Clients 7. Repeat steps 5 and 6 10 times		
Comment		

sAssN2	**Associate with incorrect association parameters**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 8.3.2
IEC 61850-8-1 Subclause 10.2, PIXIT: As5, As6

Expected result

1. DUT sends Associate response+
2. DUT sends Release response+
4. DUT sends Associate response- when PIXIT indicates the DUT verifies the parameter, otherwise the DUT sends Associate response+

Test description

1. Configure the Client and DUT with correct association and authentication parameters and request Associate
2. Client requests Release
3. Configure the Client and DUT with correct authentication parameters and one of the following incorrect configurable association parameters:
    - called / calling transport selector
    - called / calling session selector
    - called / calling presentation selector
    - called / calling AP title
    - called / calling AE qualifier
4. Client requests Associate
5. When DUT sends Associate response+, Client sends Release request
6. Repeat step 1 to 5 for the next association parameter till all parameters are verified

Comment

The following table indicates the associate response results with incorrect:

- called / calling transport selector - / +
- called / calling session selector - / +
- called / calling presentation selector - / +
- called / calling AP title + / +
- called / calling AE qualifier + / +

“-” = associate failed, DUT does check the incorrect parameter and sends response-

“+” = associate succeeded, DUT does not check the incorrect parameter and sends response+

sAssN3	**Associate with maximum+1 number of clients simultaneously**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2 SCL IED [AccessPoint] Services DynAssociation max		
Expected result 2. DUT sends Association response+ for at least the maximum server associates as defined in the SCL Services and response- for the last associate 3. DUT sends Release response+		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client 1 to N send Associate requests until the DUT sends response- 3. Client 1 to N-1 send release 4. Repeat step 2 and 3 250 times		
Comment Prerequisite for testing: the maximum number of clients shall be specified in the SCL - Services - DynAssociation max		

sAssN4	**Detection of lost link**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As2, As3		
Expected result 2. DUT sends Associate response+ 3. DUT sends GetDataValues response+ 4. DUT sends KEEP ALIVE messages according to PIXIT specified interval 7. DUT sends no response 8. DUT sends Associate response+ for all requested associations		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Client requests a correct GetDataValues 4. Wait multiple KEEP ALIVE timeouts 5. Disable TCP communication between the Client and the DUT. For example, disconnect the physical link between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the lost connection detection timeout specified in the PIXIT 6. Enable TCP communication. E.g. connect the physical link 7. Verify the DUT has lost the association by sending a correct GetDataValues request using the same association established in step 2 8. Client 1 to max requests Associate 9. Client 1 to max requests Release		
Comment Tested with a KEEP ALIVE timeout of **…** seconds and a lost connection detection timeout of … seconds		

sAssN5	**Power supply interrupt**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As8		
Expected result 2. DUT sends Associate response+ 4. The DUT sends Associate response+ within the specified power-up time (PIXIT)		
Test description 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Power down and wait until DUT is off. Restore the DUT power supply and wait the specified power-up time (PIXIT) or until the DUT is initialised 4. Client requests Associate		
Comment		

sAssN6	**Re-use of dropped association resource**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As2		
Expected result 2. DUT sends at least one Associate response+ 3. DUT sends Abort response+ 5. DUT sends Associate response+ 6. DUT sends GetDataValues response+ 7. Note: DUT should internally abort all stack layers, a half-open TCP connection is not allowed 9. DUT sends Associate response+. 10. DUT sends GetDataValues response+		
Test description 1. Configure Client 1 and Client 2 and DUT with the correct association and authentication parameters 2. Client 1 requests multiple associations until they are refused 3. Client 1 aborts the last association 4. Wait for DUT to issue several keepalives on all associations 5. Client 2 requests association 6. Client 2 requests a correct GetDataValues 7. Disable TCP communication (e.g. disconnect physical link) between Client 2 and the switch, some seconds longer than the lost connection detection timeout as specified in the PIXIT 8. Enable the TCP communication (e.g. connect the physical link) to Client2 9. Client 2 requests association 10. Client 2 requests a correct GetDataValues		
Comment		

sAssN7	**Server Associate with mismatching association parameters**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As10		
Expected result 2. Client replies Associate response-. DUT behaves as specified in the PIXIT-As10		
Test description 1. Configure the Client simulator to refuse the associate request from DUT 2. DUT requests Associate		
Comment		

A4.1b Application association with IPv6

Abstract test cases

Test case	Test case description
sAss61	Associate and client-release a TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss62	Associate and client-abort TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss63	Associate with maximum number of clients simultaneously (PIXIT)
sAss64	Verify the negotiation of MMS initiate parameters
sAss65	Verify the server initiates the Associate
sAss66	Associate with one IPv4 and Associate with one IPv6

Test case	Test case description
sAss6N1	Check that with incorrect authentication parameters and authentication turned on at server the association fails, and with authentication turned off the server associates (IEC 61850-7-2 Subclause 8.3
sAss6N2	Check that with incorrect association parameters at server or client the association fails (IEC 61850-7-2 Subclause 8.3, PIXIT)
sAss6N3	Set up maximum+1 associations, verify the last associate is refused
sAss6N4	Disconnect the communication interface, the DUT shall detect association lost within a specified period
sAss6N5	Interrupt and restore the power supply, the DUT shall accept an association request when ready
sAss6N6	Verify the re-use of dropped association resources
sAss6N7	Verify associate failure when server initiates the Associate

Detailed test procedures

sAss61	**Associate and client-release a TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAss1 using IPv6		
Comment		

sAss62	**Associate and client-abort a TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAss2 using IPv6		
Comment		

sAss63	**Associate with maximum number of clients simultaneously**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAss3 using IPv6		
Comment		

sAss64	**MMS Associate Support**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAss4 using IPv6		
Comment		

sAss65	**Server Associate and Release/Abort a TPAA association**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAss5 using IPv6		
Comment		

sAss66	**Associate with IPv4 and IPv6**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
Expected result 2. DUT sends Associate response+ 3. DUT sends Associate response+ 4. DUT sends Release response+ 5. DUT sends Release response+		
Test description 1. Configure the IPv4Client and IPv6Client and DUT with the correct association and authentication parameters 2. IPv4Client request Associate 3. IPv6Client request Associate 4. IPv4Client request Release 5. IPv6Client request Release 6. Repeat steps 2…5 10 times		
Comment		

sAss6N2	**Associate with incorrect association parameters**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN2 using IPv6		
Comment		

sAss6N3	**Associate with maximum+1 number of clients simultaneously**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN3 using IPv6		
Comment		

sAss6N4	**Detection of lost link**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN4 using IPv6		
Comment		

sAss6N5	**Power supply interrupt**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN5 using IPv6		
Comment		

sAss6N6	**Re-use of dropped association resource**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN6 using IPv6		
Comment		

sAss6N7	**Server Associate with mismatching association parameters**	☐ Passed ☐ Failed ☐ Inconclusive
Test description Repeat sAssN7 using IPv6		
Comment		

A4.1a Server & Logical Device & Logical Node & Data

Abstract test cases

Test case	Test case description
sSrv1	Request GetServerDirectory(LOGICAL-DEVICE) and check response (IEC 61850-7-2 Subclause 7.2.2)
sSrv2	For each GetServerDirectory(LOGICAL-DEVICE) response issue a GetLogicalDeviceDirectory request and check response (IEC 61850-7-2 Subclause 9.2.1)
sSrv3	For each GetLogicalDeviceDirectory response issue a GetLogicalNodeDirectory(DATA) request and check response (IEC 61850-7-2 Subclause 10.2.2)
sSrv4	For each GetLogicalNodeDirectory(DATA) response issue a GetDataDirectory request and check response (IEC 61850-7-2 Subclause 11.4.4) GetDataDefinition request and check response (IEC 61850-7-2 Subclause 11.4.5) GetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.2)
sSrv5	Issue one GetDataValues request with different data reference hierarchy
sSrv6	For each write enabled DATA object issue a SetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.3)
sSrv7	Issue one SetDataValues request with the maximum number of data values and check response. (Deprecated, this is not a valid SetDataValues request)
sSrv8	Request GetAllDataValues for each functional constraint and check response (IEC 61850-7-2 Subclause 10.2.3)
sSrv9	Evaluate the semantic of selected (volt/amp) analogue measurements: Verify analogue value (plausibility check, not accuracy) Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy) Verify scaling, range and units, change a setting and verify resulting value Verify dead band, change dead band and verify result Verify limit indications
sSrv10	Evaluate the semantic of selected status points: Verify status value Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy)
sSrv11	Verify that when blkEna is set to true by an operator the quality bit oldData and operatorBlocked is set by the server and the process data is not updated anymore (IEC 61850-7-3 Subclause 6.2.6)
sSrv12	Verify Mod/Beh values: off, test, blocked When Mod/Beh is off process data is not updated, Mod and Beh are updated, quality is set to invalid When Mod/Beh is test or test-blocked the process data quality test is set When Mod/Beh is blocked the process data quality is valid (IEC 61850-7-4 Annex A)

Test case	Test case description
sSrv13	Verify logical device hierarchy; the LLN0.GrRef shall reference a valid logical device the reference shall not result in a hierarchy loop Beh value at higher level influences the lower levels correctly (i.e. like LD Beh influences LN behaviour dependent on LN Mod)
sSrv14	Verify blocking by operator using blkEna (deprecated)
sSrv15	Verify timestamps are identical for each phase in a WYE, DEL, SEQ data object

Test case	Test case description
sSrvN1	Request following data services with wrong parameters (unknown object, name case mismatch, wrong logical device or wrong logical node) and verify response- service error GetServerDirectory(LOGICAL-DEVICE) (IEC 61850-7-2 Subclause 7.2.2) GetLogicalDeviceDirectory (IEC 61850-7-2 Subclause 9.2.1) GetLogicalNodeDirectory(DATA) (IEC 61850-7-2 Subclause 10.2.2) GetAllDataValues (IEC 61850-7-2 Subclause 10.2.3) GetDataValues (IEC 61850-7-2 Subclause 11.4.2) SetDataValues (IEC 61850-7-2 Subclause 11.4.3) GetDataDirectory (IEC 61850-7-2 Subclause 11.4.4) GetDataDefinition (IEC 61850-7-2 Subclause 11.4.5)
sSrvN2	Request SetDataValues of ENUMERATED data with out-of-range value and verify response- service error (IEC 61850-7-2 Subclause 11.4.3)
sSrvN3	Request SetDataValues with mismatching data type (e.g. int-float) and verify response- service error (IEC 61850-7-2 Subclause 11.4.3)
sSrvN4	Request SetDataValues for read-only data values and verify response- service error (IEC 61850-7-2 Subclause 11.4.3)

Detailed test procedures

sSrv1	**GetServerDirectory(LOGICAL-DEVICE)**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 7.2.2 IEC 61850-8-1 Subclause 9.3		
Expected result 1. DUT sends Association response+ 2. DUT sends GetServerDirectory(LOGICAL-DEVICE) response+ with a list of logical devices		
Test description 1. Client requests correct Association 2. Client requests GetServerDirectory(LOGICAL-DEVICE) 3. Continue with sSrv2		

Comment

sSrv2	GetLogicalDeviceDirectory	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 9.2.1 IEC 61850-8-1 Subclause 11.1 ISO 9506-1 Subclause 5.4.2 and ISO 9506-2 Subclause 7.5.2		
Expected result 1. DUT sends GetLogicalDeviceDirectory response+ with an ordered list of logical nodes within the logical device		
Test description 1. For each responded logical device Client requests GetLogicalDeviceDirectory 2. Continue with sSrv3		
Comment		

sSrv3	GetLogicalNodeDirectory(DATA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 9.2.2 IEC 61850-8-1 Subclause 12.3.1 ISO 9506-1 Subclause 5.4.2 and ISO 9506-2 Subclause 7.5.2		
Expected result 1. DUT sends GetLogicalNodeDirectory(DATA) response+ with an ordered list of data		
Test description 1. For each responded logical node directory Client requests GetLogicalNodeDirectory(DATA) 2. Continue with sSrv4		
Comment		

sSrv4	GetDataDirectory, GetDataDefinition and GetDataValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.4, 11.4.5 and 11.4.2 IEC 61850-8-1 Subclause 13.4.3, 13.4.4 and 13.4.1		
Expected result 1. - DUT sends GetDataDirectory response+ - DUT sends GetDataDefinition response+ - DUT sends GetDataValues response+		

Test description 1. For each responded data object Client requests a: - GetDataDirectory - GetDataDefinition - GetDataValues
Comment

sSrv5	**GetDataValues with data hierarchy**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.2 IEC 61850-8-1 Subclause 13.2.1		
Expected result 1. DUT sends GetDataValues response+ with requested data hierarchy		
Test description 1. Client requests one GetDataValues of at least the following data objects for the supported data hierarchy level: • Functional constrained data: LLN0STBeh • Functional constrained data attribute: LLN0STBeh$stVal • Functional constrained data attribute type attribute		
Comment		

sSrv6	**SetDataValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.3 IEC 61850-8-1 Subclause 13.2.2		
Expected result 1. DUT sends SetDataValues response- with data access error “object-access-denied” 2. DUT sends SetDataValues(FC=BL, CF, SP, DC) response- for read-only data and response+ for write enabled data as specified in the ICD using valKind=”RO” for read-only and valKind=“Set” or missing for write enabled data attributes. 3. DUT sends SetDataValues response+ 4. DUT sends GetDataValues response+ with requested value, the value does match 5. DUT sends SetDataValues response+ 6. DUT sends GetDataValues response+ with requested value, the value does match		
Test description 1. For each data object with FC=ST, MX or EX client sends a SetDataValues request with the current value 2. For each data object with FC=BL, CF, SP or DC client sends a SetDataValues request with the current value For each type of write-enabled data objects 3. Client sends a SetDataValues with a valid new value 4. Client sends a GetDataValues request and check the value does match 5. Client sends a SetDataValues with the original value 6. Client sends a GetDataValues request and check the value does match		
Comment		

sSrv8	**GetAllDataValues**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclaucse 10.2.3
IEC 61850-8-1 Subclause 12.3.2

Expected result

1. DUT sends GetAllDataValues response+
2. DUT sends GetAllDataValues response+

Test description

1. For each Logical Node and supported functional constraint the Client sends a GetAllDataValues request using MMS Alternate Access where the alternate access contains at least an allowed Data FC = ST, MX, CF, SP, DC, EX, BL, OR.
2. For each Logical node, the Client sends a GetAllDataValues request using object reference <IED><LD>/<LN>$<FC> where FC = ST, MX, CF, SP, DC, EX, BL, OR.

Comment

sSrv9	**Semantic of measured value (MV, CMV, WYE, DEL, SEQ)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-3 Subclause 6.2, 6.3, 6.4, 6.5 and 7.4.2, Table 3
PIXIT: Sr1

Expected result

1. DUT sends GetDataValues Response+. The quality shall match the forced value. The quality validity shall follow the quality details according to Table 3; Default quality attribute value shall be supplied when the functionality of the related quality attribute is not supported (PIXIT)
2. DUT sends GetDataValues Response+. Verify the range enum value changes from low-low, low, normal, high, high-high according to the rangeC limits
3. DUT sends GetDataValues Response+. Verify that the .f and .i value match the scaleFactor, offset and units.multiplier

Test description

1. Force situation to set the following supported quality values for this measured value:
   - detail: overflow, out of range, bad reference, failure, old data, inaccurate, inconsistent
   - validity: good, invalid, questionable
   - source: process

   Client request GetDataValues after each change
2. When range is available change the measured value from min to max, Client request GetDataValues after each change
3. When both AnalogueValue.i and .f are available change the measured value, Client request GetDataValues after each change

Comment

PIXIT indicates that the following detailed quality bits are supported: <to be completed>
The following detailed quality bits could be forced for the specified data object: <to be completed>
range is [not] supported.
AnalogueValue.i and .f are [not] available
Note: quality source substituted is tested during Substitution, quality test is tested in sSrv12, quality operatorBlocked at sSrv11.

sSrv10	**Semantic of single and double point status value**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-3 Subclause 6.2, 6.3, 6.4, 6.5 and 7.4.2, Table 3
PIXIT: Sr2

Expected result

2. DUT sends GetDataValues Response+, status value matches the forced change.
4. DUT sends GetDataValues Response+. The quality shall match the forced value. The quality validity shall follow the quality details according to Table 3

The default quality attribute value shall be supplied when the functionality of the related quality attribute is not supported (PIXIT)

Test description

1. Force EQUIPMENT SIMULATOR to change a single and/or double point status value
2. Client request GetDataValues for the q, t and stVal members of the status point value
3. Force situation to set the following quality values for this status point:
   - detail: oscillatory, failure, old data, inconsistent
   - validity: good, invalid, questionable
   - source: process
4. Client requests GetDataValues for the q, t and stVal members of the status point value
5. Repeat steps 3 and 4 for the other supported quality bits

Comment

PIXIT indicates that the following quality bits are supported: <to be completed>

The following quality bits could be forced for the specified data object: <to be completed>

Note: quality source substituted is tested during Substitution, quality test is tested in sSrv12, quality operatorBlocked at sSrv11.

sSrv11	**Blocking by operator**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-3 Subclause 6.2.6, Table 3
IEC 61850-8-1 Subclause 13.4.1, 13.4.2

Expected result

1. DUT sends SetDataValues Response+ when supported
2. The quality bits oldData and operatorBlocked shall be set and validity: questionable and the timeStamp has been updated to the quality change
3. The process value does not change (is the same as in step 2) and the quality bits oldData and operatorBlocked are still set and the timestamp is not updated
4. DUT sends SetDataValues Response+ when supported
5. The quality has oldData and operatorBlocked bits cleared, validity: valid, the value represents the value delivered by the EQUIPMENT SIMULATOR and the timeStamp has been updated to the quality change

Test description

1. Test engineer enables blocking (blkEna =True) for a data object, for example client requests SetDataValues (blkEna=TRUE) when supported.
2. Client requests GetDataValues of the corresponding data object
3. Force EQUIPMENT SIMULATOR to change the process value of the blocked object, client requests GetDataValues of the corresponding data object
4. Test engineer disables blocking (blkEna =False) for a data object, for example client requests SetDataValues (blkEna=FALSE) when supported.
5. Client requests GetDataValues of the corresponding data object

Comment

sSrv12	**Mode / Behaviour: off, test and/or blocked**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-4 Table 10, Annex A

IEC 61850-8-1 Subclause 13.4.1, 13.4.2

Expected result

2. Mode and Behaviour values are updated, quality of process data is invalid
4. Mode and Behaviour values are updated, quality bit “test” is set in process data
6. Mode and Behaviour values are updated, quality bit “test” is set in process data
8. Mode and Behaviour values are updated, quality is the same as in Mode = on
10. Mode and Behaviour values are updated, all quality bits are cleared in process data

Mod, Beh and Health are not process values and their quality is always ‘validity=good’ and quality bit test is not set

Test description

1. Force DUT into Mode = off for one logical node (when supported)
2. Client requests GetDataValues of the Mode, Behaviour, Health and process data
3. Force DUT into Mode = test for one logical node (when supported)
4. Client requests GetDataValues of the Mode, Behaviour, Health and process data
5. Force DUT into Mode = test/blocked for one logical node (when supported)
6. Client requests GetDataValues of the Mode, Behaviour, Health and process data
7. Force DUT into Mode = blocked for one logical node (when supported)
8. Client requests GetDataValues of the Mode, Behaviour, Health and process data
9. Force DUT into Mode = on for one logical node
10. Client requests GetDataValues of the Mode, Behaviour, Health and process data

Comment

sSrv13	**Logical device hierarchy (GrRef)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Subclause 8.2.5

IEC 61850-7-4 Subclause 5.3.4, Table 10

IEC 61850-8-1 Subclause 13.4.1, 13.4.2

Expected result

1. The GrRef value references a valid logical device, the reference shall not result in a hierarchy loop, the format of the GrRef.setSrcRef value in SCL is: “@<LDevice.inst>” or “<IED.name><LDevice.inst>” and in the online datamodel: “<IED.name><LDevice.inst>” or <LDevice.ldName>
3. The Beh values on all lower hierarchy level(s) do match with IEC 61850-7-4 Table 10

Test description

1. Client requests GetDataValues of all GrRef data objects
2. Change the Mod of a logical device on a higher level
3. Client requests GetDataValues of all lower hierarchy Beh data objects

Comment

sSrv14	State change when blocking is enabled (deprecated)	
Comment Same as sSrv11		

sSrv15	WYE, DEL, SEQ time stamp	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 Subclause 6.2, 6.3, 6.4, 6.5 and 7.4.2, Table 3 PIXIT: Sr1		
Expected result 2. DUT sends GetDataValues Response+, for WYE, DEL, SEQ the SDO.t for all phases are identical		
Test description 1. Force EQUIPMENT SIMULATOR to change a measured value on one phase. 2. Client request GetDataValues on one object reference with CDC = WYE, DEL and SEQ		
Comment		

sSrvN1	LD/LN/Data services with incorrect parameters	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 7.2.2, 8.2.1, 10.2-3, 11.4.2-5 IEC 61850-8-1 Subclause 8.1.3.4		
Expected result 1. a) DUT sends MMS service error with error class access “object-non-existent” b) DUT sends MMS service error with error class access “object-non-existent” c) DUT sends MMS service error with error class access “object-non-existent” d) DUT sends response with data access error “object-non-existent” e) DUT sends response with data access error “object-non-existent” f) DUT sends response with data access error “object-non-existent”		
Test description 1. Client requests the following data services with wrong parameters (unknown object, logical device and/or logical node, known object but with a name case mismatch when applicable): a) GetLogicalDeviceDirectory b) GetLogicalNodeDirectory(DATA) c) GetDataDirectory / GetDataDefinition (same for part 8-1) d) GetDataValues e) SetDataValues f) GetAllDataValues		
Comment		

sSrvN2	SetDataValues with out-of-range ENUMERATED value	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.3 IEC 61850-8-1 Subclause 8.1.3.4.4.2, Table 23		
Expected result 1. DUT sends response with data access error “object-value-invalid”		
Test description 1. Client sends a SetDataValues request of an ENUMERATED data attribute with an out-of-range value		
Comment		

sSrvN3	SetDataValues with mismatching data type	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.3 IEC 61850-8-1 Subclause 8.1.3.4.4.2, Table 23		
Expected result 1. DUT sends response with data access error “type-inconsistent” 2. DUT sends response with data access error “type-inconsistent” 3. DUT sends response with data access error “type-inconsistent” 4. DUT sends response with data access error “type-inconsistent”		
Test description 1. Client sends a SetDataValues request with an integer data object with a float value 2. Client sends a SetDataValues request with a float data object with an integer value 3. Client sends a SetDataValues request with a boolean data object with a float value 4. Client sends a SetDataValues request with a bitstring data object with a float value		
Comment		

sSrvN4	SetDataValues of read-only FCDA	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 11.4.3 IEC 61850-8-1 Subclause 8.1.3.4.4.2, Table 23		
Expected result 1. DUT sends response with data access error “object-access-denied”		
Test description 1. Client sends a SetDataValues request with a read-only FCDA		
Comment		

A4.2 Data set

Abstract test cases

Test case	Test case description
sDs1	Request GetLogicalNodeDirectory(DATA-SET) and check response (IEC 61850-7-2 Subclause 10.2.2) For each response issue a GetDataSetValues request and check response (IEC 61850-7-2 Subclause 13.3.2) GetDataSetDirectory request and check response (IEC 61850-7-2 Subclause 13.3.6)
sDs2	Request a persistent CreateDataSet with one member and with maximum possible members and check response (IEC 61850-7-2 Subclause 13.3.4) and verify that the persistent data set is visible for another client
sDs3	Request a non-persistent CreateDataSet with one, maximum members and check response (IEC 61850-7-2 Subclause 13.3.4) and verify that the persistent data set is not visible for another client
sDs4	Create and delete a persistent dataset, create the dataset again with the same name with one extra data value / re-ordered member and check the members
sDs5	Create and delete a non-persistent dataset, create the dataset again with the same name with one extra data value / re-ordered member and check the members
sDs6	Create a non-persistent dataset, release/abort the association, associate again and check the dataset has been deleted (IEC 61850-7-2 Subclause 13.1)
sDs7	Create a persistent dataset, release/abort the association, associate again and check the dataset is still present (IEC 61850-7-2 Subclause 13.1)
sDs8	Create and delete a persistent data set several times and verify every data set can be created normally
sDs9	Create and delete a non-persistent data set several times and verify every data set can be created normally
sDs10	Verify SetDataSetValues / GetDataSetValues with GetDataValues and SetDataValues
sDs11	Verify that the maximum number of persistent data sets with the maximum number of members can be created as specified in SCL
sDs12	Verify that the maximum number of non-persistent data sets with the maximum number of members can be created as specified in SCL
sDs13	Verify that a persistent data set can be created with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)
sDs14	Verify that a non-persistent data set can be created with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)
sDs15	Verify that the DUT supports data sets containing elements with different data hierarchy levels

Test case	Test case description
sDsN1	Request following data set services with wrong parameters (unknown object, name case mismatch, wrong logical device or wrong logical node) and verify response- service error: GetDataSetValues (IEC 61850-7-2 Subclause 13.3.2) SetDataSetValues (IEC 61850-7-2 Subclause 13.3.3) CreateDataSet (IEC 61850-7-2 Subclause 13.3.4) DeleteDataSet (IEC 61850-7-2 Subclause 13.3.5) GetDataSetDirectory (IEC 61850-7-2 Subclause 13.3.6)
sDsN2	Create a persistent dataset with the same name twice, and verify response- service error
sDsN3	Create a non-persistent dataset with the same name twice, and verify response- service error
sDsN4	Continue to create persistent data sets until a correct response- service error is returned
sDsN5	Continue to create non-persistent data sets until a correct response- service error is returned
sDsN6	Create a persistent dataset with unknown member verify response- service error
sDsN7	Create a non-persistent dataset with unknown member verify response- service error
sDsN8	Delete a (pre-defined) non-deletable dataset, and verify response- service error
sDsN9	Delete a persistent dataset twice, and verify response- service error
sDsN10	Delete a non-persistent dataset twice, and verify response- service error
sDsN11	Delete a persistent dataset referenced by a (report) control class, and verify response- service error (IEC 61850-7-2 Subclause 13.1)
sDsN12	Delete a non-persistent dataset referenced by a (report) control class, and verify response- service error (IEC 61850-7-2 Subclause 13.1)
sDsN13	Request SetDataSetValues with a dataset with one or more read-only members, and verify response- service error

Detailed test procedures

sDs1	**GetLogicalNodeDirectory, GetDataSetDirectory, GetDataSetValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6 IEC 61850-8-1 Subclause 14.3		
Expected result 1. DUT sends a GetLogicalNodeDirectory (DATA-SET) response+ 2. DUT sends a GetDataSetDirectory response+, mmsDeletable = False for pre-configured datasets 3. DUT sends a GetDataSetValues response+		

Test description 1. For each logical node Client requests a GetLogicalNodeDirectory (DATA-SET) 2. For each returned data set, Client requests a GetDataSetDirectory 3. For each returned data set, Client requests a GetDataSetValues
Comment

sDs2	**Persistent data set, one and max no. of members**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.4 IEC 61850-8-1 Subclause 12.3.1, 14.3.3		
Expected result 1. DUT sends CreateDataSet response+ 2. DUT responds GetLogicalNodeDirectory(DATA-SET) response+. The response includes the name of the just created data set 3. DUT responds GetLogicalNodeDirectory(DATA-SET) response+. The response includes the name of the just created data set		
Test description 1. Client1 requests a persistent CreateDataSet with one member 2. Client1 requests GetLogicalNodeDirectory(DATA-SET) 3. Client2 requests GetLogicalNodeDirectory(DATA-SET) 4. Repeat step 1-2-3 but now with the maximum number of members		
Comment		

sDs3	**Non-persistent data set, one and max no. of members**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.4 IEC 61850-8-1 Subclause 12.3.1, 14.3.3		
Expected result 1. DUT sends CreateDataSet response+ 2. DUT responds GetLogicalNodeDirectory(DATA-SET) response+. The response includes the name of the just created data set 3. DUT sends GetLogicalNodeDirectory(DATA-SET) response+, but without the name of the just created data set		
Test description 1. Client1 requests a non-persistent CreateDataSet with one member 2. Client1 requests GetLogicalNodeDirectory(DATA-SET) 3. Client2 requests GetLogicalNodeDirectory(DATA-SET) 4. Repeat step 1-2-3 but now with the maximum number of members		

Comment

sDs4	**Create and delete persistent data set with same name, one extra member, and re-ordered members**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.4, 13.3.5, 13.3.6
IEC 61850-8-1 Subclause 12.3.1, 14.3.3, 14.3.4, 14.3.5

Expected result

1. DUT sends a CreateDataSet response+
2. DUT sends:
   - GetLogicalNodeDirectory(DATA-SET) response+, the data set is present.
   - DUT sends GetDataSetDirectory response+ and contains the members as defined and mmsDeletable=True
3. DUT sends a DeleteDataSet response+
4. DUT sends:
   - CreateDataSet response+
   - GetLogicalNodeDirectory(DATA-SET) response+, the data set is present
   - GetDataSetDirectory response+ and contains the members as defined members as defined. The extra member is available
5. DUT sends a DeleteDataSet response+
6. DUT sends:
   - CreateDataSet response+
   - GetLogicalNodeDirectory(DATA-SET) response+, the data set is present
   - GetDataSetDirectory response+ and contains the members in the order as defined and mmsDeletable=True

Test description

1. Client requests a persistent CreateDataSet with a number of members (at least two)
2. For this just created data set, Client requests a GetLogicalNodeDirectory(DATA-SET) and a GetDataSetDirectory
3. Client requests a DeleteDataSet on the just created data set
4. Client requests again a persistent CreateDataSet but now with one extra member. Clients requests a GetLogicalNodeDirectory(DATA-SET) and a GetDataSetDirectory
5. Client requests a DeleteDataSet on the just created data set
6. Client requests again a persistent CreateDataSet with the same members as step 2 but with the first two members reordered (the first member is now listed as the second member,the second member is now listed as the first member). Request a GetLogicalNodeDirectory(DATA-SET) and a GetDataSetDirectory

Comment

sDs5	**Create and delete non-persistent data set with same name, one extra member, and re-ordered members**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.4, 13.3.5, 13.3.6
IEC 61850-8-1 Subclause 12.3.1, 14.3.3, 14.3.4, 14.3.5

Expected result

1. See sDs4

Test description

1. Repeat sDs4 but now with a non-persistent data set

Comment

sDs6	Deletion of non-persistent dataset after Release	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.2, 13.3.4, 13.3.5 IEC 61850-8-1 Subclause 12.3.1, 14.3.1, 14.3.3, 14.3.4, Table 17		
Expected result 1. DUT sends a CreateDataSet response+ 2. DUT responds GetLogicalNodeDirectory(DATA-SET) response+. The response includes the name of the just created data set 3. DUT sends an Associate response+ 4. The data set is not available anymore. DUT sends MMS ServiceError with Error class access and Error code object-non-existent		
Test description 1. Client requests a non-persistent CreateDataSet with at least one member 2. Client requests a GetLogicalNodeDirectory(DATA-SET) 3. Client requests Release and then Associate 4. Client requests a GetDataSetValues for the just created data set 5. Repeat step 1 to 4, but in step 3 use Abort instead of Release 6. Repeat step 1 to 4, but in step 3 disable the TCP communication between Client1 and the DUT. E.g. disconnect the physical link, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the lost connection detection timeout (specified in the PIXIT) and then enable TCP communication. E.g. connect the physical link		
Comment		

sDs7	Non-deletion of persistent dataset after Release	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.1, 13.3.2, 13.3.4, 13.3.5 IEC 61850-8-1 Subclause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. DUT sends a CreateDataSet response+ 2. DUT responds GetLogicalNodeDirectory(DATA-SET) response+. The response includes the name of the just created data set 3. DUT sends an Associate response+ 4. DUT sends a GetDataSetValues response+. The data set is available, it is not deleted		

Test description

1. Client requests a persistent CreateDataSet with at least one member
2. Client requests a GetLogicalNodeDirectory(DATA-SET)
3. Client requests Release and then Associate
4 Client requests a GetDataSetValues for the just created data set
5. Repeat step 1 to 4 but in step 3 use Abort instead of Release
6. Repeat step 1 to 4, but in step 3 disable the TCP communication between Client1 and the DUT. E.g. disconnect the physical link, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the lost connection detection timeout (specified in the PIXIT) and then enable TCP communication. E.g. connect the physical link

Comment

sDs8	**Create and delete persistent data set several times**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.1, 13.3.4, 13.3.5
IEC 61850-8-1 Subclause 14.3.3, 14.3.4

Expected result

1. DUT responds with a CreateDataSet response+
2. DUT responds with a DeleteDataSet response+
3. Every data set can be created and deleted without problems

Test description

1. Client requests a persistent CreateDataSet with multiple members
2. Client requests a DeleteDataSet on the just created data set
3. Repeat step 1 and 2 250 times

Comment

sDs9	**Create and delete non-persistent data set several times**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.1, 13.3.4, 13.3.5
IEC 61850-8-1 Subclause 14.3.3, 14.3.4

Expected result

1. DUT responds with a CreateDataSet response+
2. DUT responds with a DeleteDataSet response+
3. Every data set can be created and deleted without problems

Test description

1. Client requests a non-persistent CreateDataSet with multiple members
2. Client requests a DeleteDataSet on the just created data set
3. Repeat steps 1 and 2 250 times

Comment

sDs10a	GetDataSetValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.2, 13.3.3 IEC 61850-8-1 Subclause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. The DUT returns CreateDataSet response+ if creating a data set is used 2. The DUT returns the corresponding values for GetDataSetValues 3. The DUT returns the same values for GetDataValues		
Test description 1. Select or create a data set with read-only elements 2. Client requests a GetDataSetValues 3. Client requests a GetDataValues for each member of the dataset.		
Comment		

sDs10b	SetDataSetValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.2, 13.3.3 IEC 61850-8-1 Subclause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. The DUT returns CreateDataSet response+ if creating a data set is used 2. The DUT returns GetDataSetValues response+ 3. The values returned by GetDataSetValues and GetDataValues are the same 4. The DUT returns SetDataSetValues response+ with a listOfVariable success 5. The values returned by GetDataSetValues contain the new values 6. The DUT returns SetDataValues response+ with a listOfVariable success 7. The values returned by GetDataSetValues contain the new values		
Test description 1. Select or create a data set with writable elements 2. Client requests a GetDataSetValues 3. Client requests a GetDataValues for each member of the dataset. 4. Client requests a SetDataSetValues with different values than received by GetDataValues 5. Client requests a GetDataSetValues 6. Client requests a SetDataValues for each member of the dataset with different values than received by GetDataSetValues 7. Client request GetDataSetValues		
Comment		

sDs11	**Create maximum persistent data sets with maximum number of members**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.4, 13.3.5
IEC 61850-8-1 Subclause 14.3.3, 14.3.4

Expected result

1. Every data set can be created. In case data sets are already pre-configured the total number of data sets are equal to the maximum number of data sets
2. Each created data set can be deleted
3. Every data set can be created
4. Each created data set can be deleted

Test description

1. Client requests CreateDataSet for maximum number of persistent data sets (as specified in ICD DynDataSet – max) with the maximum number of **FCDAs** (as specified in ICD DynDataSet - maxAttribute)
2. Client request DeleteDataSet with all just created data sets
3. Client requests CreateDataSet for maximum number of persistent data sets (as specified in ICD DynDataSet – max) with the maximum number of **FCDs** (as specified in ICD DynDataSet - maxAttribute)
4. Client request DeleteDataSet with all just created data sets

Comment

sDs12	**Create maximum non-persistent data sets with maximum number of members**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.4, 13.3.5
IEC 61850-8-1 Subclause 14.3.3, 14.3.4

Expected result

1. Every data set can be created. In case data sets are already configured the total number of data sets is equal to the maximum
2. Each created dataset can be deleted
3. Every data set can be created
4. Each created dataset can be deleted

Test description

1. Client requests CreateDataSet for maximum number of non-persistent data sets (as specified in ICD DynDataSet – max) with the maximum number of FCDAs (as specified in ICD DynDataSet-maxAttribute)
2. Client request DeleteDataSet with all just created data sets
3. Client requests CreateDataSet for maximum number of non-persistent data sets (as specified in ICD DynDataSet – max) with the maximum number of FCDs (as specified in ICD DynDataSet – maxAttribute)
4. Close the association to delete all non-persistent datasets

Comment

On closing the association, the non-persistent datasets are already deleted by the server

sDs13	**Create persistent data set with maximum name length**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 22.2 IEC 61850-8-1 Subclause 14.3.3, 14.3.4		
Expected result 1. DUT sends a CreateDataSet response+ 2. Data set can be deleted		
Test description 1. Client requests a persistent CreateDataSet with maximum name length (32 char) with at least one member with the longest available data reference in the data model 2. Client requests DeleteDataSet		
Comment		

sDs14	**Create non-persistent data set with maximum name length**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 22.2 IEC 61850-8-1 Subclause 14.3.3, 14.3.4		
Expected result 1. DUT sends a CreateDataSet response+		
Test description 1. Client requests a non-persistent CreateDataSet with maximum name length (32 char) with at least one member with the longest available data reference in the data model 2. Close the association to delete the dataset		
Comment		

sDs15	**Dataset with most to least data hierarchy FCDA elements**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6

IEC 61850-8-1 Subclause 14.3

Expected result

1. In the SCD/IID file the FCDA doName contains maximum one dot (for example doName="neut.phsA" and daName="cVal.mag.f")
2. DUT sends a GetDataSetDirectory response+
3. DUT sends a GetDataSetValues response+

Test description

1. Configure DUT with one or more datasets with the least detailed data hierarchy to the most detailed data hierarchy available in the DUT data model. For example:
   - MMXU.PhV
   - MMXU.A.phsA
   - MMXU.A.phsB.cVal
   - MMXU.A.phsC.cVal.mag
   - MMXU.A.neut.cVal.mag.f
2. Client requests a GetDataSetDirectory for these dataset(s)
3. Client requests a GetDataSetValues for these dataset(s)

Comment

sDsN1	DataSet services with illegal parameters	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.2, 13.3.3, 13.3.4, 13.3.5, 13.3.6
IEC 61850-8-1 Subclause 8.1.3.4

Expected result

a) DUT sends ServiceError with errorClass=access errorCode=object-non-existent
b) DUT sends ServiceError with errorClass=access errorCode=object-non-existent
c) DUT sends ServiceError with errorClass=access errorCode=object-non-existent
d) DUT sends DeleteDataSet response- with numberMatched=0, numberDeleted=0
e) DUT sends ServiceError with errorClass=access errorCode=object-non-existent

Test description

a)
1. Client requests a GetDataSetValues with an unknown data set name as DataSetReference.
2. Client requests a GetDataSetValues for a known data set but with the first character of the DataSetReference in opposite case. E.g. if the first character is 'M', use 'm' now. If it was 'm', use 'M'.
3. Client requests a GetDataSetValues with a non-existing Logical Device in the DataSetReference
4. Client requests a GetDataSetValues where the Logical Device in the DataSet reference is replaced by another, existing Logical Device in this DUT, but which does not contain a dataset with the same name
5. Client requests a GetDataSetValues with a non-existing Logical Node in the DataSetReference
6. Client requests a GetDataSetValues where the Logical Node in the DataSet reference is replaced by another, existing Logical Node in another Logical Device in the DUT

b) Repeat steps 1 to 6 for SetDataSetValues
c) Repeat steps 3 and 5 for CreateDataSet
d) Repeat steps 1 to 6 for DeleteDataSet
e) Repeat steps 1 to 6 for GetDataSetDirectory

Comment

Steps 4 and 6 are applicable only if DUT contains more than one Logical Device.

existent".

- A Write-Request that specifies a NamedVariableList object does not exist, the MMPM shall return a MMS Confirmed-Error PDU. The ServiceError, within the Confirmed-ErrorPDU shall be errorClass="access" with an errorCode="object-non-existent".

sDsN2	Create a persistent dataset twice	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.4
IEC 61850-8-1 Subclause clause 8.1.3.4.3.4

Expected result

1. DUT sends a response+,
2. DUT sends MMS service error with errorClass=definition errorCode=object-exists

Test description

1. Client requests a CreateDataSet for a persistent data set with at least one member
2. Client requests the same CreateDataSet again

Comment

sDsN3	**Create a non-persistent dataset twice**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.4 IEC 61850-8-1 Subclause 8.1.3.4.3.4		
Expected result 1. DUT sends a response+, 2. DUT sends MMS service error with errorClass=definition errorCode=object-exists		
Test description 1. Client requests a CreateDataSet for a non-persistent data set with at least one member 2. Client requests the same CreateDataSet again		
Comment		

sDsN4	**Continue to create persistent data sets until a response-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.4 IEC 61850-8-1 Subclause 8.1.3.4.3.3		
Expected result 1. The DUT responds with a CreateDataSet response+ for every successful created data set and for the failed request DUT responds with a CreateDataSet response- with errorClass=resource and errorCode=capability-unavailable; The total number of data sets (including datasets configured in SCL, and datasets created by CreateDataSet service request) shall be equal or greater than the value of the SCL attribute: DynDataSet.max		
Test description 1. Client continues to request persistent CreateDataSet till a response- is received 2. Client deletes all created data sets		
Comment NOTE: Value of SCL attribute ConfDataSet.max is checked in system/IED configuration tool conformance test thus is out-of-scope of server conformance test.		

sDsN5	**Continue to create non-persistent data sets until a response-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.4 IEC 61850-8-1 Subclause 8.1.3.4.3.3		
Expected result 1. The DUT responds with a CreateDataSet response+ for every successful created data set and for the failed request DUT responds with a CreateDataSet response- with errorClass=resource and errorCode=capability-unavailable; The total number of data sets (including datasets configured in SCL, and datasets created by CreateDataSet service request) shall be equal or greater than the value of the SCL attribute: DynDataSet.max		
Test description 1. Client continues to request non-persistent CreateDataSet till a response- is received 2. Client releases the association		
Comment NOTE: Value of SCL attribute ConfDataSet.max is checked in system/IED configuration tool conformance test thus is out-of-scope of server conformance test.		

sDsN6	**Create persistent data set with unknown data reference**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.4 IEC 61850-8-1 Subclause 8.1.3.4.3.3		
Expected result 1. The DUT responds with a CreateDataSet response- with errorClass=definition and errorCode=object-undefined		
Test description 1. Client requests a persistent CreateDataSet with at least two data references of which one is unknown		
Comment		

sDsN7	**Create non-persistent data set with unknown data reference**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.4 IEC 61850-8-1 Subclause 8.1.3.4.3.3		
Expected result 1. The DUT responds with a CreateDataSet response- with errorClass=definition and errorCode=object-undefined		
Test description 1. Client requests a non-persistent CreateDataSet with at least two data references of which one is unknown		
Comment		

sDsN8	Delete a pre-configured data set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.5 IEC 61850-8-1 Subclause 8.1.3.4.3.6		
Expected result 1. The DUT sends a DeleteDataSet response+ with numberMatched=1 and numberDeleted = 0		
Test description 1. Client requests a DeleteDataSet to delete a pre-configured, non-deletable data set, not referenced in a report control block		
Comment		

sDsN9	Delete a persistent data set twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.5 IEC 61850-8-1 Subclause 8.1.3.4.3.6		
Expected result 1. DUT sends a CreateDataSet response+ 2. DUT sends a response+ with numberMatched=1 and numberDeleted = 1 3. DUT sends a response+ with numberMatched=0 and numberDeleted = 0		
Test description 1. Client requests a persistent CreateDataSet 2. Client requests a DeleteDataSet for the created data set in step 1 3. Client requests the same DeleteDataSet		
Comment		

sDsN10	Delete a non-persistent data set twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.5 IEC 61850-8-1 Subclause 8.1.3.4.3.6		
Expected result 1. DUT sends a CreateDataSet response+ 2. DUT sends a response+ with numberMatched=1 and numberDeleted = 1 3. DUT sends a response+ with numberMatched=0 and numberDeleted = 0		
Test description 1. Client requests a non-persistent CreateDataSet 2. Client requests a DeleteDataSet for the created data set in step 1 3. Client requests the same DeleteDataSet		
Comment		

sDsN11	Delete referenced persistent data set	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.5

IEC 61850-8-1 Subclause 8.1.3.4.3.6

Expected result

1. DUT sends a CreateDataSet response+
2. DUT sends a SetBRCBValues response+ (when datSet=”dyn”)
3. DUT sends a SetURCBValues response+ (when datSet=”dyn”)
4. DUT sends a DeleteDataSet response- with MMS service error with errorClass “service”, errorCode “object-constraint-conflict” and serviceSpecificInformation deleteNamedVarList 0
5. DUT sends a DeleteDataSet response- with MMS service error with errorClass “service”, errorCode “object-constraint-conflict” and serviceSpecificInformation deleteNamedVarList 0
6. DUT sends a SetURCBValues response+ and SetBRCBValues response+
7. DUT sends a DeleteDataSet response+ with numberMatched=1 and NumberDeleted=1

Test description

1. Client requests a persistent CreateDataSet.
2. Client reserves and configures a BRCB with this data set (when supported)
3. Client reserves and configures and enables an URCB with this data set (when supported)
4. Client requests a DeleteDataSet on the data set created in step 1
5. Client disables the URCB and requests a DeleteDataSet on the data set created in step 1
6. Client configures another or empty dataset to the BRCB and URCB to detach the dataset from step 1
7. Client requests a DeleteDataSet on the data set created in step 1

Comment

Note: this is expected: MMS serviceError { errorClass service object-constraint-conflict,
serviceSpecificInformation deleteNamedVarList 0 } } } } }

sDsN12	Delete referenced non-persistent data set	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 13.3.5

IEC 61850-8-1 Subclause 8.1.3.4.3.6

Expected result

1. DUT sends a CreateDataSet response+
2. DUT sends a SetBRCBValues response- with data access error “object-value-invalid” (when datSet=”dyn”)
3. DUT sends a SetURCBValues response+ (when datSet=”dyn”)
4. DUT sends a DeleteDataSet response- with MMS service error with errorClass “service”, errorCode “object-constraint-conflict” and serviceSpecificInformation deleteNamedVarList 0
5. DUT sends a DeleteDataSet response- with MMS service error with errorClass “service”, errorCode “object-constraint-conflict” and serviceSpecificInformation deleteNamedVarList 0
6. DUT sends a SetURCBValues response+ and SetBRCBValues response+
7. DUT sends a DeleteDataSet response+ with numberMatched=1 and NumberDeleted=1

Test description

1. Client requests a non-persistent CreateDataSet.
2. Client reserves and configures a BRCB with this data set (when supported)
3. Client reserves and configures and enables an URCB with this data set (when supported)
4. Client requests a DeleteDataSet on the data set created in step 1
5. Client disables the URCB and requests a DeleteDataSet on the data set from step 1
6. Client configures another or empty dataset to the BRCB and URCB to detach the dataset from step 1
7. Client requests a DeleteDataSet on the data set created in step 1

Comment

sDsN13	**SetDataSetValues on read-only data attribute**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 13.3.3 IEC 61850-8-1 Subclause 8.1.3.4.3.3 and 8.1.3.4.4.2		
Expected result 1. DUT sends a SetDataSetValues response+ with a list of access results indicating failure + object-access-denied for read-only attributes and success where succeeded		
Test description 1. Client requests a SetDataSetValues on a data set with at least one read-only data attribute		
Comment All other errors/processing shall be per 8.1.3.4.4.2.		

A4.3 Substitution

Abstract test cases

Test case	Test case description
sSub1	Disable subEna and set subVal, subMag, subCMag, subQ, subID and verify the substituted values are not transmitted when subEna is disabled and are transmitted when subEna enabled (IEC 61850-7-3 Table 64).
sSub2	Verify that in case the association fails, the substituted values shall remain unchanged
sSub3	Verify setting subVal, subMag, subCMag, subQ and subID is allowed and the substituted values are transmitted and Quality.Source is set to Substituted when subEna is enabled

Detailed test procedures

sSub1	**Transmission of substituted values**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 Table 64		
Expected result 1. DUT sends GetDataValues response+ with process values and quality source = process 2. DUT sends SetDataValues response+ 3. DUT sends GetDataValues response+ with process values and quality source = process 4. DUT sends SetDataValues response+ 5. DUT sends GetDataValues response+ with substituted values and quality source = substituted and timestamp is updated 6. DUT sends SetDataValues response+ 7. DUT sends GetDataValues response+ with process values and quality source = process and and timestamp is updated		
Test description 1. Client requests GetDataValues of one ST and/or MX data value 2. Client requests SetDataValues of the SV attributes: subVal, subMag, subCVal, subQ and subID with different values than the process values 3. Client requests GetDataValues of one ST and/or MX data values and SV attributes 4. Client requests SetDataValues to enable substitution 5. Client requests GetDataValues of one ST and/or MX data value and SV attributes 6. Client requests SetDataValues to disable substitution 7. Client requests GetDataValues of one ST and/or MX data value and SV attributes		
Comment		

sSub2	**Transmission of substituted values on aborted association**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 Table 64		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues response+ 3. DUT sends SetDataValues response+ 4. DUT aborts association 5. DUT sends Associate response+ 6. DUT sends GetDataValues response+ with substituted values 7. DUT sends SetDataValues response+		
Test description 1. Client requests GetDataValues of one ST and/or MX data value 2. Client requests SetDataValues of the SV data value attributes with different values than the process values 3. Client requests SetDataValues to enable substitution 4. Client requests Abort 5. Client requests Associate 6. Client requests GetDataValues of one ST and/or MX data value 7. Client requests SetDataValues to disable substitution		
Comment		

sSub3	**Change of substituted values when substitution is enabled**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 Table 64		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues response+ 3. DUT sends SetDataValues response+ 4. DUT sends GetDataValues response+ with substituted values 5. DUT sends SetDataValues response+ 6. DUT sends GetDataValues response+ with new substituted values 7. DUT sends SetDataValues response+ 8. DUT sends GetDataValues response+ with process values		
Test description 1. Client requests GetDataValues of one ST and/or MX data object 2. Client requests SetDataValues of the SV data value attributes with different values than the process values 3. Client requests SetDataValues to enable substitution 4. Client requests GetDataValues of one ST and/or MX data object 5. Client requests SetDataValues of the SV with new data value attributes 6. Client requests GetDataValues of the ST and/or MX data object 7. Client requests SetDataValues to disable substitution 8. Client requests GetDataValues of the ST and/or MX data object		
Comment		

A4.4 Setting group control

Abstract test cases

Test case	Test case description
sSg1	Request GetLogicalNodeDirectory(SGCB) and check response+. For each SGCB request GetSGCBValues and check response+
sSg2	Verify the following setting group state machine path (IEC 61850-7-2 Subclause 16 figure 22); SelectEditSG Use SetEditSGValue [FC=SE] to change values Use GetEditSGValue [FC=SE] to verify the new values ConfirmEditSGValues
sSg3	Verify SelectActiveSG (IEC 61850-7-2 Subclause 16 figure 22); SelectActiveSG of the first setting group GetSGCBValues to verify active setting group and last activation time Use GetDataValues to verify the values are of fist setting group Repeat for all setting groups
sSg4	Verify that after loss of association the server cancels the editing (EditSG=0) and the client can use SelectEditSG again to copy the values to the edit buffer (IEC 61850 7-2 Subclause 16.3.3)
sSg5	Verify that when SGCB ResvTms is present The first client can edit the setting group when ResvTms = 0 A second client can not edit the setting group when ResvTms > 0 A server resets the ResvTms when it does not receive a ConfirmEditSGValues within the reservation time
sSg6	Verify that when SGCB ResvTms is not present The first client can edit the setting group A second client can’t edit the setting group within a certain time (PIXIT)
sSg7	Verify that editing and activating the active setting group is allowed
sSg8	Verify that a client can cancel the editing of a setting group and that the original setting group values remain unchanged
sSg9	Request SelectEditSG of the first setting group, change one value and SelectEditSG of the second setting group without (ConfirmEditSGValues). Verify the response+
sSg10	Verify that when a setting group is being edited the SG values of that group can be read
sSg11	Verify that the active setting group number is stored in non-volatile memory
sSg12	Verify that when new settings are confirmed these settings are stored in non-volatile memory

Test case	Test case description
sSgN1	Request following setting group selection services with wrong parameters (out of range values, or non-existent/null setting group) and verify response- service error SelectActiveSG (IEC 61850-7-2 Subclause 16.3.2) GetSGCBValues (IEC 61850-7-2 Subclause 16.3.7)
sSgN2	Request following setting group definition services with wrong parameters (out of range values, or non-existent/null setting group) and verify response- service error SelectEditSG (IEC 61850-7-2 Subclause 16.3.3) SetEditSGValue (IEC 61850-7-2 Subclause 16.3.4) ConfirmEditSGValues (IEC 61850-7-2 Subclause 16.3.5) GetEditSGValue [FC=SE] (IEC 61850-7-2 Subclause 16.3.6)
sSgN3	Request SetEditSGValue on a setting group value with FC=SG, verify response- service error
sSgN4	Request SetEditSGValue and GetEditSGValue without SelectEditSG (EditSG = 0), verify response- service error
sSgN5	Verify that when a client is editing settings, another client can't edit settings

Detailed test procedures

sSg1	**GetLogicalNodeDirectory(SGCB) and GetSGCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 16.3.7 IEC 61850-8-1 Subclause 12.3.1, 16.2.6		
Expected result 1. DUT sends response+ with zero or one SGCB. The SGCB shall only be present in LLN0 and shall have the name "SGCB" 2. DUT sends GetSGCBValues response+ with the mandatory SGCB attributes		
Test description 1. For each logical device and logical node Client requests GetLogicalNodeDirectory(SGCB) 2. For each SGCB Client requests GetSGCBValues		
Comment		

sSg2	SelectEditSG, SetEditSGValue, ConfirmEditSGValues	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.2, 16.3
IEC 61850-8-1 Subclause 16.2

Expected result

1. DUT sends SelectEditSG response+
2. DUT sends SetEditSGValue [FC=SE] response+
3. DUT sends GetEditSGValue [FC=SE] response+
4. DUT sends SetEditSGValue [FC=SE] response- with data access error = object-access-denied
5. DUT sends ConfirmEditSGValues response+
6. The value of SGCB.CnfEdit shall return to FALSE once the storage is completed
7. The active (SG) values match with the edited (SE) values

Test description

1. Client requests SelectEditSG
2. For each data type in the setting group that is writable (valKind=Set) Client requests SetEditSGValue [FC=SE] with a new valid value
3. Client requests GetEditSGValue [FC=SE] to verify the new values
4. For each data type in the setting group that is not writable (valKind=RO) Client requests SetEditSGValue [FC=SE]
5. Client requests ConfirmEditSGValues
6. Client requests GetSGCBValues
7. Client activates the edited setting group and request GetDataValues for each updated SG value

Comment

sSg3	SelectActiveSG	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.2, 16.3
IEC 61850-8-1 Subclause 16.2.1, 16.2.5

Expected result

1. DUT sends SelectActiveSG response+
2. DUT has updated the activated setting group value and last activation time (when the setting group value has changed)
3. DUT sends GetDataValues response+

Test description

1. Client requests SelectActiveSG of the first setting group
2. Client requests GetSGCBValues
3. Client requests GetDataValues to verify the SG values in the first setting group when available
4. Repeat steps 1 to 3 for other setting groups for this SGCB

Comment

sSg4	**SelectEditSG after lost association**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.3.3
IEC 61850-8-1 Subclause 16.2.2

Expected result

1. DUT sends SelectEditSG response+
2. DUT sends SetEditSGValue [FC=SE] response+
3. DUT aborts the association
4. DUT send associate response+
5. DUT sends response+ with SGCB.EditSG = 0
6. DUT sends SelectEditSG response+ and the values in the edit buffer are refreshed.
7. DUT sends GetEditSGValue [FC=SE] response+ with the original value(s)
8. DUT sends SetEditSGValue [FC=SE] response+
9. DUT sends ConfirmEditSGValues response+

Test description

1. Client requests SelectEditSG of the first setting group
2. For each data type in the setting group that is writable (valKind=Set) Client requests a SetEditSGValue [FC=SE] with a new valid value
3. Clients aborts the association
4. Client requests associate
5. Client requests GetSGCBValues
6. Client requests SelectEditSG of the first setting group
7. Client requests GetEditSGValue [FC=SE]
8. Client requests SetEditSGValue [FC=SE] to change values
9. Client requests ConfirmEditSGValues

Comment

sSg5	**SGCB reservation with ResvTms**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.2.2.8
IEC 61850-8-1 Subclause 16.2

Expected result

1. DUT sends SelectEditSG response+
2. DUT responds ResvTms > 0
3. DUT responds with SelectEditSG response-
5. DUT responds ResvTms = 0
6. DUT sends SelectEditSG response+

Test description

1. Client 1 requests a valid SelectEditSG on a unreserved SGCB (ResvTms = 0)
2. Client 1 requests GetSGCBValues
3. Client 2 requests SelectEditSG with the same SGCB
4. Client 1 waits 2 seconds longer than the SGCB.ResvTms value
5. Client 1 requests GetSGCBValues
6. Client 2 requests SelectEditSG with the same SGCB

Comment

sSg6	**SGCB reservation without ResvTms**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.2.2.8 and 16.3.3.1 IEC 61850-8-1 Subclause 16.2 PIXIT: Sg6		
Expected result 1. DUT sends SelectEditSG response+ 2. DUT sends SelectEditSG response- 3. DUT sends SelectEditSG response+ 4. DUT sends SelectEditSG response+		
Test description 1. Client 1 requests a valid SelectEditSG 2. After 2 seconds a second client requests SelectEditSG with the same SGCB 3. Client 1 cancels the editing by SelectEditSG to 0 4. Client 2 requests SelectEditSG with the same SGCB		
Comment		

sSg7	**Edit the active setting group**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.2 IEC 61850-8-1 Subclause 16.2.1, 16.2.5		
Expected result 1. DUT sends SelectActiveSG response+ 2. DUT sends SelectEditSG response+ 3. DUT sends SetEditSGValue response+ 4. DUT sends GetSGCBValues response+ 5. DUT sends ConfirmEditSGValues response+ 6. The values in the active setting group correspond to the changes done in step 3 7. The SGCB.lastActTm is updated to the time of the ConfirmEditSGValues		
Test description 1. Client requests SelectActiveSG of the first setting group 2. Client requests SelectEditSG of the first setting group 3. Client requests SetEditSGValue [FC=SE] 4. Client requests GetSGCBValues 5. Client requests ConfirmEditSGValues 6. Client requests GetEditSGValue [FC=SG] of the changed setting(s) 7. Client requests GetSGCBValues		
Comment		

sSg8	**Cancel editing of a setting group**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.2, 16.3 IEC 61850-8-1 Subclause 16.2.1, 16.2.5		
Expected result 1. DUT sends SelectEditSG response+ 2. DUT sends GetEditSGValue response+ 3. DUT sends SetEditSGValue response+ 4. DUT sends SelectEditSG response+ 5. DUT sends SelectEditSG response+ 6. DUT sends GetEditSGValue response+ with the same values as in step 2		
Test description 1. Client requests SelectEditSG of the first setting group 2. Client requests GetEditSGValue [FC=SE] 3. Client requests SetEditSGValue [FC=SE] with new valid values 4. Client requests SelectEditSG with group 0 (cancel) 5. Client requests SelectEditSG of the first setting group again 6. Client requests GetEditSGValue [FC=SE]		
Comment		

sSg9	**Select another setting group**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.2 IEC 61850-8-1 Subclause 16.2.1, 16.2.5		
Expected result 1. DUT sends SelectEditSG response+ 2. DUT sends GetEditSGValue response+ 3. DUT sends SetEditSGValue response+ 4. DUT sends SelectEditSG response+ 5. DUT sends SelectEditSG response+ 6. DUT sends GetEditSGValue response+ with the same values as in step 2		
Test description 1. Client requests SelectEditSG of the first setting group 2. Client requests GetEditSGValue [FC=SE] 3. Client requests SetEditSGValue [FC=SE] with new valid values 4. Client requests SelectEditSG of the second setting group 5. Client requests SelectEditSG of the first setting group 6. Client requests GetEditSGValue [FC=SE]		
Comment		

sSg10	**Verify that while a setting group is being edited the SG values of that group can be read (and are not updated before a ConfirmEditSGValues)**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.2 IEC 61850-8-1 Subclause 16.2.1, 16.2.5		
Expected result 1. DUT sends GetSGCBValues response+ 2. DUT sends SelectEditSG response+ 3. DUT sends GetEditSGValue response+ 4. DUT sends SetEditSGValue response+ 5. DUT sends GetEditSGValue response+ with the same values as in step 3		
Test description 1. Client requests GetSGCBValues (ActSg) 2. Client requests SelectEditSG(EditSg) with EditSg = ActSg 3. Client requests GetEditSGValue [FC=SE] 4. Client requests SetEditSGValue [FC=SE] with new valid values 5. Client requests GetEditSGValue [FC=SG] 6. Client requests SelectEditSG with group 0 (cancel)		
Comment		

sSg11	**Active setting group is stored in non-volatile memory**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.3.3 IEC 61850-8-1 Subclause 16.2.2		
Expected result 1. DUT sends response+ 2. DUT sends SelectActiveSG response+ 3. DUT send Associate response+ 4. DUT sends response+ with SGCB.ActSG is the same active setting group as before the restart		
Test description 1. Client requests GetSGCBValues 2. Client requests SelectActiveSG to another setting group 3. Cause unexpected DUT restart by simulating a temporarily power outage and client requests associate 4. Client requests GetSGCBValues		
Comment		

sSg12	**Settings are stored in non-volatile memory**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.3.3
IEC 61850-8-1 Subclause 16.2.2

Expected result

1. DUT sends SelectEditSG response+
2. DUT sends GetEditSGValue [FC=SE] response+
3. DUT sends SetEditSGValue [FC=SE] response+
4. DUT sends ConfirmEditSGValue response+
5. DUT send associate response+
6. DUT sends response+ with SGCB.EditSG = 0
7. DUT sends SelectEditSG response+ and then GetEditSGValues [FC=SE] response+ with the values written in step 3
8. DUT sends SetEditSGValue [FC=SE] response+
9. DUT sends GetEditSGValue [FC=SE] response+ with the original values from step 2
10. DUT sends ConfirmEditSGValues response+

Test description

1. Client requests SelectEditSG of the first setting group
2. For each data type in the setting group that is writable (valKind=Set) Client requests a GetEditSGValue [FC=SE]
3. For each data type in the setting group that is writable (valKind=Set) Client requests a SetEditSGValue [FC=SE] with a new valid value
4. Clients confirms the setting group
5. Cycle power of the DUT and client requests associate
6. Client requests GetSGCBValues
7. Client requests SelectEditSG of the first setting group then GetEditSGValues[FC=SE] for each value written in step 3
8. Client requests SetEditSGValue [FC=SE] to restore the original values from step 2
9. Client requests GetEditSGValue [FC=SE]
10. Client requests ConfirmEditSGValues

Comment

sSgN1	**Setting group selection services with wrong parameters**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.2, 16.3
IEC 61850-8-1 Subclause 16.2

Expected result

a) DUT sends SelectActiveSG response- with data access error=object-value-invalid
b) DUT sends GetSGCBValues response- with data access error=object-non-existent

Test description

a) Client requests SelectActiveSG with 0 and then NumOfSg+1 setting group
b) Client requests GetSGCBValues with unknown object

Comment

sSgN2	**Setting group definition services with wrong parameters**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.2, 16.3
IEC 61850-8-1 Subclause 16.2

Expected result

1. DUT sends SelectEditSG response- with data access error object-value-invalid
2. DUT sends SelectEditSG response+
3. DUT sends SetEditSGValue response- with error object-non-existent
4. DUT sends SetEditSGValue response- with error type-inconsistent
5. DUT sends SetEditSGValue response- with error object-value-invalid
6. DUT sends GetEditSGValue response- with error object-non-existent
7. DUT sends ConfirmEditSGValues response- with error object-non-existent

Test description

1. Client requests SelectEditSG with NumOfSg+1 setting group
2. Client requests SelectEditSG with first setting group
3. Client requests SetEditSGValue with unknown object reference
4. Client requests SetEditSGValue with wrong data type
5. Client requests SetEditSGValue with out-of-range value
6. Client requests GetEditSGValue[FC=SE] with unknown object reference
7. Client requests ConfirmEditSGValues with unknown SGCB reference

Comment

sSgN3	**SetEditSGValue [FC=SG]**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 16.3.4
IEC 61850-8-1 Subclause 16.2.3

Expected result

1. DUT sends SetEditSGValue response- with data access error object-access-denied

Test description

1. Client requests a valid SetEditSGValue with [FC=SG]

Comment

sSgN4	**SetEditSGValue and GetEditSGValue when EditSG=0**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.3.4 and 16.3.6 IEC 61850-8-1 Subclause 8.1.3.4.4.2, 16.2.3 and 16.2.5		
Expected result 1. DUT sends SetEditSGValue response- with data access error “temporarily-unavailable” 2. DUT sends SetEditSGValue response- with data access error “temporarily-unavailable” or “object-access-denied” 3. DUT sends GetEditSGValue response- with data access error “temporarily-unavailable”		
Test description Test engineer ensures EditSG=0 by for example, restart the DUT or SelectEditSG(0) 1. Client requests a valid SetEditSGValue [FC=SE] with valKind=Set 2. Client requests a valid SetEditSGValue [FC=SE] with valKind=RO (if available) 3. Client requests a valid GetEditSGValue [FC=SE] with any valKind		
Comment		

sSgN5	**SelectEditSG with two clients**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 16.3.3 IEC 61850-8-1 Subclause 16.2		
Expected result 1. DUT sends SelectEditSG response+ 2. DUT sends SelectEditSG response- with data access error object-access-denied or temporarily-unavailable 3. DUT sends SelectEditSG response+ 4. DUT sends SelectEditSG response+ 5. DUT sends SelectEditSG response+		
Test description 1. Client 1 requests SelectEditSG with first setting group 2. Client 2 requests SelectEditSG with last setting group 3. Client 1 requests SelectEditSG with setting group 0 4. Client 2 requests SelectEditSG with last setting group 5. Client 2 requests SelectEditSG with setting group 0		
Comment		

A4.5 Unbuffered Reporting

Abstract test cases

Test case	Test case description
sRp1	Request GetLogicalNodeDirectory(URCB) and check response Request GetURCBValues of all responded URCB's
sRp2	Verify the reporting of optional fields of a URCB Configure/enable a URCB with all optional fields combinations: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, and/or data-reference (IEC 61850-7-2 Subclause 17.2.3.2.2.1), force/trigger a report and check the reports contain the enabled optional fields
sRp3	Verify the trigger options of a URCB Configure and enable a URCB with optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name and data-reference and check the reports are transmitted according to the following trigger options: on integrity on update (dupd) on update with integrity on data change (dchg) on data and quality change on data and quality change with integrity period Verify the validity of the ReasonCode (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that when more trigger options are met preferably only one report is generated (IEC 61850-7-2 Subclause 17.2.3.2.3.2) Verify that reports are only sent when RptEna is set to True. (IEC 61850-7-2 Subclause 17.2.2.5), when reporting is disabled no reports shall be transmitted
sRp4	General interrogation (IEC 61850-7-2 Subclause 17.2.2.13) Setting the GI attribute of an URCB shall start the general-interrogation process. One report with the current data values will be sent. After initiation of the general-interrogation, the GI attribute is reset to False.
sRp5	Segmentation of reports Verify that if a long report does not fit in one message, the report is split into sub-reports. Enable sequence-number and report-time-stamp optional field and check validity of: (IEC 61850-7-2 Subclause 17.2.3.2.2.5) SqNum (not changed) SubSqNum (0 for first report, incrementing, roll-over) MoreSeqmentsFollow TimeOfEntry (not changed as SqNum is not altered) (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that an update of a data value during sending of a segmented report caused by an integrity or general-interrogation trigger can be interrupted by a report with change of one of the data values with a new sequence number. (IEC 61850-7-2 Subclause 17.2.3.2.3.5) A new request for general-interrogation shall stop the sending of remaining segments of the GI-report that is still going on. A new GI-report shall start with a new sequence number and the sub-sequence number shall be 0 (IEC 61850-7-2 Subclause 17.2.3.2.3.4)

Test case	Test case description
sRp6	Configuration revision (IEC 61850-7-2 Subclause 17.2.2.7) Verify that ConfRev represents a count of the number of times the configuration of the data set referenced by DatSet has been changed. Changes that are counted are: deletion of a member of the data-set re-ordering of members in the data-set Verify that the server increments the ConfRev in case the data sets changes due to processing of ACSI services ConfRev shall never be 0 (zero) in case DatSet is not null.
sRp7	Verify that after a restart of the server, the value of ConfRev is restored to its original value of the base local configuration OR the value is retained from the configuration prior to restart (PIXIT)
sRp8	Buffer Time (IEC 61850-7-2 Subclause 17.2.2.9) Verify that in the case where a second internal notification of the same member of a DATA-SET has occurred prior to the expiration of BufTm, the server: (IEC 61850-7-2 Subclause 17.2.2.9) shall for status information behave as if BufTm has expired and immediately send the report, restart the timer with value BufTm and process the second notification or may for analogue information behave as if BufTm has expired and immediately transmit the report for transmission, restart the timer with value BufTm and process the second notification or for analogue information substitute the current value in the pending report with the new one. Configure Buffer Time to 1.000 ms and force a data value change of multiple dataset members within buffer time. Server shall send not more than one report per buffer time with all the data values changes since last report. Verify that the value 0 for buffer time indicates that the buffer time attribute is not used. (IEC 61850-7-2 Subclause 17.2.2.9) Verify that the BufTm value can contain at least the value 360.0000 (= 1 h in ms)
sRp9	Verify the DUT can send reports with data objects
sRp10	Verify the DUT can send reports with data attributes
sRp11	Verify the DUT send any buffered events before the integrity report
sRp12	Verify the DUT send any buffered events before the GI report
sRp13	Verify that the server sets URCB Owner to a non-NULL value when the URCB is configured by a client and reset to NULL when a client releases the URCB. For a pre-assigned URCB the server resets the Owner to the pre-assigned client address
sRp14	Verify that the DUT can process an URCB with maximum name length for RptID and DatSet (IEC 61850-7-2 Subclause 22.2)
sRp15	Verify report with dataset with most to least data hierarchy FCDA elements
sRp16	Verify the DUT can process a SetURCBValues with all writable attributes in one request
sRp17	Verify that events are no longer suppressed when val/cVal are updated with instantaneous values when db=0
sRp23	Pre-assigned URCB has Resv = True

Test case	Test case description
sRpN1	Request GetURCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 Subclause 17.2.5.3)
sRpN2	Configure reporting with trigger option GI (not dchg, qchg, dupd, integrity). When enabled only GI reports are transmitted. No reports shall be send when generating events (IEC 61850-7-2 Subclause 17.2.3.2.3.4)
sRpN3	Setting the integrity period to 0 with TrgOps = integrity will result in no integrity reports will be sent (IEC 61850-7-2 Subclause 17.2.3.2.3.3)
sRpN4	Incorrect configuration of a URCB: configure when enabled, configure ConfRev and SqNum and configure with unknown data set
sRpN5	Exclusive use of URCB and lost association Configure a URCB and set the Resv attribute and enable it. Verify another client cannot set any attribute of that URCB (IEC 61850-7-2 Subclause 17.2.4.5)
sRpN6	Configure unsupported URCB options (PIXIT); Configure unsupported trigger options, optional fields and related parameters
sRpN7	Verify another client can not configure a pre-assigned URCB
sRpN8	Verify that when TrgOps – GI is not set, the device does not send reports with reason code GI when RptEna=FALSE setting the GI=TRUE will fail when RptEna=TRUE resetting the GI=FALSE is accepted with no impact (no GI report)
sRpN9	Enable a free URCB without reservation

Note: sRpN6 is not applicable for part 8-1.

Detailed test procedures

sRp1	**GetLogicalNodeDirectory(URCB) and GetURCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2 and 17.2.5.3 IEC 61850-8-1 Subclause 12.3.1 and 17.2.4		
Expected result 1. DUT sends GetLogicalNodeDirectory(URCB) response+ with a list of URCB's 2. DUT sends GetURCBValues response+		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(URCB) 2. For each URCB Client requests GetURCBValues		
Comment		

sRp2	**Reporting of optional fields for a URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.8
IEC 61850-8-1 Subclause 17.2, Table 64

Expected result

1. DUT sends SetURCBValues response+
2. DUT sends SetURCBValues response+
3. DUT sends SetURCBValues response+ and sends a correct report according to IEC 61850-8-1 Table 64 with all data set members for reason general-interrogation and for reason data-change only the changed data set members. The configured and reported optional fields shall match and
   the sequence number starts with 0
   the report time stamp has UTC value and matches the trigger time
   the reason for inclusion matches the trigger option
   the configured and reported data set name do match
   the data-reference(s) match the data set member(s) and use “$” as seperator
   Configuration revision matches the URCB configuration
4. DUT sends SetURCBValues response+ and sends no reports anymore

Test description

1. Client reserves and configures an available URCB using SetURCBValues with all combinations of the following optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference and conf-rev
2. Client enables the URCB (set RptEna to True)
3. Client requests a GI report (trigger option general-interrogation) or EQUIPMENT SIMULATOR triggers a report (trigger option data change)
4. Client disables the URCB (set RptEna to False)
5. Repeat step 1 to 4 for next combination of optional fields

Comment

sRp3	**Trigger options for a URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3
IEC 61850-8-1 Subclause 8.1.3.9, 17.2
PIXIT: Rp10

Expected result

1. DUT sends SetURCBValues response+
2. DUT sends SetURCBValues response+
3. DUT sends a report according to trigger option
   integrity reports are transmitted at integrity period timeout
   data change reports are transmitted at the minimum buffer timeout
   the sequence number is incremented
   the configured and reported optional fields shall match
   the reason code(s) is one of the configured trigger options
4. DUT sends SetURCBValues response+
5. DUT does not sends reports

Test description

1. Client reserves and configures an available URCB using SetURCBValues with all optional fields, the minimum BufTm and one of the following trigger options:
   - on integrity
   - on update (dupd)
   - on data-change
   - on data-change and quality-change
   - on data-change, quality-change and integrity with a valid integrity period
2. Client enables the RCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set
4. Client disables the URCB, set RptEna to False
5. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set
6. Repeat step 1 to 5 for next trigger option combination

Comment

sRp4	**General interrogation URCB and RptID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3.4
IEC 61850-8-1 Subclause 8.1.3.9, 17.2

Expected result

2. DUT sends SetURCBValues response+ and then sends GI report
3. DUT sends GetURCBValues response+, the GI attribute is reset
6. DUT sends GetURCBValues response+, the RptID is an empty string
7. DUT sends SetURCBValues response+ and a report where the RptID value is the exact reference of the URCB: RptID includes the index when the URCB is indexed, without index when not
10. DUT sends SetURCBValues response+ and a report where the RptID value is the configured value

Test description

1. Client reserves and configures and enables an available URCB
2. Client requests SetURCBValues to trigger the GI report
3. Client requests GetURCBValues
4. Client disables the URCB

When the URCB RptID is dynamic (“dyn”)

5. Client reserves and configures the URCB RptID with an empty string
6. Client requests GetURCBValues(RptID)
7. Client enables the URCB and triggers the GI report
8. Client disables the URCB
9. Client configures the URCB RptID with a non-empty string
10. Client enables the URCB and triggers the GI report
11. Client disables the URCB

Comment

sRp5	**Segmentation of reports URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.2.5
IEC 61850-8-1 Subclause 8.1.3.8, 17.2
PIXIT: Rp3

Expected result

2. DUT sends associate response+
4. If it was not possible to force report segmentation, check if each report contains all expected data values and all header fields. If it is possible to force report segmentation, the DUT sends the integrity report in two or more segments. The segmented report messages have the same SqNum and the same report time stamp, incremented SubSqNum starting with 0 and MoreSegmentsFollow is set except for the last report segment.

Test description

1. Select, configure or create a big dataset with the maximum available/allowed number of dataset elements with the largest available data values (for example data objects of the WYE and DEL Common Data Classes)
2. Client associates with the minimum PDU size.
3. Client reserves and configures an available URCB with the big dataset, trigger-condition integrity, and all optional fields
4. Client enables the RCB and waits for several integrity reports
5. Client disables the RCB

Comment

sRp6	**Configuration revision URCB**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2.7 IEC 61850-8-1 Subclause 17.2		
Expected result 2. DUT sends GetURCBValues response+ with ConfRev >0 4. The value of ConfRev is incremented		
Test description 1. Client reserves and configures a URCB with a data-set 2. Client request GetURCBValues 3. Client configures the same URCB with another data-set 4. Client request GetURCBValues		
Comment		

sRp7	**Configuration revision URCB after reboot**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2.7 IEC 61850-8-1 Subclause 17.2, PIXIT: Rp12		
Expected result 3. The value of ConfRev is incremented 5. The values of ConfRev and DatSet are restored to its original value of the base local configuration OR the values are retained from the configuration prior to restart (PIXIT)		
Test description 1. Client request GetURCBValues 2. Client reserves and configures an URCB with a data-set 3. Client request GetURCBValues 4. Cause unexpected DUT restart by simulating a temporarily power outage 5. Client request GetURCBValues		
Comment		

sRp8	**Buffer time URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.9
IEC 61850-8-1 Subclause 17.2
PIXIT: Rp4

Expected result

3. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer, at BufTm expiration DUT sends the report of the second data change
4. DUT sends one report with both status events after BufTm of the first data change expires
5. On second data change in BufTm DUT sends the report of the first data change, restarts the timer and at BufTm expiration DUT sends the report of the second data change OR DUT substitutes the current value in the pending report with the new one and sends it at BufTm expiration. Verify the behavior matches PIXIT
6. DUT sends one report with both analogue events after BufTm of the first data change expires
7. DUT sends SetURCBValues response+
8. DUT shall not send the pending report
9. Each data change result in a report
10. DUT accepts BufTm value 3.600.000

Test description

1. Client reserves and configures an available URCB using SetURCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data-change and quality-change. Either ST and/or MX shall be supported.
2. Client enables the URCB, set RptEna to True

If applicable (availability of status elements) perform steps 3 and 4

3. EQUIPMENT SIMULATOR forces two data changes of the same status data set element in the data set before expiration of BufTm
4. EQUIPMENT SIMULATOR forces one data change of two different status data set elements in the data set before expiration of BufTm of the first data change

If applicable (availability of analogue elements) perform steps 5 and 6

5. EQUIPMENT SIMULATOR forces two data changes of the same analogue data set element in the data set before expiration of BufTm
6. EQUIPMENT SIMULATOR forces one data change of two different analogue data set elements in the data set before expiration of BufTm
7. EQUIPMENT SIMULATOR forces one data change and Client disables the URCB before the DUT sends the pending report
8. Client enables the same URCB again
9. Client disables the URCB, Client sets BufTm to zero; repeat steps 2 to 6
10. Client disables the URCB, Client sets BufTm to 3.600.000

Comment

Tested with Status elements (ST) and/or Analogue elements (MX).

sRp9	Report data objects (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2 IEC 61850-8-1 Subclause 17.2		
Expected result 2. Verify the DUT does report the whole data object		
Test description 1. Client reserves and configures an available URCB using SetURCBValues with a data-set that contains at least one data object, and all optional fields with the trigger option: data-change. Client enables the URCB. 2. Change a data attribute within one data object in the data-set		
Comment		

sRp10	Report data attributes (FCDA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2 IEC 61850-8-1 Subclause 17.2 PIXIT: Sr1, Sr2		
Expected result 2. DUT reports the “data” attribute. The “timestamp” and “quality” attributes are not sent 3. DUT reports the “quality” attribute. The “timestamp” and “data” attributes are not sent 4. All attributes are reported 5. All attributes are reported		
Test description 1. Client reserves and configures an available URCB using SetURCBValues with a data-set that contains the “data”, “quality” and “timestamp” attributes of a data object, and the trigger options: data-change, quality-change, integrity and general-interrogation. Client enables the URCB 2. Force a change of a data attribute value 3. If supported, force a change of a quality attribute value 4. Request a general interrogation 5. Wait for integrity report		
Comment		

sRp11	**Send buffered events before integrity report**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.3.3 IEC 61850-8-1 Subclause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data-change and then the integrity report		
Test description 1. Client reserves and configures an available URCB using SetURCBValues with a valid BufTm, a valid IntgPd whose value is smaller than the BufTm value and all optional fields with the trigger options: data-change and integrity 2. Client enables the URCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a data change in the data set, wait for integrity report 4. Client disables the URCB		
Comment		

sRp12	**Send buffered events before GI report**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.3.3 IEC 61850-8-1 Subclause 17.2		
Expected result 4. DUT does send 2 reports: first a report with the buffered data-change and then the GI report		
Test description 1. Client reserves and configures an available URCB using SetURCBValues with all optional fields, with a valid BufTm and with the trigger options: data-change and general-interogation 2. Client enables the URCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a data change in the data set 4. Client requests SetURCBValues with GI=TRUE before BufTm expiration 5. Client disables the URCB		
Comment		

sRp13	URCB owner	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.18
IEC 61850-8-1 Subclause 17.1.2

Expected result

1. Owner is empty
3. Owner is the IP-address of the Client or gateway
5. Owner is the IP-address of the Client or gateway
7. Owner is empty

Test description

1. Client requests GetURCBValues of a free (not pre-assigned) URCB
2. Client reserves and configures and enables an available URCB using SetURCBValues
3. Client requests GetURCBValues
4. Client disables the URCB
5. Client requests GetURCBValues
6. Client requests SetURCBValues with Resv=False
7. Client requests GetURCBValues

Comment

For-example IP-address 192.168.0.23 shall be encoded as C0A80017

sRp14	Max URCB name length	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 22.2
IEC 61850-8-1 Subclause 17.1.3
SCL Services ReportSettings cbName, datSet and rptID

Expected result

2. DUT sends SetURCBValues response+
3. DUT sends GI report with the pre-configured DatSet name and RptID value
5. DUT sends SetURCBValues response+
6. DUT sends SetURCBValues response+
7. DUT sends GI report with the same DatSet name and report ID value from step 5

Test description

1. Configure DUT with URCB with maximum name length (32 including the index), with maximum name length of the data set (32 chars) and RptID (129 chars) when these attributes are not fixed (“fix”)
2. Client reserves and enables the pre-configured URCB with at least OptFlds data-set-name and trigger condition GI
3. Client requests SetURCBValues with GI=true
4. Client disables the pre-configured URCB
5. Client reserves and requests SetURCBValues of an URCB with an existing data set with the maximum allowed name length and maximum length RptID when these attributes are dynamic (“dyn”)
6. Client enables this URCB with at least OptFlds data-set-name and trigger condition GI
7. Client requests SetURCBValues with GI=true
8. Client disables this URCB

Comment

sRp15	Report with dataset with most to least data hierarchy FCDA elements	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6
IEC 61850-8-1 Subclause 14.3

Expected result

1. In the SCL file the FCDA doName contains maximum one dot (for example doName="neut.phsA" and daName="cVal.mag.f")
2. DUT sends a SetURCBValues response+
3. DUT sends the GI report with correct data references

Test description

1. Reserve and configure one or more URCBs with one or more datasets with the least detailed data hierarchy to the most detailed data hierarchy available in the DUT data model. For example in the SCL file add the following FCDA elements:
   - doName="MMXU.PhV"
   - doName="MMXU.A" daName="phsA"
   - doName="MMXU.A" daName="phsB.cVal"
   - doName="MMXU.A" daName="phsC.cVal.mag"
   - doName="MMXU.A" daName="neut.cVal.mag.f"
2. Client enables the URCB with all supported optional fields and trigger condition GI
3. Client request GI

Comment

sRp16	SetURCBValues with multiple attributes in one request	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3.4
IEC 61850-8-1 Subclause 17.2

Expected result

1. DUT sends SetURCBValues response+ for each attribute and sends GI report
2. DUT sends SetURCBValues response+

Test description

1. Client reserves and configures all supported "dyn" attributes, enables and triggers the GI in a single SetURCBValues request. The order of the ListOfVariables is: Resv=T, RptID/DatSet/OptFlds/BufTm/TrgOps/IntgPd, RptEna=T, GI=T
2. Client disables the URCB

Comment

Note: A single ACSI request is mapped to an MMS Write with a ListOfVariable for each RCB attribute

sRp17	**Events are no longer suppressed when db=0**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3
IEC 61850-8-1 Subclause 8.1.3.9, 17.2
PIXIT: Rp15

Expected result

1. DUT sends SetURCBValues response+
2. DUT sends SetURCBValues response+
3. DUT sends data change reports
4. DUT sends SetURCBValues response+

Test description

1. Reserve and configure an available URCB using SetURCBValues with all optional fields, the minimum BufTm and trigger option data-change and db=0 of one or more dataset members with FC=MX
2. Client enables the URCB
3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members with db=0 in the data set
4. Client disables the URCB

Comment

sRp23	**Pre-assigned URCB has Resv = True**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Annex E
IEC 61850-8-1 Subclause 17.2
PIXIT: Rp13

Expected result

1. DUT responds URCB.Resv = True
2. DUT responds URCB.Resv = False
3. DUT accepts configuration and send reports as configured

Test description

Test engineer configures (pre-assigns) an URCB with one ClientLN

1. Client requests GetURCBValues on the pre-assigned URCB instance
2. Client requests GetURCBValues on a free URCB instance
3. Client with matching communication configuration, reserves, configures and enables the URCB with index 01, requests GetURCBValues, forces GI, disables the URCB and releases the association

Comment

Note: Authentication based on Owner is not supported in 8-1. As such, a server, could (not shall) accept any client although the URCB.Resv = True (compare PIXIT Rp13).
Note: The access point is also relevant: Resv = true on the AP where the ClientLN is connected. Not on the other access points.

sRpN1	Incorrect GetURCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.5.3 IEC 61850-8-1 Subclause 17.2		
Expected result 1. DUT sends response with data access error “object-non-existent”		
Test description 1. Client request GetURCBValues with unknown URCB object		
Comment		

sRpN2	Only trigger option GI	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.2.9 IEC 61850-8-1 Subclause 17.2		
Expected result 3. DUT does not send reports		
Test description 1. Reserve and configure an available URCB using SetURCBValues with all optional fields, BufTm=0, IntgPd=1000 and only trigger option general-interrogation 2. Client enables the URCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set		
Comment		

sRpN3	Integrity period zero URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.2.9 IEC 61850-8-1 Subclause 17.2		
Expected result 4. DUT does not send reports when reporting is enabled		
Test description 1. Reserve and configure an available URCB using SetURCBValues with trigger option Integrity and integrity period 0 2. Wait one minute 3. Client enables the URCB, set RptEna to True 4. Wait one minute 5. Client disables the URCB, set RptEna to False		
Comment		

sRpN4	**Incorrect configuration of URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.5.4
IEC 61850-8-1 Subclause 17.1.3, 8.1.3.4.3, Table 61

Expected result

2. DUT sends SetURCBValues response- with data access error “temporarily-unavailable”
4. DUT sends SetDataValues response- with data access error “object-access-denied”
5. DUT sends SetURCBValues response- with data access error “object-access-denied”
6. DUT sends SetURCBValues response- with data access error “object-value-invalid”
7. DUT sends SetURCBValues response+
8. DUT sends SetURCBValues response- with data access error “temporarily-unavailable”
9. DUT sends SetURCBValues response- with data access error “temporarily-unavailable”

Test description

1. Client reserves, configures and enables an available URCB
2. Client requests SetURCBValues with one of the following “dyn” attributes: RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd
3. Client disables the URCB
4. Client requests SetDataValues with one of the following attributes: ConfRev, SqNum and Owner (when available)
5. Client requests SetURCBValues with the “fix” or “conf” attributes from step 2

When datSet=”dyn” then perform the following steps

6. Client requests SetURCBValues with unknown DatSet
7. Client changes datSet to empty
8. Client enables an URCB with empty DatSet

When datSet=”conf” then perform the following steps

9. Client enables a URCB with empty DatSet (when supported)

Comment

sRpN5	**Exclusive use of URCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.1
IEC 61850-8-1 Subclause 17.2
PIXIT: As2

Expected result

2. DUT sends SetURCBValues response- with data access error = temporarily-unavailable
4. DUT sends SetURCBValues response+
8. DUT sends SetURCBValues response+
10. DUT sends SetURCBValues response+
11. DUT sends SetURCBValues response- with data access error = temporarily-unavailable
13. DUT sends a GetURCBValues response+, the parameter Resv = False
14. DUT sends SetURCBValues response+
15. DUT sends SetURCBValues response+

Test description

1. Client1 reserves an available URCB
2. Client2 reserves and configures the same URCB by requesting SetURCBValues with one of the following dynamic (“dyn”) attributes Resv, RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd
3. Client1 resets the reservation of the URCB
4. Client2 reserves and configures the URCB
5. Client2 resets the reservation of the URCB
6. Client1 reserves the URCB
7. Client1 aborts and re-establishes the association
8. Client1 configures the URCB
9. Client1 resets the reservation of the URCB
10. Client1 reserves the URCB
11. Client2 requests SetURCBValues of a “dyn” attribute
12. Disable the TCP communication between Client1 and the DUT. E.g. disconnect the physical link, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the lost connection detection timeout specified in the PIXIT and then enable TCP communication. E.g. connect the physical link
13. Client2 requests GetURCBValues
14. Client2 reserves the URCB
15. Client2 requests SetURCBValues of a “dyn” attribute

Comment

Step 12 – Tested with a lost detection timeout of …. Seconds.

sRpN7	**Verify another client can [not] configure a pre-assigned URCB**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Annex E IEC 61850-8-1 Subclause 17.2 PIXIT: Rp13		
Expected result 1. DUT accepts configuration and send reports as configured or rejects client depending on behaviour described in PIXIT: Rp13		
Test description Test engineer configures (pre-assigns) an indexed URCB with one ClientLN 1. Client with mis-matching communication configuration tries to reserve, configure and enable the URCB with index 01, requests GetURCBValues, forces GI and disables the URCB		
Comment		

sRpN8	**Trigger option GI not set**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.2.9 IEC 61850-8-1 Subclause 17.2		
Expected result 1. DUT sends SetURCBValues response+ 2. DUT sends SetURCBValues response+, however sends no GI report 3. DUT sends SetURCBValues response+ 4. DUT sends SetURCBValues response- with data access error “temporarily unavailable” 5. DUT sends SetURCBValues response+ 6. DUT sends SetURCBValues response+ and sends no GI report 7. DUT sends SetURCBValues response+ and does send the GI report		
Test description 1. Client reserves and configures and enables an available URCB without trigger option general-interrogation 2. Client requests SetURCBValues with GI=TRUE 3. Client disables the URCB and set trigger option general-interrogation 4. Client requests SetURCBValues with GI=TRUE 5. Client enables the URCB 6. Client requests SetURCBValues with GI=FALSE 7. Client requests SetURCBValues with GI=TRUE		
Comment		

sRpN9	**Enable a free URCB without reservation**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Annex E IEC 61850-8-1 Subclause 17.2		
Expected result 1. DUT sends SetURCBValues response+ 2. DUT sends SetURCBValues response+ 3. DUT sends a GetURCBValues response+, the parameter Resv = False 4. DUT sends SetURCBValues response- 5. DUT sends SetURCBValues response-		
Test description 1. Client reserves, configures and enables an available URCB 2. Client disables and resets the reservation of the URCB 3. Client requests GetURCBValues on the URCB 4. Client configures the URCB without reservation 5. Client enables the URCB		
Comment		

A4.6 Buffered Reporting

Abstract test cases

Test case	Test case description
sBr1	Request GetLogicalNodeDirectory(BRCB) and check response Request GetBRCBValues of all responded BRCB's
sBr2	Verify the reporting of optional fields of a BRCB Configure/enable a BRCB with all optional fields combinations: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer-overflow, and/or entryID (IEC 61850-7-2 Subclause 17.2.3.2.2.1), force/trigger a report and check the reports contain the enabled optional fields
sBr3	Verify the trigger options of a BRCB Configure and enable a BRCB with optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer-overflow, and entryID and check the reports are transmitted according to the following trigger options: – on integrity – on update (dupd) – on update with integrity – on data change (dchg) – on data and quality change – on data and quality change with integrity period Verify the validity of the ReasonCode (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that when more trigger options are met preferably only one report is generated (IEC 61850-7-2 Subclause 17.2.3.2.3.2) Verify that reports are only sent when RptEna is set to True. (IEC 61850-7-2 Subclause 17.2.2.5), when reporting is disabled no reports shall be transmitted
sBr4	General interrogation (IEC 61850-7-2 Subclause 17.2.2.13) Setting the GI attribute of a BRCB shall start the general-interrogation process. One report with the current data values will be sent. After initiation of the general-interrogation, the GI attribute is reset to False.
sBr5	Segmentation of reports Verify that if a long report does not fit in one message, the report is split into sub-reports. Enable sequence-number and report-time-stamp optional field and check validity of: (IEC 61850-7-2 Subclause 17.2.3.2.2.5) SqNum (not changed) SubSqNum (0 for first report, incrementing, roll-over) MoreSeqmentsFollow TimeOfEntry (not changed as SqNum is not altered) (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that an update of a data value during sending of a segmented report caused by an integrity or general-interrogation trigger can be interrupted by a report with change of one of the data values with a new sequence number. (IEC 61850-7-2 Subclause 17.2.3.2.3.5) A new request for general-interrogation shall stop the sending of remaining segments of the GI-report that is still going on. A new GI-report shall start with a new sequence number and the sub-sequence number shall be 0 (IEC 61850-7-2 Subclause 17.2.3.2.3.4) Verify that when OptFlds=sequence-number is NOT set, neither SubSqNum nor SqNum are present in the sub-reports (IEC 61850-7-2 Subclause 17.2.3.2.2.4 and 17.2.3.2.2.5)

Test case	Test case description
sBr6	Configuration revision (IEC 61850-7-2 Subclause 17.2.2.7) Verify that ConfRev represents a count of the number of times the configuration of the data set referenced by DatSet has been changed. Changes that are counted are: deletion of a member of the data-set re-ordering of members in the data-set Verify that the server increments the ConfRev in case the data sets changes due to processing of ACSI services ConfRev shall never be 0 (zero) in case DatSet is not null
sBr7	Verify that after a restart of the server, the value of ConfRev is restored to its original value of the base local configuration OR the value is retained from the configuration prior to restart (PIXIT)
sBr8	Buffer Time (IEC 61850-7-2 Subclause 17.2.2.9) Verify that in the case where a second internal notification of the same member of a DATA-SET has occurred prior to the expiration of BufTm, the server: (IEC 61850-7-2 Subclause 17.2.2.9) shall for status information behave as if BufTm has expired and immediately send the report, restart the timer with value BufTm and process the second notification or may for analogue information behave as if BufTm has expired and immediately transmit the report for transmission, restart the timer with value BufTm and process the second notification or may for analogue information substitute the current value in the pending report with the new one. Configure Buffer Time to 1.000 ms and force a data value change of multiple dataset members within buffer time. Server shall send not more than one report per buffer time with all the data values changes since last report. Verify that the value 0 for buffer time indicates that the buffer time attribute is not used. (IEC 61850-7-2 Subclause 17.2.2.9) Verify that the BufTm value can contain at least the value 3.600.000 (= 1 h in ms)
sBr9	Verify the DUT can send reports with data objects
sBr10	Verify the DUT can send reports with data attributes
sBr11	Verify that all buffered events shall be sent before integrity reports can be sent (IEC 61850-7-2 Subclause 17.2.3.2.3.3)
sBr12	Verify that all buffered events shall be sent before the GI report can be sent (IEC 61850-7-2 Subclause 17.2.3.2.3.3)
sBr13	Verify that the server sets BRCB Owner to a non-NULL value when the BRCB is configured by a client and reset to NULL when a client releases the BRCB. For a pre-assigned BRCB the server resets the Owner to the pre-assigned client address
sBr14	Verify that the DUT can process a BRCB with maximum name length for RptID and DatSet (IEC 61850-7-2 Subclause 22.2)
sBr15	Verify report with Dataset with most to least data hierarchy FCDA elements
sBr16	Verify the DUT can process a SetBRCBValues with all writable attributes in one request
sBr17	Verify that events are no longer suppressed when val/cVal are updated with instantaneous values when db=0
	Specific to BRCB (leave a gap for future reporting test cases)

Test case	Test case description
sBr20	Buffered reporting (BRCB) state machine (IEC 61850-7-2 Subclause 17.2.2 figure 24) with setting the EntryID Verify events are buffered after the association is released Verify reporting is disabled after the association is lost Verify that not received reports while not associated are received now in the correct order (SOE) (IEC 61850-7-2 Subclause 17.2.1, IEC 61850-7-2 Subclause 17.2.2.5) Do the same but now set PurgeBuf to True before enabling the reporting. No stored buffered reports shall be send (IEC 61850-7-2 Subclause 17.2.2.14) Force buffer overflow, the OptFlds buffer-overflow shall be set in the first report that is sent with events that occurred after the overflow. (IEC 61850-7-2 Subclause 17 2.3.2.2.8)
sBr21	Buffered reporting (BRCB); buffering events (IEC 61850-7-2 Subclause 17.2.3.2.3.6) without setting the EntryID Verify that after the association is available again and after the client has NOT set the EntryID, and enabled the BRCB, the BRCB shall start sending both already sent reports and new reports of events that have been buffered. The BRCB shall use the sequence and subsequence numbers so that no gaps occur.
sBr22	Verify that integrity reports are buffered
sBr23	Verify successful ResvTms behaviour On ResvTms = -1 the BRCB can be used by the pre-assigned client On lost association, the pre-assigned BRCB is released after the ResvTms number of seconds (ResvTms set to -1)
sBr24	Verify that a SetBRCBValues request, for setting ResvTms, shall: Generate a negative response if the BRCB's ResvTms value = -1. Generate a negative response if the BRCB's ResvTms value is non-zero and if the SetBRCBValues request is being issued by another client for whom the BRCB is not reserved. Generate a negative response if the ResvTms value to be set is negative.
sBr25	Verify that a change of one of the following BRCB parameters purges the buffer: RptID, BufTm, TrgOps, IntgPd, DatSet. A change of OptFlds shall not purge the buffer. (IEC 61850-7-2 Table 37)
sBr26	Verify that after setting an invalid, null or non-existing EntryID the DUT sends all reports in the buffer
sBr27	Verify that when the BRCB state is RptEna=FALSE a GetBRCBValues shall return the EntryID value that represents the last (newest) entry that has been entered into the buffer. And when the BRCB RptEna=TRUE: The value of EntryID, returned in a GetBRCBValues response, shall be the EntryID of the last EntryID formatted and queued for transmission.
sBr28	Verify that at most the last buffered GI report is transmitted after restoring a lost association
sBr29	Verify that reports are already buffered before the configured report control block is enabled

Test case	Test case description
sBrN1	Request GetBRCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 Subclause 17.2.3.3.2)
sBrN2	Configure reporting with trigger option GI (not dchg, qchg, dupd, integrity). When enabled only GI reports are transmitted. No reports shall be send when generating events (IEC 61850-7-2 Subclause 17.2.3.2.3.4)
sBrN3	Setting the integrity period to 0 with TrgOps = integrity will result in no integrity reports will be sent (IEC 61850-7-2 Subclause 17.2.2.12)
sBrN4	Incorrect configuration of a BRCB: configure when enabled, configure ConfRev and SqNum and configure with unknown data set
sBrN5	Exclusive use of BRCB and lost association Configure a BRCB and enable it. Verify another client can not set attributes value in this BRCB. (IEC 61850-7-2 Subclause 17.2.1)
sBrN6	Configure unsupported BRCB options (PIXIT); Configure unsupported trigger options, optional fields and related parameters
sBrN7	Verify another client can not configure a pre-assigned BRCB
sBrN8	Verify that when TrgOps – GI is not set the device does not send reports with reason code GI when RptEna=FALSE setting the GI=TRUE will fail when RptEna=TRUE resetting the GI=FALSE is accepted with no impact (no GI report)
sBrN9	Enable a free and pre-assigned BRCB without reservation
sBrN10	Verify that on lost association, before the ResvTms time expiration, no other client can reserve the BRCB except the one who did it originally

Note: sBrN6 is not applicable for part 8-1

Detailed test procedures

sBr1	**GetLogicalNodeDirectory(BRCB) and GetBRCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 10.2.2 and 17.2.3.3 IEC 61850-8-1 Subclause 12.3.1 and 17.2.2		
Expected result 1. DUT sends GetLogicalNodeDirectory(BRCB) response+ with a list of BRCB's 2. DUT sends GetBRCBValues response+, with ResvTms present		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(BRCB) 2. For each BRCB Client requests GetBRCBValues		
Comment		

sBr2	**Reporting of optional fields for a BRCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.8
IEC 61850-8-1 Subclause 17.2.1

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response+
3. DUT sends a correct report according to trigger option and IEC 61850-8-1 Table 64 with all data set members for reason integrity and otherwise only the changed members. The configured and reported optional fields shall match
   - the sequence number starts with 0
   - the report time stamp has UTC value and matches the trigger time
   - the reason for inclusion matches the trigger option
   - the configured and reported data set name do match
   - the data-reference(s) match the data set member(s) and use “$” as seperator
   - EntryID not zero
   - Configuration revision matches the BRCB configuration
4. DUT sends SetBRCBValues response+ and sends no reports anymore

Test description

1. Client reserves and configures an available BRCB using SetBRCBValues with all combinations of the following optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer overflow, entryID and conf-rev
2. Client enables the BRCB (set RptEna to True)
3. Client waits for a report (trigger option integrity) or EQUIPMENT SIMULATOR triggers a report (trigger option data-change)
4. Client disables the BRCB (set RptEna to False)
5. Repeat step 1 to 4 for next combination of optional field

Comment

sBr3	**Trigger options for a BRCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.8
IEC 61850-8-1 Subclause 8.1.3.9, 17.2.1
PIXIT: Rp10

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response+
3. DUT sends a report according to trigger option
   - integrity reports shall be transmitted immediately at timeout
   - data change reports are transmitted immediately after buffer timeout
   - the first report has sequence number 0
   - the sequence number is incremented
   - the configured and reported optional fields shall match
   - the reason code(s) is one of the configured trigger options
4. DUT sends SetBRCBValues response+
5. DUT does not sends reports

Test description

1. Reserve and configure an available BRCB using SetBRCBValues with all optional fields, minimum BufTm and one of the following trigger options:
   - on integrity
   - on update (dupd)
   - on data-change
   - on data-change and quality-change
   - on data-change, quality-change and integrity with a valid integrity period
2. Client enables the BRCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set
4. Client disables the BRCB, set RptEna to False
5. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set
6. Repeat step 1 to 5 for next trigger option combination

Comment

sBr4	**General interrogation BRCB and RptID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.8, 17.2.2.13
IEC 61850-8-1 Subclause 8.1.3.8, 17.2.1

Expected result

3. DUT sends SetBRCBValues response+ and then sends GI report
4. DUT sends GetBRCBValues response+ with GI attribute not set
7. DUT sends GetBRCBValues response+ with empty RptID
8. DUT sends SetBRCBValues response+ and a report where the RptID value is the exact reference of the BRCB: RptID includes the index when the BRCB is indexed, without index when not
11. DUT sends SetBRCBValues response+ and a report where the RptID value is the configured value

Test description

1. Client reserves and configures an available BRCB
2. Client enables the BRCB
3. Client requests SetBRCBValues to set the GI report
4. Client requests GetBRCBValues
5. Client disables the BRCB

When the BRCB RptID is dynamic (“dyn”)

6. Client configures the BRCB RptID with an empty string
7. Client requests GetBRCBValues(RptID)
8. Client enables the BRCB and triggers the GI report
9. Client disables the BRCB
10. Client configures the BRCB RptID with a non-empty string
11. Client enables the BRCB and triggers the GI report
12. Client disables the BRCB

Comment

sBr5	**Segmentation of reports BRCB**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2.8, 17.2.3.2.2.5, 17.2.3.2.2.9, 17.2.3.2.3.5, 17.2.3.2.3.4 IEC 61850-8-1 Subclause 8.1.3.8, 17.2.1, PIXIT: Rp3		
Expected result 2. DUT sends associate response+. 4. If it was not possible to force report segmentation check if each report contains all expected data values and all header fields. If it is possible to force report segmentation, the DUT sends the integrity report in two or more segments. The segmented report messages have the same SqNum, the same report time stamp and EntryID, incremented SubSeqNum starting with 0 and MoreSegmentsFollow is set except for the last report segment.		
Test description 1. Select, configure or create a dataset with the maximum available/allowed numbers of dataset elements with the largest available data values (for example data objects of the WYE and DEL Common Data Classes) 2. Client associates with the minimum PDU size. 3. Client reserves and configures an available BRCB with the data set, trigger-condition integrity, and all optional fields 4. Client enables the RCB and waits for several integrity reports 5. Client disables the RCB		
Comment		

sBr6	**Configuration revision**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2.7 IEC 61850-8-1 Subclause 17.2		
Expected result 2. DUT sends GetBRCBValues response+ with ConfRev >0 4. The value of ConfRev is incremented		
Test description 1. Client reserves and configures a BRCB to use a data set 2. Client request GetBRCBValues 3. Client configures the same BRCB with another data set 4. Client request GetBRCBValues		
Comment		

sBr7	**Configuration revision BRCB after reboot**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2.7 IEC 61850-8-1 Subclause 17.2.1 PIXIT: Rp12		
Expected result 3. The value of ConfRev is incremented 5. The values of ConfRev and DatSet are restored to its original value of the base local configuration OR the values are retained from the configuration prior to restart (PIXIT)		
Test description 1. Client request GetBRCBValues 2. Client reserves and configures a BRCB with a data set 3. Client request GetBRCBValues 4. Cause unexpected DUT restart by simulating a temporarily power outage 5. Client request GetBRCBValues		
Comment		

sBr8	**Buffer time**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.9
IEC 61850-8-1 Subclause 17.2
PIXIT: Rp4

Expected result

3. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer, at BufTm expiration DUT sends the report of the second data change
4. DUT sends one report with both status events after BufTm of the first data change expires
5. On second data change in BufTm DUT sends the report of the first data change, restarts the timer and at BufTm expiration DUT sends the report of the second data change OR DUT substitutes the current value in the pending report with the new one and sends it at BufTm expiration. Verify the behavior matches PIXIT
6. DUT sends one report with both analogue events after BufTm of the first data change expires
7. Each data change result in a report
8. DUT accepts BufTm value 3.600.000

Test description

1. Client reserves and configures an available BRCB using SetBRCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data-change and quality-change. Either ST and/or MX shall be supported.
2. Client enables the BRCB, set RptEna to True

If applicable (availability of status elements) perform steps 3 and 4

3. EQUIPMENT SIMULATOR forces two data changes of the same status data set element in the data set before expiration of BufTm
4. EQUIPMENT SIMULATOR forces one data change of two different status data set elements in the data set before expiration of BufTm of the first data change

If applicable (availability of analogue elements) perform steps 5 and 6

5. EQUIPMENT SIMULATOR forces two data changes of the same analogue data set element in the data set before expiration of BufTm
6. EQUIPMENT SIMULATOR forces one data change of two different analogue data set elements in the data set before expiration of BufTm
7. Client disables the BRCB, Client sets BufTm to zero; repeat steps 2 to 6
8. Client disables the BRCB, Client sets BufTm to 3.600.000

Comment

Tested with Status elements (ST) and/or Analogue elements (MX).

sBr9	Report data objects (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2 IEC 61850-8-1 Subclause 17.2		
Expected result 2. Verify the DUT does report the whole data object		
Test description 1. Client reserves and configures an available BRCB using SetBRCBValues with a data-set that contains at least one data object, and all optional fields with the trigger option: data-change. Client enables the BRCB. 2. Change a data attribute within one data object in the data-set		
Comment		

sBr10	Report data attributes (FCDA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.2 IEC 61850-8-1 Subclause 17.2 PIXIT: Sr1, Sr2		
Expected result 2. DUT reports the “data” attribute. The “timestamp” and “quality” attributes are not sent 3. DUT reports the “quality” attribute. The “timestamp” and “data” attributes are not sent 4. All attributes are reported 5. All attributes are reported		
Test description 1. Client reserves and configures an available BRCB using SetBRCBValues with a data-set that contains the “data”, “quality” and “timestamp” attributes of a data object, and the trigger options: data-change, quality-change, integrity and general-interrogation. Client enables the BRCB 2. Force a change of a data attribute value 3. If supported, force a change of a quality attribute value 4. Request a general interrogation 5. Wait for integrity report		
Comment		

sBr11	**Send buffered events before integrity report**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.3.3 IEC 61850-8-1 Subclause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data change event and then the integrity report		
Test description 1. Client reserves and configures an available BRCB using SetBRCBValues with a valid BufTm, a valid IntgPd whose value is smaller than the BufTm value and all optional fields with the trigger options: data-change and integrity 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a data change in the data set, wait for integrity report 4. Client disables the BRCB		
Comment		

sBr12	**Send buffered events before GI report**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.3.3 and 17.2.3.2.3.4 IEC 61850-8-1 Subclause 17.2		
Expected result 4. DUT does send 2 reports: first a report with the buffered data-change and then the general interrogation report		
Test description 1. Client reserves and configures an available BRCB using SetBRCBValues with all optional fields, with a valid BufTm and with the trigger options: data change and general-interrogation 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a change in the data set 4. Client requests SetBRCBValues(GI=TRUE) before BufTm expiration 5. Client disables the BRCB		
Comment		

sBr13	**BRCB owner**	☒ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.18
IEC 61850-8-1 Subclause 17.1.2
PIXIT Rp13, Rp14

Expected result

1. Owner is empty
3. Owner is the IP-address presented by the Client at the server
5. Owner is the IP-address presented by the Client at the server
7. Owner is empty
8. Owner is the address pre-assigned in SCL as IP-ADDRESS of the client
10. Owner is the IP-address presented by the Client at the server
12. Owner is the IP-address presented by the Client at the server
14. Owner is the address pre-assigned in SCL as IP-ADDRESS of the client

Test description

1. Client requests GetBRCBValues of a free (not pre-assigned) BRCB
2. Client reserves and configures and enables this BRCB using SetBRCBValues
3. Client requests GetBRCBValues
4. Client disables the BRCB
5. Client requests GetBRCBValues
6. Client releases the association, waits more then the reservation time and associates again
7. Client requests GetBRCBValues
8. A non pre-assigned Client requests GetBRCBValues of a pre-assigned BRCB

When PIXIT Rp13 indicates, the server accepts any client to configure/enable a pre-assigned BRCB continue with:

9. Client reserves and configures and enables this BRCB using SetBRCBValues
10. Client requests GetBRCBValues
11. Client disables the BRCB
12. Client requests GetBRCBValues
13. Client releases the association, waits more than the reservation time and associates again
14. Client requests GetBRCBValues

Comment

For example IP-address 192.168.0.23 shall be encoded as C0A80017

sBr14	**Max BRCB name length**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 22.2

IEC 61850-8-1 Subclause 17.1.2

SCL Services ReportSettings cbName, datSet and rptID

Expected result

2. DUT sends SetBRCBValues response+
3. DUT sends GI report with pre-configured DatSet name and RptID value
5. DUT sends SetBRCBValues response+
6. DUT sends SetBRCBValues response+
7. DUT sends GI report with the same DatSet name and RptID value from step 5

Test description

1. Reserve and configure DUT with BRCB with maximum name length (32 including the index), with maximum name length of the data set (32 chars) and RptID (129 chars) when these attributes are not fixed (“fix”)
2. Client enables the pre-configured BRCB with at least OptFlds data-set-name and trigger condition GI
3. Client requests SetBRCBValues with GI=true
4. Client disables the pre-configured BRCB
5. Client requests SetBRCBValues of a BRCB with an existing data set with the maximum allowed name length and RptID when these attributes are dynamic (“dyn”)
6. Client enables this BRCB with at least OptFlds data-set-name and trigger condition GI
7. Client requests SetBRCBValues with GI=true
8. Client disables this BRCB

Comment

sBr15	**Report with dataset with most to least data hierarchy FCDA elements**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6

IEC 61850-8-1 Subclause 14.3

Expected result

1. In the SCL file the FCDA doName contains maximum one dot (for example doName=“neut.phsA” and daName=”cVal.mag.f”)
2. DUT sends a SetBRCBValues response+
3. DUT sends the GI report with correct data references

Test description

1. Reserve and configure one or more BRCBs with one or more datasets with the least detailed data hierarchy to the most detailed data hierarchy available in the DUT data model. For example in the SCL file add the following FCDA elements:
   - doName=”MMXU.PhV”
   - doName=”MMXU.A” daName=”phsA”
   - doName=”MMXU.A” daName=”phsB.cVal”
   - doName=”MMXU.A” daName=”phsC.cVal.mag”
   - doName=”MMXU.A” daName=”neut.cVal.mag.f“
2. Client enables the BRCB with all supported optional fields and trigger condition GI
3. Client request GI

Comment

sBr16	**SetBRCBValues with multiple attributes in one request**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2
IEC 61850-8-1 Subclause 17.2

Expected result

1. DUT sends SetBRCBValues response+ and sends GI report
2. DUT sends SetBRCBValues response+
3. DUT sends SetBRCBValues response+ and sends GI report
4. DUT sends SetBRCBValues response+

Test description

1. Client reserves and configures all supported “dyn” attributes, purges, enables and triggers the GI in a single SetBRCBValues request. The order of the ListOfVariables is: ResvTms, RptID/DatSet/OptFlds/BufTm/TrgOps/IntgPd/PurgeBuf=T, RptEna=T, GI=T
2. Client disables the BRCB
3. Client reserves, resyncs, enables and triggers the GI in a single SetBRCBValues request
   The order of the ListOfVariables is: ResvTms, EntryID, RptEna=T, GI=T
4. Client disables the BRCB

Comment

Note: A single ACSI request is mapped to an MMS Write with a ListOfVariable for each RCB attribute

sBr17	**Events are no longer suppressed when db=0 (tissue #1565)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3
IEC 61850-8-1 Subclause 8.1.3.9, 17.2
PIXIT: Rp15

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response+
3. DUT sends data change reports
4. DUT sends SetBRCBValues response+

Test description

1. Reserve and configure an available BRCB using SetBRCBValues with all optional fields, the minimum BufTm and trigger option data-change and configure db=0 for one or more dataset members with FC=MX
2. Client enables the BRCB
3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members with db=0 in the data set
4. Client disables the BRCB

Comment

Specific test procedures for buffered reporting

sBr20	**Buffered reporting state machine with setting the EntryID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.1, 17.2.2.14, 17.2.2.5, 17.2.3…8
IEC 61850-8-1 Subclause 17.2.1
PIXIT: Rp7

Expected result

1 to 6: Events are buffered, the EntryID value is not equal to the last received EntryID
7. The DUT sends SetBRCBValues response+ when the EntryID value exists in the queue of entries and response- when the EntryID value does not exist (buffer overflow)
8. The DUT sends reports in the time sequence order starting with the next event after the event specified in EntryID
9. The DUT sends reports in the time sequence order starting with the next event after the event specified in EntryID
10. Reports that are buffered while not associated have been purged, purged reports are not sent after enabling the BRCB. The first report is the GI report and have buffer-overflow set
11. The Optional field buffer-overflow shall be set only in the first report that is sent after enabling the BRCB. All reports that are in the buffer are sent in time sequence order
12. The DUT sends reports in the time sequence order starting with the next event after the event specified in EntryID

Test description

1. Client reserves and configures an available BRCB with all optional fields with the trigger data-change and general-interrogation
2. Client enables the BRCB (set RptEna to True)
3. EQUIPMENT SIMULATOR forces several data changes
4. Client requests Release
5. EQUIPMENT SIMULATOR forces several more data changes
6. Client re-establishes the association and requests GetBRCBValues
7. Client reserves and sets the EntryID to the last received report in the BRCB
8. Client enables the BRCB, wait for report(s) and disables the BRCB
9. Repeat steps 2-8, but Abort the association at step 4
10. Repeat steps 2-8, but set PurgeBuf=TRUE instead of EntryID at step 7 and force a GI at step 8
11. Repeat steps 2-8, but generate more data changes in step 5 than the buffer can hold, to force a buffer overflow (PIXIT)
12. Repeat steps 2-8, but at step 4 disconnect the link longer then the lost detection time and connect the link again.

Comment

sBr21	**Buffered reporting state machine without setting EntryID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.1, 17.2.2.14, 17.2.2.5, 17.2.3...8
IEC 61850-8-1 Subclause 17.2.1
PIXIT: Rp7

Expected result

1 to 6: Events are buffered, the EntryID value is not the same as the EntryID in the last received report
7. The Optional field buffer-overflow shall be set only in the first report that is sent after enabling the BRCB. All reports that are in the buffer (from step 2 and step 5) are sent in time sequence order

Test description

1. Client reserves and configures an available BRCB with all optional fields with the trigger data-change
2. Client enables the BRCB (set RptEna to True)
3. EQUIPMENT SIMULATOR forces several data changes
4. Client requests Release
5. EQUIPMENT SIMULATOR forces several more data changes
6. Client re-establishes the association and requests GetBRCBValues
7. Client reserves and enables the BRCB, wait for report(s) and disables the BRCB

Comment

sBr22	**Buffered reporting of integrity reports**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.1, 17.2.2.14, 17.2.2.5, 17.2.3...8
IEC 61850-8-1 Subclause 17.2.1
PIXIT: Rp7

Expected result

1 to 6: Events are buffered and the EntryID value is not the same as the EntryID in the last received report
7. The DUT sends SetBRCBValues response+
8. The DUT sends (integrity) reports in the time sequence order starting with the next event after the event specified in EntryID

Test description

1. Client reserves and configures an available BRCB with all optional fields with the trigger integrity
2. Client enables the BRCB (set RptEna to True)
3. Wait for several integrity periods
4. Client requests Release
5. Wait for several integrity periods
6. Client re-establishes the association and requests GetBRCBValues
7. Client reserves and sets the EntryID to the last received report in the BRCB
8. Client enables the BRCB, wait for integrity report(s) and disables the BRCB

Comment

sBr23	**Successful pre-assigned BRCB ResvTms reservation**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3
IEC 61850-8-1 Subclause 17.2

Expected result

1. DUT responds ResvTms = -1
2. DUT accepts configuration and send reports as configured
3. DUT accepts configuration and send reports as configured
4. DUT responds ResvTms = -1 (see IEC 61850-7-2 Subclause 17.2.2.17)
5. DUT sends Release response+
6. DUT responds ResvTms = -1

Test description

1. Test engineer configures (pre-assigns) an indexed BRCB with one ClientLN and Client requests GetBRCBValues on the BRCB with index 01
2. Client with matching authentication parameters, reserves and enables the BRCB with index 01, requests GetBRCBValues, forces GI, disables the BRCB and releases the association
3. Client re-establishes the association and sets the ResvTms to 10 and then configures and enables this BRCB
4. Client requests GetBRCBValues
5. Client requests Release and wait 12 seconds
6. Client re-establishes the association and requests GetBRCBValues

Comment

An SCL preconfigured **BRCB** for a set of specific clients based upon configuration displays an attribute **ResvTms** with a value set to - 1. In that case,

- **SetBRCBValues.Request(ReserveTimeSecond=0)** by the client **TPAA** owner, un-reserves the **BRCB** from the **TPAA** (positive response),
- **SetBRCBValues.Request(ReserveTimeSecond>0)** by a client **TPAA** identified as being member of that set, allows the client to confirm the **TPAA** over which the **BRCB** will be used,

but the **ResvTms** attribute will continue to reflect the SCL reservation value - 1.

sBr24	**Failed BRCB ResvTms reservation**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3 IEC 61850-8-1 Subclause 17.2		
Expected result 1. DUT sends SetBRCBValues response+ 2. DUT sends SetBRCBValues response- 3. DUT sends SetBRCBValues response+ 4. DUT sends SetBRCBValues response- 5. DUT sends SetBRCBValues response+		
Test description 1. Client1 reserves a BRCB with ResvTms = 0 by setting the ResvTms to a positive value 2. Client2 reserves and configures the same BRCB 3. Client1 disables the reservation by setting ResvTms = 0 4. Client1 set ResvTms=-1 on the same BRCB 5. Client2 reserves the same BRCB by setting the ResvTms = 0 to a positive value		
Comment		

sBr25	**Buffer is purged on re-configuration**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3, Table 37 IEC 61850-8-1 Subclause 17.2		
Expected result 3. dchg and integrity reports are received. 6. the EntryID is not the same as the EntryID in the last received report 8..12. The buffer is purged, purged reports are not transmitted. The first report has a report time stamp value newer than the time of changing the entry in the BRCB which causes the buffer purge 13. The buffer is NOT purged, buffered reports are transmitted		
Test description 1. Client reserves and configures a BRCB with all optional fields with the trigger options: data-change and Integrity with a valid Integrity period 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes 4. Client requests Release 5. EQUIPMENT SIMULATOR forces several more data changes 6. Client re-establishes the association and requests GetBRCBValues 7. Client reserves and changes the RptID, when rptid is “dyn” 8. Client enables the BRCB and waits at least one integrity period 9. Repeat step 3 to 8 and at step 7, client changes the BufTm, when buftm is “dyn” 10. Repeat step 3 to 8 and at step 7, client changes the TrgOps, when trgops is “dyn” 11. Repeat step 3 to 8 and at step 7, client changes the IntgPd, when intgpd is “dyn” 12. Repeat step 3 to 8 and at step 7, client changes the DatSet, when datset is “dyn” 13. Repeat step 3 to 8 and at step 7, client changes the OptFlds, when optflds is “dyn”		

Comment

sBr26	Unkown and all zero EntryID	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.2.9, 17.2.2.15, 17.2.2.1
IEC 61850-8-1 Subclause 17.1.2

Expected result

3. The DUT sends data-change and integrity reports
7. DUT sends SetBRCBValues response- with data access error code object-value-invalid
8. DUT responds with the EntryID value of the last Entry entered in the buffer
9. All reports in the buffer are transmitted (the BRCB transits from disabled to enabled state). The BufOvl flag is only set in the first report
12. DUT sends SetBRCBValues response+
13. DUT responds with the EntryID value of the last Entry entered in the buffer
14. All reports in the buffer are transmitted. The BufOvl flag is only set in the first report

Test description

1. Client reserves and configures a BRCB with all optional fields with the trigger options data-change and integrity with a valid integrity period
2. Client enables the BRCB (set RptEna to True)
3. EQUIPMENT SIMULATOR forces several data changes
4. Client requests Release
5. EQUIPMENT SIMULATOR forces several more data changes
6. Client re-establishes the association and requests GetBRCBValues
7. Client reserves and sets an unknown EntryID value
8. Client requests GetBRCBValues
9. Client enables the BRCB and waits for some reports
10. Client disables the BRCB
11. Repeat steps 2 to 6
12. Client reserves and sets an all zero EntryID value
13. Client requests GetBRCBValues
14. Client enables the BRCB and waits for some reports
15. Client disables the BRCB

Comment

On setting an all zero EntryID the state shall transition from resync to disabled (clause 17.2.2.1).

sBr27	**GetBRCBValues and EntryID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.2.9
IEC 61850-8-1 Subclause 17.1.2

Expected result

3. DUT sends data-change and integrity reports
7. DUT responds the EntryID of the last entry that has been entered into the buffer (this value is different from the EntryID received in the last report)
9. DUT transmits the reports in the buffer (not transmitted before)
10. DUT responds the EntryID of last entry that has been formatted and queued for transmission
12. DUT responds the EntryID of the last entry that has been entered into the buffer
14. DUT responds the EntryID of the last entry that has been entered into the buffer
15. DUT transmits all reports in the buffer (including the reports transmitted before)
16. DUT responds the EntryID of last entry that has been formatted and queued for transmission

Test description

1. Client reserves and configures a BRCB with all optional fields with the trigger option data change and integrity with a valid integrity period
2. Client enables the BRCB (set RptEna to True)
3. EQUIPMENT SIMULATOR forces several data changes
4. Client requests Release
5. EQUIPMENT SIMULATOR forces several more data changes
6. Client re-establishes the association
7. Client request GetBRCBValues
8. Client reserves and sets EntryID to last received EntryID
9. Client enables the BRCB and wait for at least 1 report
10. Client request GetBRCBValues while DUT is sending buffered reports
11. Client disables the BRCB
12. Client request GetBRCBValues
13. Client sets EntryID = 0
14. Client request GetBRCBValues
15. Client enables the BRCB
16. Client request GetBRCBValues while DUT is sending buffered reports
17. Client disables the BRCB

Comment

sBr28	**At most the last GI report is retransmitted**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3
IEC 61850-8-1 Subclause 17.1.2

Expected result

3. DUT transmits at least one integrity report and 3 GI reports
6. DUT responds the EntryID of last entry added to the buffer
7. DUT sends SetBRCBValues response+
8. DUT transmits the old and all new integrity reports and only the last GI report OR if GI has already been removed from the buffer (FIFO), only entries that occurred after the GI entries are reported

Test description

1. Client reserves and configures a BRCB with all optional fields with the trigger options general-interrogation and integrity with an integrity period of 30 seconds
2. Client enables the BRCB (set RptEna to True)
3. Client requests GI report and wait about 12 seconds, repeat 3 times
4. Client requests Release and waits several integrity periods
5. Client re-establishes the association
6. Client request GetBRCBValues
7. Client reserves and sets EntryID to all zero
8. Client enables the BRCB

Comment

sBr29	**Buffered reporting before enabling**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Sub-clause 17.2
IEC 61850-8-1 Sub-clause 17
PIXIT As8

Expected result

3. The DUT sends minimum 3 integrity reports and one data-change report with a TimeOfEntry before enabling the BRCB
4. DUT sends the GI report.

Test description

1. Server is configured with SCD containing an available BRCB with all optional fields, IntgPd > 0, BufTm=0 with TrgOps = integrity,data-change,GI and a valid data set
2. Wait until startup is complete plus 3 integrity periods, meanwhile use the EQUIPMENT SIMULATOR to generate a data-change on a data set entry
3. Client reserves and enables the BRCB (set RptEna to True)
4. Client requests GI
5. Client disables the BRCB

Comment

sBrN1	**Incorrect GetBRCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.3.2 IEC 61850-8-1 Subclause 17.2.2		
Expected result 1. DUT sends response with data access error “object-non-existent”		
Test description 1. Client request GetBRCBValues with unknown BRCB object		
Comment		

sBrN2	**Only trigger option GI**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.2.9 IEC 61850-8-1 Subclause 17.1.2		
Expected result 3. DUT does not send reports		
Test description 1. Reserve and configure an available BRCB using SetBRCBValues with all supported fields, BufTm=0, IntgPd=1000 and only trigger option general-interrogation 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set		
Comment		

sBrN3	**Integrity period zero**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.2.9 IEC 61850-8-1 Subclause 17.2		
Expected result 3. DUT does not send integrity reports		
Test description 1. Reserve and configure an available BRCB using SetBRCBValues with trigger option Integrity and integrity period 0 2. Client sets the BRCB RptEna to True (without synchronizing the BRCB by setting the BRCB EntryID) 3. Wait one minute 4. Client disables the BRCB		
Comment		

sBrN4	**Incorrect configuration of BRCB**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.2.1
IEC 61850-8-1 Subclause 17.1.2, 8.1.3.4.3, Table 61

Expected result

2. DUT sends SetBRCBValues response- with data access error “temporarily-unavailable”
4. DUT sends SetDataValues response- with data access error “object-access-denied”
5. DUT sends SetBRCBValues response- with data access error “object-access-denied”
6. DUT sends SetBRCBValues response- with data access error “object-value-invalid”
7. DUT sends SetBRCBValues response+
8. DUT sends SetBRCBValues response- with data access error “temporarily-unavailable”
9. DUT sends SetBRCBValues response- with data access error “temporarily-unavailable”

Test description

1. Client reserves, configures and enables an available BRCB
2. Client requests SetBRCBValues with a new valid value on each one of the following “dyn” attributes: RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd and the attributes PurgeBuf, EntryID
3. Client disables the BRCB
4. Client requests SetDataValues with one of the following attributes: ConfRev, SqNum, TimeOfEntry and Owner (when available)
5. Client requests SetBRCBValues with the “fix” or “conf” attributes from step 2

When datSet=”dyn” then perform the following steps

6. Client requests SetBRCBValues with unknown DatSet
7. Client changes datSet to empty
8. Client enables a BRCB with empty DatSet

When datSet=”conf” then perform the following steps

9. Client enables a BRCB with empty DatSet (when supported)

Comment

sBrN5	**Exclusive use of BRCB**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2 IEC 61850-8-1 Subclause 17.2		
Expected result 2. DUT sends SetBRCBValues response- with data access error “temporarily-unavailable” 4. DUT sends a SetBRCBValues response+		
Test description 1. Client1 reserves and configures and enables an available BRCB 2. Client2 reserves and configures the same BRCB by requesting SetBRCBValues with one of the following dynamic (“dyn”) attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd, PurgeBuf, EntryID 3. Disable the TCP communication between Client1 and the DUT. E.g. disconnect the physical link between two Ethernet switches (preventing Ethernet hardware error detection at both client and server) some seconds longer than the lost connection detection timeout (specified in the PIXIT) and the ResvTms reached the value 0 and then enable TCP communication. E.g. connect the physical link 4. Client2 reserves and requests a SetBRCBValues of a “dyn” attribute		
Comment		

sBrN7	**Verify another client can [not] configure a pre-assigned BRCB**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3 IEC 61850-8-1 Subclause 17.2 PIXIT: Rp13		
Expected result 2. DUT responds ResvTms = -1 3. DUT accepts configuration and send reports as configured or rejects client depending on behaviour described in PIXIT Rp13		
Test description 1. Test engineer configures (pre-assigns) an indexed BRCB with one ClientLN 2. Client requests GetBRCBValues on the BRCB with index 01 3. Client with mis-matching authentication parameters, reserves, enables the BRCB with index 01, requests GetBRCBValues, forces GI and disables the BRCB		
Comment Figure E.2 states: “Client cannot configure/enable prior setting ResvTms to a positive value” (this shall be refused by the server)		

sBrN8	**Trigger option GI not set**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.2.9
IEC 61850-8-1 Subclause 17.2

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response+, however sends no GI report
3. DUT sends SetBRCBValues response+
4. DUT sends SetBRCBValues response- with data access error “temporarily unavailable”
5. DUT sends SetBRCBValues response+
6. DUT sends SetBRCBValues response+ and sends no GI report
7. DUT sends SetBRCBValues response+ and does send the GI report

Test description

1. Client reserves and configures and enables an available BRCB without trigger option general-interrogation
2. Client requests SetBRCBValues with GI=TRUE
3. Client disables the BRCB and set trigger option general-interrogation
4. Client requests SetBRCBValues with GI=TRUE
5. Client enables the BRCB
6. Client requests SetBRCBValues with GI=FALSE
7. Client requests SetBRCBValues with GI=TRUE

Comment

sBrN9	**Enable a free and pre-assigned BRCB without reservation**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Annex E
IEC 61850-8-1 Subclause 17.2

Expected result

1. DUT sends SetBRCBValues response-
2. DUT sends SetBRCBValues response-

Test description

1. Client configures and enables a free BRCB without reservation
2. Matching client configures and enables a pre-assigned BRCB without reservation

Comment

sBrN10	**Reserve BRCB by the same and another client when ResvTms is not expired**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.2.3
IEC 61850-8-1 Subclause 17.2
PIXIT-Rp13

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response-
3. DUT sends Release response+
4. DUT sends Associate response+
5. DUT sends SetBRCBValues response+
6. DUT sends Release response+
7. DUT behaves as specified in PIXIT-Rp13

Test description

1. Client1 reserves a BRCB with ResvTms = 0 by setting the ResvTms to a positive value
2. Client2 with a different IP-address (and different parameters according to PIXIT-Rp13 when possible) reserves and configures the same BRCB
3. Client1 sends Release request
4. Client1 sends Associate request
5. Client1 reserves and configures the same BRCB within the ResvTms expiration
6. Client1 sends Release request
7. Client2 reserves and configures the same BRCB within the ResvTms expiration

Comment

A4.7 Logging

Abstract test cases

Test case	Test case description
sLog1	Request GetLogicalNodeDirectory(LOG) and check response+
sLog2	Request GetLogicalNodeDirectory(LCB) and check response+
sLog3	Request GetLCBValues with functional constraint LG of all responded LCB's
sLog4	Request SetLCBValues with functional constraint LG when LCB is disabled
sLog5	Verify that logging is independent of a limited set of external application associations
sLog6	Configure and enable logging and check that the following logging trigger options place a correct entry in the log with the correct members of the data set – on integrity – on update (dupd) – on update with integrity – on data change (dchg) – on quality change (qchg) – on data and quality change – on data and quality change with integrity period
sLog7	Request QueryLogByTime and check response+
sLog8	Request QueryLogAfter and check response+
sLog9	Request GetLogStatusValues and check response+, verify that the responded entries indicate the oldest/newest entry ID/time available in the log
sLog10	Check that data is logged as defined in the settings of logical node GLOG. The corresponding reason code shall be "application-trigger"
sLog11	Verify that server can process a LCB and LOG with maximum name length for LCBRef, LogRef and DatSet (IEC 61850-7-2 Subclause 22.2)
sLog12	Verify that log entries are non-volatile and not lost after reboot and power loss
sLog13	Verify the DUT can process a SetLCBValues with all writable attributes in one request

Note: sLog1 is not applicable for IEC 61850-8-1.

Test case	Test case description
sLogN1	Request the following log services with wrong parameters (out of range entries, or non existent Dataset, LCB or Log) and verify response– service error – GetLCBValues (IEC 61850-7-2 Subclause 17.3.2.5) – SetLCBValues (IEC 61850-7-2 Subclause 17.3.2.6) – QueryLogByTime (IEC 61850-7-2 Subclause 17.3.5.2) – QueryLogAfter (IEC 61850-7-2 Subclause 17.3.5.3) – GetLogStatusValues (IEC 61850-7-2 Subclause 17.3.5.4)
sLogN2	Request SetLCBValues when LCB is enabled and disabled and verify response– service error

Detailed test procedures

sLog2 **sLog3**	**GetLogicalNodeDirectory(LCB) and GetLCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 9.2.2 and 17.3.2.5 IEC 61850-8-1 Subclause 12.3.1 and 17.2.4		
Expected result 1. DUT sends GetLogicalNodeDirectory(LCB) response+ with a list of LCB's 2. DUT sends GetLCBValues response+		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(LCB) 2. For each LCB Client requests GetLCBValues		
Comment		

sLog4	**SetLCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.3.2.6 IEC 61850-8-1 Subclause 17.3.4.3		
Expected result 1. DUT sends SetLCBValues response+ 2. DUT sends SetLCBValues response+ and starts logging 3. DUT adds entries to the corresponding log with trigger option integrity and data change 4. DUT sends GetLCBValues response+ with updated NewEnt and NewEntrTm 5. DUT sends SetLCBValues response+ and stops logging		
Test description 1. Client configures an available LCB using SetLCBValues with trigger option data change and integrity 2. Client enables the LCB (set LogEna to True) 3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set during multiple integrity periods 4. Client sends GetLCBValues request 5. Client disables the LCB (set LogEna to False)		
Comment		

sLog5	**Verify that logging is independent from application associations**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.2.3 IEC 61850-8-1 Subclause 17.3.4		
Expected result 1. Each client receives the logged entries		
Test description 1. Client enables logging 2. Client releases the association 3. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set 4. Maximum numbers of clients associate 5 Each client queries the logged entries 6. All clients release their association		
Comment		

sLog6 **sLog7** **sLog8** **sLog9**	**Trigger options for a LCB** **QueryLogByTime** **QueryLogAfter** **GetLogStatusValues**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 17.3.5
IEC 61850-8-1 Subclause 17.3.4

Expected result

1. DUT sends SetLCBValues response+
2. DUT sends SetLCBValues response+ and adds an event condition ACTIVE to the log
3. DUT sends SetLCBValues response+ and adds an event condition DISABLED to the log
4. DUT sends SetLCBValues response+ and adds an event condition ACTIVE to the log
5. DUT adds entries to the log according to trigger option, the reason code shall match the trigger option
6. DUT sends GetLogStatusValues response+. The responded entries indicate the oldest/newest entry ID/time available in the log
7. DUT sends QueryLogByTime response+ with a list of the corresponding log entries with matching reason code
   - the log time stamp value is UTC and matches the trigger time
   - the reason for inclusion matches the trigger option
   - the data-reference(s) match the data set member(s)
8. DUT sends QueryLogAfter response+ with a list of the corresponding log entries with matching reason code
9. DUT sends QueryLogAfter response+ with a list all log entries
10. DUT sends QueryLogAfter response+ with an empty list of entries
11. DUT sends QueryLogAfter response+ with log entries after the specified time
12. DUT sends QueryLogAfter response+ with log entries after those of the specified timestamp
13. DUT sends QueryLogAfter response+ with an empty list of entries
14. DUT sends QueryLogAfter response+ with entries specified at the timestamp but excludes all entries equal and prior to the specified entry value
15. DUT sends GetLogStatusValues response+
17. DUT responses the same log status values as in step 15
19. DUT responses the same log status values as in step 15

Test description

1. Configure an available LCB using SetLCBValues with the following trigger options:
   - on integrity
   - on update (dupd)
   - on data and quality change
   - on data and quality change with integrity period
2. Client enables the LCB, set LogEna to True
3. Client disables the LCB, set LogEna to False
4. Client enables the LCB, set LogEna to True
5. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set including multiple values of entry identifiers with same timestamp
6. Client sends GetLogStatusValues request
7. Client sends valid QueryLogByTime request
8. Client sends valid QueryLogAfter request
9. Client sends valid QueryLogAfter with invalid entry and RangeStartTime before first Log entry
10. Client sends valid QueryLogAfter with invalid entry and RangeStartTime after last Log entry
11. Client sends valid QueryLogAfter with invalid entry and RangeStartTime between the first Log entry but before the final Log entry but not equal to any log entries
12. Client sends valid QueryLogAfter with invalid entry and RangeStartTime equal to one of the entries after the first timestamp but before the entry with the last timestamp
13. Client sends valid QueryLogAfter with invalid entry and RangeStartTime equal to the entries with the most recent timestamps
14. Client sends valid QueryLogAfter with RangeStartTime equal to that with multiple entry value and with entry equal to the non-first entry at that time
15. Repeat step 1 to 12 for next trigger option combination
16. Client disables the LCB, set LogEna to False
17. Client sends GetLogStatusValues request
18. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set
19. Client sends GetLogStatusValues request

Comment

sLog10	GLOG data object values	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Subclause 7.9, 6.4.3.3.3
IEC 61850-7-2 Subclause 14.2.2.8
IEC 61850-7-4 Subclause 5.7.4
IEC 61850-8-1 Subclause 17.3.4

Expected result

2. DUT sends QueryLogByTime/After response+ with a list of the corresponding log entries for the configured references (both GLOG.TrgRef and GLOG.InRef) with reason code "application-trigger".
4. DUT sends QueryLogByTime/After response+ with a list of the corresponding log entries for the configured references (both GLOG.TrgRef and GLOG.InRef) with reason code "application-trigger".

Test description

1. EQUIPMENT SIMULATOR forces several data changes of the GLOG configured trigger references (GLOG.TrgRef)
2. Client sends valid QueryLogByTime/After request
3. Client operates the optional GLOG.LogTrg
4. Client sends valid QueryLogByTime/After request

Comment

sLog11	Max LCB name length	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 22.2
IEC 61850-8-1 Subclause 17.3.4

Expected result

2. DUT sends SetLCBValues response+
4. DUT sends GetLCBValues response+ and updated LCB.newEnt
5. DUT sends QueryLogByTime/After response+ and sends an entryID corresponding to the integrity expiration, in which all DataSet members have been logged with a reason code Integrity or DUT sends an EntryID corresponding to the data change with the changed data set member(s) with reason code data-change.

Test description

1. Configure DUT with LCB with maximum name length (32), with maximum name length data set with maximum name length data set element and trigger option integrity and data-change
2. Client requests SetLCBValues with maximum length dataset when supported
3. Client enables the LCB and waits for integrity expiration or force data-change
4. Client requests GetLCBValues
5. Client sends valid QueryLogByTime/After request
6. Client disables the LCB

Comment

sLog12	Log entries are non-volatile	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 22.2 IEC 61850-8-1 Subclause 17.3.4		
Expected result 1. DUT sends log entries 3. DUT sends at least same log entries as under 1 5. DUT sends at least same log entries as under 3		
Test description 1. Client sends valid QueryLogByTime/After request 2. Cause unexpected DUT restart by simulating a temporarily power outage 3. Client associates and sends same valid QueryLogByTime/After request 4. Interrupt and restore the power supply 5. Client associates and sends same valid QueryLogByTime/After request		
Comment Note: on reboot, new log entries may be added		

sLog13	SetLCBValues with multiple attributes in one request	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.3.2 IEC 61850-8-1 Subclause 17.3		
Expected result 1. DUT sends SetLCBValues response+ 2. DUT sends GetLCBValues response+ with LogEna = T		
Test description 1. Client configures all supported “dyn” attributes and enables the LCB in a single SetLCBValues request The order of the ListOfVariables is: LogRef/DatSet/TrgOps/IntgPd, LogEna=T 2. Client request GetLCBValues		
Comment IEC 61850-8-1 Table 65 specifies LogEna, LogRef, DatSet, TrgOps and IntgPd may be writable		

sLogN1	Incorrect GetLCBValues, QueryLogByTime, QueryLogAfter, GetLogStatusValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.3.2.6 IEC 61850-8-1 Subclause 17.3.4.3		
Expected result 1. DUT sends GetLCBValues response- with data access error " object-non-existent" 2. DUT sends QueryLogByTime response- with errorClass "access" and errorCode "object-non-existent" 3. DUT sends QueryLogAfter response- with errorClass "access" and errorCode "object-non-existent" 4. DUT sends GetLogStatusValues response- with data access error " object-non-existent"		
Test description 1. Client request GetLCBValues with unknown LCB object 2. Client requests QueryLogByTime with unknown LogRef 3. Client requests QueryLogAfter with unknown LogRef 4. Client request GetLogStatusValues with unknown LCB attribute.		
Comment		

sLogN2	Incorrect SetLCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 17.3.2.6 IEC 61850-8-1 Subclause 17.3.4.3		
Expected result 2. DUT sends SetLCBValues response- with data access error "temporarily-unavailable" 4. DUT sends SetLCBValues response- with data access error "object-access-denied" 5. DUT sends SetLCBValues response- with data access error "object-value-invalid"		
Test description 1. Client configures and enables the LCB 2. Client requests SetLCBValues with each of the following attributes which are “dyn”: datSet, trgOps, and intgPd 3. Client disables the LCB (set LogEna to False). When not supported skip step 4 4. Client requests SetLCBValues with each of the following attributes: oldEntrTm, newEntrTm, oldEnt and newEnt and the attributes: datSet, trgOps, and intgPd which are "fix" or "conf" 5. Client requests SetLCBValues with unknown datSet (when datSet="dyn")		
Comment Note: if any of the datSet, trgOps, and intgPd are “dyn” then logEna must also be “dyn”		

A4.9a GOOSE Publish

Abstract test cases

Test case	Test case description
sGop1	Request GetLogicalNodeDirectory(GoCB) and request GetGoCBValues (IEC 61850-7-2 Subclause 18.2.2.5 and 10.2.2)
sGop2	GOOSE messages are published with a long (SCL maxtime) cycle time, check the GOOSE data with configured data; (IEC 61850-7-2 Subclause 18.2.3) – gocbRef is a valid GoCB reference – timeAllowedtoLive > 0 and the next GOOSE message is transmitted within the specified value of the current GOOSE message – datSet is same as the GoCB and SCL and contains a valid dataset reference – goID is same as the GoCB and SCL, the default value is the GoCB reference – t contains the time of the status increment or start-up – sqNum is incremented, stNum>0 and isn't changed – Simulation is not present or if present with value FALSE – confRev >0 and is same as the GoCB and SCL (IEC 61850-7-2 Subclause 18.2.1.6) – needsCommissioning is not present or if present same as GoCB – numDatSetEntries matches with the number of data entries in allData – allData values match with the datSet element type
sGop3	Verify that a newly activated device sends the initial GOOSE message with stNum initial value one (1) (IEC 61850-7-2 Subclause 18.1 and 18.2.3)
sGop4	Force a data change of a data value in the GOOSE dataset, DUT shall publish GOOSE messages as specified/configured (SCL mintime), stNum is incremented, sqNum = 0
sGop5	When supported, verify that the DUT publishes GOOSE messages with the simulation flag set (IEC 61850-7-2 Subclause 18.2.3.8)
sGop6	Disable GoCB, verify that changing parameters with SetGoCBValues are active (IEC 61850-7-2 Subclause 18.2.1.3 and 18.2.2) and no GOOSE messages are transmitted anymore
sGop7	Verify that after a restart the device keeps the same Configuration revision value in the GoCB and GOOSE messages (IEC 61850-7-2 Subclause 18.2.1.6)
sGop8	Verify that ConfRev increments every time when the configuration of the data set referenced by DatSet has been changed (IEC 61850-7-2 Subclause 15.2.1.6). Changes that are counted are: – deletion of a member of the data-set – re-ordering of members in the data-set – changing the value of the attribute DatSet
sGop9	Verify that GoCB attribute NdsCom is set when DatSet is not yet configured (is NULL) (IEC 61850-7-2 Subclause 18.2.1.7)
sGop10	Verify the DUT can send GOOSE messages with data attributes and/or data objects
sGop11	Verify that the server can process a GoCB with maximum name length for DatSet, GoCBRef and GoID (IEC 61850-7-2 Subclause 22.2)
sGop12	GOOSE message with sequence number value 128

Note: sGop7 and sGop8 are not applicable for part 8-1

Test case	Test case description
sGopN1	When GoEna=TRUE, no attributes of the GoCB control block can be set except for GoEna. (IEC 61850-7-2 Subclause 18.2.1.3)
sGopN2	Verify that if the number or size of values being conveyed by the elements in the dataset exceeds the SCSM determined maximum number, NdsCom is set to True. (IEC 61850-7-2 Subclause 18.2.1.7)

Detailed test procedures

sGop1	**GetLogicalNodeDirectory(GoCB) and GetGoCBValues**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.2.5 IEC 61850-8-1 Subclause 18.1.2.3		
Expected result 1. DUT sends GetLogicalNodeDirectory(GoCB) response+ with a list of GoCB's. The GoCB shall be located in LLN0. 2. DUT sends GetGoCBValues response+, the returned values match with the SCL configured values		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(GoCB) 2. For each GoCB Client requests GetGoCBValues		
Comment		

sGop2	**GOOSE message**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 18.2.3.6+7
IEC 61850-8-1 Subclause 18.1, A.3
PIXIT: Gp3, Gp4

Expected result

a) DUT sends valid GOOSE messages with valid references, time stamp, incrementing sequence number, status number is the same, offset is variable, the GoCB.FixedOffs is false or is not available

b) DUT sends valid GOOSE messages with valid references, time stamp, incrementing sequence number, status number is the same, the GOOSE header and Data values use fixed length encoding according to table A.1 and A.2, the GoCB.FixedOffs is true when available

In both cases the GOOSE messages:

- gocbRef matches the SCL file
- timeAllowedtoLive > 0 and the next GOOSE message is transmitted within the specified value of the current GOOSE message
- datSet matches the SCL file and contains a valid dataset reference
- goID matches SCL file appID, the default value is the GoCB reference
- t contains the time of the status increment or start-up
- sqNum is incremented, stNum>0 and isn't changed and t shall remain the same with the same stNum
- simulation value FALSE
- confRev >0 matches the SCL file (IEC 61850-7-2 Subclause 18.2.1.6)
- needsCommissioning is False
- numDatSetEntries matches with the number of data entries in allData
- allData values match with the datSet element type
- Destination MAC-Address, APPID, VLAN-ID and VLAN-PRIORITY, match the SCL file
- Ethertype of Ethernet packet is 0x8100 and VLAN CFI = 0
- Ethertype of GOOSE is 0x88B8
- The slow retransmission time does not exceed the SCL MaxTime

Test description

Configure SCD file with MAC-Address, APPID, VLAN-ID, VLAN-PRIORITY different from ICD/IID

a) Variable length encoding
   1. Configure and enable a GoCB with MAC-Address, APPID, VLAN-ID, VLAN-PRIORITY different from ICD and with GSEControl fixedOffs=false or absent
   2. Force no data change. Wait for several GOOSE messages
   3. Client associates, request GetGoCBValues of this GoCB and releases

b) Fixed length encoding
   4. Configure and enable a GoCB with MAC-Address, APPID, VLAN-ID, VLAN-PRIORITY different from ICD and with GSEControl.fixedOffs=true
   5. Force no data change. Wait for several GOOSE messages with at least one Boolean, one quality, one float and one signed integer with a negative value and one unsigned integer when supported
   6. Client associates, request GetGoCBValues of this GoCB and releases

Comment

sGop3	**Initial GOOSE message**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 Table 94 IEC 61850-8-1 Subclause 18.1 PICS S39 (SetGoCBValues) PIXIT: Gp7, As9		
Expected result 1. DUT sends initial GOOSE message with stNum=1 and sqNum=0 or 1 (PIXIT Gp7) 3. DUT sends initial GOOSE message with stNum=1 and sqNum same as step 1		
Test description 1. Configure DUT with a valid GOOSE control block configuration and start DUT 2. If PICS S39=Yes then set GoEna=false 3. If PIXIT As9=No then cycle power to DUT, otherwise disable then enable the GOOSE on DUT		
Comment Note: when tissue #1679 is “In Force” execute step 2, otherwise skip step 2		

sGop4	**GOOSE on data change**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.3.2.2 IEC 61850-8-1 Subclause 18.1, PIXIT: Gp5		
Expected result DUT sends GOOSE messages according to the configured retransmission strategy, the first retransmission does not exceed the SCL MinTime, stNum is incremented, sqNum = 0 in the first message after data change		
Test description 1. Force a data change of a data value in the GoCB data set 2. Wait for GOOSE messages		
Comment		

sGop5	Simulation mode and simulation flag	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3.8 IEC 61850-8-1 Subclause 18.1.2.5, figure C.5, PIXIT: Gp1		
Expected result 1. DUT sends a GOOSE messages with Simulation flag set and Reserved1 - Simulated bit is set		
Test description 1. Test engineer enables DUT to send simulated GOOSE messages		
Comment		

sGop6	SetGoCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.1.3, 18.2.2.5, 18.2.2.6 IEC 61850-8-1 Subclause 18.1.1		
Expected result 1. GoEna=TRUE and stNum>1 2. DUT sends a SetGoCBValues response+ and stops transmitting GOOSE messages 3. DUT sends a SetGoCBValues response+ and initializes/starts transmitting GOOSE messages. The first message has stNum=1		
Test description 1. Force GoEna=TRUE and stNum>1 2. Client requests a SetGoCBValues with GoEna set to FALSE 3. Client requests a SetGoCBValues with GoEna set to TRUE		
Comment GoEna is the only attribute that may be written according to part 8-1.		

sGop9	DatSet not configured	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.1.7 IEC 61850-8-1 Subclause 18.1		
Expected result 1. DUT (including IED tool) either refuses the entire configuration or it ignores parts of the new configuration or it accepts the configuration 2. DUT sends SetGoCBValues response- 3. DUT sends no GOOSE messages for GoCB with empty datSet 4. If DUT acceptes configuration, GoCB.datSet is empty and GoCB.NdsCom is TRUE		
Test description 1. DUT is configured with a GSEControl element without the datSet 2. If supported, client sends SetGoCBValues request to enable this GoCB 3. Wait one minute after reconfiguration is completed 4. If supported, client sends GetGoCBValues request		
Comment		

sGop10	**GOOSE with data attributes (FCDA) and/or data objects (FCD)**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2 IEC 61850-8-1 Subclause 18.1		
Expected result 1) DUT sends GOOSE messages with data attributes 2) DUT sends GOOSE messages with data objects		
Test description If the DUT supports GOOSE datasets with at least one FCDA (PIXIT): 1) Verify the DUT is able to send GOOSE messages with data attributes (FCDA) If the DUT supports GOOSE datasets with at least one FCD (PIXIT): 2) Verify the DUT able to send GOOSE messages with data objects (FCD)		
Comment Tested with FCDA and/or FCD. If datasets are configurable then both steps are applicable.		

sGop11	**Max GoCB name length**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 22.2 IEC 61850-8-1 Subclause 18.1 SCL Services GSESettings cbName, datSet and appID		
Expected result 1. DUT sends valid GOOSE messages where GoCBRef, (containing a GoCB of 32), GoID (129) and data set name (32) reflect the configuration 2. DUT sends GetGoCBValues response+ where GoID (129) and Dataset name (32) reflect the configuration		
Test description 1. Configure DUT with GoCB with maximum name length (32, when not fixed), with maximum name length data set name (32, when not fixed) and GoID (129) 2. Client requests GetGoCBValues (when supported)		
Comment		

sGop12	**GOOSE message with sequence number value 128**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-6 Subclause 9.4.4 IEC 61850-7-2 Subclause 18.2.3.6+7 IEC 61850-8-1 Subclause 18.1		
Expected result 3. GOOSE message has sqNum = 128		
Test description 1. Configure one GoCB 2. Wait for GOOSE message with sqNum = 127 3. Wait for another GOOSE message		
Comment		

sGopN1	**Verify that GoCB components are read-only**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.2.3, 15.2.2.4 IEC 61850-8-1 Subclause 18.1.1		
Expected result 1. When SetGoCBValues is supported DUT sends a SetGoCBValues response+ otherwise response- 2. DUT sends a SetGoCBValues response- 3. DUT sends a SetGoCBValues response- 4. DUT sends a SetGoCBValues response- 5. DUT sends a SetGoCBValues response- 6. DUT sends a SetGoCBValues response- 7. When SetGoCBValues is supported DUT sends a SetGoCBValues response+ otherwise response-		
Test description 1. Client requests a SetGoCBValues to disable GoEna 2. Client requests a SetGoCBValues with valid GoID 3. Client requests a SetGoCBValues with valid DatSet 4. Client requests a SetGoCBValues with valid DstAddress 5. Client requests a SetGoCBValues with optional MinTime, MaxTime 6. Client requests a SetGoCBValues with optional FixedOffs 7. Client requests a SetGoCBValues to enable GoEna		
Comment		

sGopN2	**Verify too large dataset**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.1.7 IEC 61850-8-1 Subclause 18.1		
Expected result 1. DUT accepts or does not accept configuration (PIXIT) 2. DUT sends SetGoCBValues response- 3. DUT does not send GOOSE messages 4. If DUT accepts configuration, DUT sends GetGoCBValues response+ with GoEna=False and NdsCom=True		
Test description 1. Test engineer configures a GoCB with a dataset which values will not fit in a single GOOSE message, when accepted continue 2. If supported, client requests SetGoCBValues to enable GoEna 3. Wait 1 minute 4. If supported, client requests GetGoCBValues		
Comment		

A4.9b GOOSE Subscribe

Abstract test cases

Test case	Test case description
sGos1	Send GOOSE messages with/without the VLAN tag, VLANID=0, resp. with Reserved1 R>0 with new data and check if the message is received and the data has the new value by e.g. check binary output, event list, logging or MMI
sGos2	Send GOOSE messages with the ndsCom parameter set. Verify that on a status change the values are not used for operational purposes (IEC 61850-7-2 Subclause 18.2.3.8)
sGos3	Proper detection and action roll-over of sqNum with no status change (sqNum=max -> sqNum = 1) and with status change (sqNum=max -> sqNum = 0)
sGos4	Verify the logical node LGOS data object attribute values on receiving valid GOOSE messages, no GOOSE messages and GOOSE messages with mismatching ConfRev
sGos5	Verify that the server can subscribe to GOOSE messages with structured data (FCD)
sGos6	Send subscribed GOOSE messages with the Simulation parameter set (IEC 61850-7-2 Subclause 18.2.3.8). Verify that a when the subscriber is not in simulation mode (LPHD.Sim.stVal=false or not present) the simulated values are ignored. The subscriber shall keep on using the "real" GOOSE messages b when the subscriber is in simulation mode (LPHD.Sim.stVal=true) the simulated values are used for operational purposes. The subscriber shall ignore the "real" GOOSE messages **after a first simulated one has been received.** The corresponding LGOS.SimSt shall be set when the first simulated message is received and cleared when LPHD.Sim.stVal is set to false.
sGos7	Verify that the server can subscribe GOOSE messages with maximum name length for DatSet, GoCBRef and GoID (IEC 61850-7-2 Subclause 22.2)
sGos8	Subscribe GOOSE messages with non-1 boolean “true” value
sGos9	Subscribe GOOSE messages with “fixed length” GOOSE
sGos10	Subscribe GOOSE messages with ldName
sGos11	Subscribe GOOSE messages with private DO
sGos12	Process first GOOSE message after state change
sGos13	Subscribe GOOSE messages with security bits and trailer and non-zero Reserved 1 R
sGos14	Subscribe to Ed1 GOOSE message without goID
sGos15	Subscribe to 2 different GOOSE streams with the same AppID value
sGos20	Subscribe GOOSE with existing CDC extended with DA with new FC (K2.2)
sGos21	Subscribe GOOSE with existing CDC with renamed DA, subDO or subDA (K2.7)
sGos22	Subscribe GOOSE with existing CDC with extended PACKEDLIST (K2.17)
sGos23	Verify processing of GOOSE data values with quality.test

Test case	Test case description
sGosN1	Check behaviour of DUT as specified in PIXIT on Missing GOOSE message
sGosN2	Check behaviour of DUT as specified in PIXIT on Double GOOSE message
sGosN3	Check behaviour of DUT as specified in PIXIT on Delayed GOOSE message, with and without exceeding timeAllowedToLive
sGosN4	Check behaviour of DUT as specified in PIXIT on Out of order GOOSE message
sGosN5	Check behaviour of DUT as specified in PIXIT on No GOOSE messages
sGosN6	Check behaviour of DUT as specified in PIXIT on invalid GOOSE messages – gocbRef different from GoCB and NULL – timeAllowedtoLive = 0 – datSet different from GoCB and NULL – goID different from GoCB and NULL – t contains the time of a status change minus/plus one hour – confRev different from GoCB and NULL – numDatSetEntries 0, more, less with the number of data entries in the allData – allData values do not match with the datSet element type
sGosN7	Verify that the DUT rejects/discards GOOSE with inconsistent or invalid length

Detailed test procedures

To perform the DUT subscribe test procedures the DUT need to be configured as follows:

- a data value that is connected to a subscribed GOOSE member, e.g. GGIO.SPS01
- a data set that contains the value of this data point
- a GoCB that publishes this data set (or a RCB that sends a data change/quality change report)
- the subscribed GOOSE messages have variable length encoding unless specified otherwise (sGos9)

As such the analyzer trace files contain the proof when a subscribed GOOSE message is processed.

sGos1	**Subscribe GOOSE message with/without VLAN and Reserverd1 R>0**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1, Annex B PIXIT: Gs8		
Expected result 1,2,3,4. DUT updates the value and sends a GOOSE message with changed status value		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) with destination MAC-Address in the recommended range and Reserved fields all zero 1. Publisher sends GOOSE message with new data value with the VLAN tag 2. Publisher sends GOOSE message with new data value without the VLAN tag 3. Publisher sends GOOSE message with new data value with VLAN ID = 0 4. Publisher sends GOOSE message with new data value with the VLAN tag and Reserved1 R not zero		

Comment

sGos2	**Subscribe GOOSE with ndsCom set**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1		
Expected result 4. DUT shall ignore the value change		
Test description 1. Test engineer configures the DUT as specified (without a "safe position" mechanism) 2. Publisher sends GOOSE message with old data value with NdsCom=F 3. Publisher sends GOOSE message with old data value with NdsCom=T 4. Publisher sends GOOSE message with new data value with NdsCom=T		
Comment Note: The GOOSE subscribe test procedures can only be performed when the device under test does not set a GOOSE subscribe depending value to a safe position in case GOOSE message is lost		

sGos3	**SqNum roll-over with/without status change**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs4		
Expected result 1. DUT just receives the messages without any action 2. DUT just receives the messages without any action 3. DUT responds to the status change		
Test description 1. Publisher sends GOOSE message with sqNum = max–1, max and 1 without status change 2. Publisher sends GOOSE message with sqNum = max–1, max 3. Publisher forces a status change stNum and sends a GOOSE message with incremented stNum and sqNum=0		
Comment		

sGos4	LGOS data object values	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3.8 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs1, Gs2, Gs11		
Expected result 1. LGOS.St.stVal=TRUE, LGOS.LastStNum.stVal (when available), LGOS.ConfRevNum.stVal (when available), LGOS.RxConfRevNum.stVal (when available) and LGOS.GoCBRef.setSrcRef match with the subscribed GOOSE message 2. LGOS.St.stVal=FALSE 3. LGOS.St.stVal=TRUE 4. LGOS.LastStNum.stVal (when available) matches with the last received GOOSE message 5. LGOS.St.stVal=FALSE; LGOS.LastStNum.stVal (when available) does not change		
Test description 1. Publisher sends normal GOOSE messages without data change 2. Publisher stops sending GOOSE messages for one minute (longer than GOOSE lost period, PIXIT) 3. Publisher sends normal GOOSE messages without data change 4. Publisher sends normal GOOSE messages with data change 5. Publisher sends GOOSE messages with data change and an incorrect “checked” GOOSE header attribute		
Comment		

sGos5	Subscribe to data set with structured data (FCD) and destination MAC-address outside recommended range	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs8		
Expected result 2. DUT responds to the status change		
Test description Test engineer configures the DUT with subscribed GOOSE ping-pong mechanism with destination MAC-Address outside the recommended range 1. Publisher sends GOOSE message with structured data 2. Publisher sends GOOSE message with a data change in a data attribute in the structured data		
Comment		

sGos6	**Subscribe GOOSE with simulation parameter set**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Subclause 7.8.2

IEC 61850-7-2 Subclause 18.2.3.8

IEC 61850-8-1 Subclause 18.1

PIXIT: Gs9

Expected result

a) LPHD.Sim.stVal = FALSE or not present
   2. DUT accepts the normal GOOSE messages, LGOS.St = TRUE, LGOS.SimSt=FALSE
   3. DUT ignores the simulated data value change, LGOS.St=TRUE, LGOS.SimSt=FALSE
   4. DUT changes LGOS.St.stVal to FALSE (and keeps LGOS.SimSt = FALSE)

b) LPHD.Sim.stVal = TRUE
   6. DUT accepts the normal GOOSE messages because no simulated GOOSE messages have been received yet, LGOS.St=TRUE, LGOS.SimSt=FALSE; state: subscription normal goose as long as no simulated goose received
   7. DUT changes LGOS.SimSt=TRUE (and keeps LGOS.St=TRUE); state: subscription simulated GOOSE
   8. DUT accepts the simulated data value change
   9. DUT changes LGOS.St to FALSE (and keeps LGOS.SimSt=TRUE); state: wait for simulated GOOSE
   10. DUT ignores the normal GOOSE messages
   11. DUT keeps LGOS.St=FALSE and LGOS.SimSt=TRUE
   12. DUT changes LPHD.Sim.stVal to FALSE and LGOS.SimSt to FALSE (and keeps LGOS.St=FALSE); state: wait for normal GOOSE
   13. DUT changes LGOS.St to TRUE (and keeps LGOS.SimSt=FALSE); state: subscription normal goose

Test description

a) LPHD.Sim=FALSE or not present
   1. Force the DUT to ignore simulated GOOSE messages when LPHD.Sim is present
   2. Publisher1 sends GOOSE message with a new data value with Simulation off
   3. Publisher2 sends GOOSE message with a new data value with Simulation set
   4. Publisher1 stops sending GOOSE message, Publisher2 stops sending GOOSE messages

b) LPHD.Sim=TRUE
   5. Force the DUT to accept simulated GOOSE messages
   6. Publisher1 sends GOOSE message with a new data value with Simulation off
   7. Then publisher2 starts sending GOOSE message with Simulation set
   8. Publisher2 sends GOOSE message with a new data value with Simulation set
   9. Publisher2 stops sending GOOSE messages with Simulation set
   10. Publisher1 sends GOOSE message with a new data value with Simulation off
   11. Publisher1 stops sending GOOSE message with Simulation off
   12. Force DUT to accept normal GOOSE messages
   13. Publisher1 sends GOOSE message with a new data value with Simulation off

Comment

Note: LGOS is optional and only verified when available. When LGOS is available the LGOS.SimSt is optional

sGos7	**GOOSE with maximum name length for DatSet, GoCBRef and GoID**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3.8 IEC 61850-8-1 Subclause 18.1		
Expected result 1. The DUT accepts the GOOSE messages and data changes		
Test description 1. Configure the DUT to accept GOOSE messages with maximum name length for DatSet (32), GoCBRef (containing a GoCB of 32) and GoID (129)		
Comment		

sGos8	**Subscribe GOOSE message with non-1 as boolean “true” value**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1		
Expected result 2. DUT updates the value and sends a GOOSE message with status value true (any value >0)		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) 1. Publisher sends GOOSE message with boolean “false” as value 0x00 2. Publisher sends GOOSE message with boolean “true” as value 0x02		
Comment Note the goal is to verify that the subscriber accepts any boolean value >0 as “true”		

sGos9	Subscribe GOOSE message with “fixed length” GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause A.3 PIXIT Gs8		
Expected result 2. DUT updates the value and sends a GOOSE message with changed integer value 4. DUT updates the value and sends a GOOSE message with changed boolean value		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) containing a “Beh” structure and an integer value and a boolean value. The pong dataset need not contain every ping attribute. When INS or ENS subscribe is supported (PIXIT Gs8) 1. Publisher sends “fixed length” GOOSE with initial integer value 2. Publisher sends “fixed length” GOOSE with other integer value When INS subscribe is not supported 3. Publisher sends “fixed length” GOOSE with initial boolean value 4. Publisher sends “fixed length” GOOSE with other boolean value		

sGos10	Subscribe GOOSE message with ldName	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1		
Expected result 2. DUT updates the value and sends a GOOSE message with changed status value		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) from a GoCB with dataset elements from a logical device with a configured ldName. 1. Publisher sends GOOSE messages with boolean “false” value 2. Publisher sends GOOSE messages with boolean “true” value		
Comment		

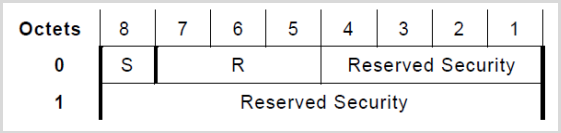
sGos11	Subscribe GOOSE message with private DO	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1		
Expected result 2. DUT updates the value and sends a GOOSE message with changed status value		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) from a GoCB with dataset elements from a private logical node and private DO. 1. Publisher sends GOOSE messages with boolean “false” value 2. Publisher sends GOOSE messages with boolean “true” value		
Comment		

sGos12	Process first GOOSE message after state change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3.6		
Expected result 2. DUT updates the value and sends a GOOSE message with changed status value within 1 second		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) 1. Publisher sends multiple GOOSE messages with incremented sqNum, timeAllowedToLive=2000 milliseconds 2. Publisher sends one GOOSE message with incremented stNum, sqNum=0, timeAllowedToLive=2000 milliseconds and wait for 2 seconds (the publisher does not re-transmit the GOOSE message in these 2 seconds)		
Comment		

sGos13	Subscribe to “secure” GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1, Annex C		
Expected result 2. DUT updates the value and sends a GOOSE message with changed status value		
Test description Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism) 1. Publisher sends GOOSE messages with boolean “false” value with, Reserved 1: S=0, R=0 and Reserved Security not zero, Reserved 2 bits not zero and several additional trailing octets outside the GOOSE APDU 2. Publisher sends GOOSE messages with boolean “true” value with the same Reserved bits and trailing octets		

Comment

Reserved 1 field:



sGos14	**Subscribe to Ed1 GOOSE message without goID**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 18.2.3

IEC 61850-8-1 Subclause 18.1, Annex C

Expected result

2. DUT updates the value and sends a GOOSE message with changed status value

Test description

Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism)

1. Publisher sends GOOSE messages with boolean “false” value without goID
2. Publisher sends GOOSE messages with boolean “true” value

Comment

sGos15	**Subscribe to 2 GOOSE streams with the same AppID value**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 18.2.3

IEC 61850-8-1 Subclause 18.1, Annex C

Expected result

2. DUT updates the first value and sends GOOSE messages with changed status value
4. DUT updates the second value and sends GOOSE messages with changed status value

Test description

Test engineer configures the DUT with 2 subscribed GOOSE streams with the same valid AppID value (ping-pong mechanism)

1. Publisher sends GOOSE1 messages with boolean “false” value
2. Publisher sends GOOSE1 messages with boolean “true” value
3. Publisher sends GOOSE2 messages with boolean “false” value
4. Publisher sends GOOSE2 messages with boolean “true” value

Comment

sGos20	**GOOSE with existing CDC extended with DA with new FC (K2.2)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Annex K2.2
IEC 61850-7-2 Subclause 18.3.2.2
IEC 61850-8-1 Subclause 18.1

Expected result

1. DUT ignores the state change (no state change, no quality change)
2. DUT sends GOOSE message with state change reflecting the edition 2 state change
3. DUT ignores the state change (no state change, no quality change)
4. DUT sends GOOSE message with state change reflecting the edition 2 state change

Test description

Configure a ping-pong mechanism with a future edition .IID file with an FCD and an FCDA dataset element with a new FC and followed by Ed2 dataset element.

1. Publisher changes the value of the FutureEd dataset element as FCD
2. Publisher changes the value of the Ed2 dataset element as FCD
1. Publisher changes the value of the FutureEd dataset element as FCDA
2. Publisher changes the value of the Ed2 dataset element as FCDA

Comment

Configure GOOSE simulator with future edition CDC=SPS DOtype with FC=MM and DA=futVal as Boolean and instantiate FutInd1 and FutInd2 and configure dataset with:

- Future SPS: FutInd1.ST.stVal and FutInd1.MM.futVal as FCDA
- Normal Ed2 SPS: Ind1.ST.stVal and Ind1.ST.q
- Future SPS: FutInd2.ST and FutInd2.MM as FCD
- Normal Ed2 SPS: Ind2.ST

Configure DUT to subscribe to the normal Ed2 Ind1.ST.stVal and Ind2.ST.stVal

sGos21	**GOOSE with existing CDC with renamed DA, subDO or subDA (K2.7)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Annex K2.7
IEC 61850-7-2 Subclause 18.3.2.2
IEC 61850-8-1 Subclause 18.1

Expected result

1. DUT ignores the state change
2. DUT sends GOOSE message with state change reflecting the edition 2 state change
3. DUT ignores the state change
4. DUT sends GOOSE message with state change reflecting the edition 2 state change

Test description

Configure a ping-pong mechanism with a future edition .IID file with an FCD/FCDA dataset element with a renamed DA/subDO/subDA and followed by Ed2 dataset element.

1. Publisher changes the value of the FutureEd dataset element as FCD
2. Publisher changes the value of the Ed2 dataset element as FCD
3. Publisher changes the value of the FutureEd dataset element as FCDA
4. Publisher changes the value of the Ed2 dataset element as FCDA

Comment

Configure GOOSE simulator with future edition CDC=SPC with FC=ST and rename DA=q to qNew and instantiate FutInd1 and FutInd2 and configure dataset with:

- Future SPC: FutInd1.ST.stVal and FutInd1.ST.qNew as FCDA
- Normal Ed2 SPS: Ind1.ST.stVal and Ind1.ST.q as FCDA
- Future SPC: FutInd2.ST as FCD
- Normal Ed2 SPS: Ind2.ST as FCD

Configure DUT to subscribe to the normal Ed2 Ind1.ST.stVal and Ind2.ST.stVal

sGos22	**GOOSE with existing CDC with extended PACKEDLIST (K2.17)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Annex K2.17
IEC 61850-7-2 Subclause 18.3.2.2
IEC 61850-8-1 Subclause 18.1

Expected result

1. DUT sends GOOSE message with state change reflecting the extended DA state change
2. DUT sends GOOSE message with state change reflecting the edition 2 state change
3. DUT sends GOOSE message with state change reflecting the extended DA state change
4. DUT sends GOOSE message with state change reflecting the edition 2 state change

Test description

Configure a ping-pong mechanism with a future edition .IID file with an FCD/FCDA dataset element with an extended PACKEDLIST and followed by Ed2 dataset element.

1. Publisher changes the value of the extended dataset element as FCD
2. Publisher changes the value of the Ed2 dataset element as FCD
3. Publisher changes the value of the extended dataset element as FCDA
4. Publisher changes the value of the Ed2 dataset element as FCDA

Comment

Configure GOOSE simulator with future edition CDC=SPC with FC=ST and extend DA=q to 16bits (extended) and instantiate FutInd1 and FutInd2 and configure dataset with:

- Future SPC: FutInd1.ST.stVal and FutInd1.ST.q as FCDA
- Normal Ed2 SPS: Ind1.ST.stVal and Ind1.ST.q as FCDA
- Future SPC: FutInd2.ST as FCD
- Normal Ed2 SPS: Ind2.ST as FCD

Configure DUT to subscribe to the normal Ed2 Ind1.ST.stVal and Ind2.ST.stVal as well as FutInd1.ST.stVal and FutInd2.ST.stVal

sGos23	**Verify that the DUT process GOOSE data values with quality test is true when the device is in test, and ignores such values when device is not in test**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61850-7-4 Annex A PIXIT Sr5, Gs12		
Expected result 2. and 5. DUT processes the data value flagged with quality test true as described in the PIXIT (for instance: keep last non test value, substitute to a configured value, ...) Other steps. DUT updates the value and sends a GOOSE message with the changed value		
Test description Test engineer configures the DUT with subscribed GOOSE with FCDA (ping-pong mechanism) Force the subscriber Logical Node into Beh = on 1. SIMULATOR publishes GOOSE message with changed data values flagged quality test false 2. SIMULATOR publishes GOOSE message with changed data values flagged quality test true 3. SIMULATOR publishes GOOSE message with changed data values flagged quality test false Force the subscriber Logical Node into Beh = blocked (when supported) 4. SIMULATOR publishes GOOSE message with changed data values flagged quality test false 5. SIMULATOR publishes GOOSE message with changed data values flagged quality test true 6. SIMULATOR publishes GOOSE message with changed data values flagged quality test false Force the subscriber Logical Node into Beh = test (when supported) 7. SIMULATOR publishes GOOSE message with changed data values flagged quality test false 8. SIMULATOR publishes GOOSE message with changed data values flagged quality test true 9. SIMULATOR publishes GOOSE message with changed data values flagged quality test false Force the subscriber Logical Node into Beh = test/blocked (when supported) 10. SIMULATOR publishes GOOSE message with changed data values flagged quality test false 11. SIMULATOR publishes GOOSE message with changed data values flagged quality test true 12. SIMULATOR publishes GOOSE message with changed data values flagged quality test false .		
Comment		

sGosN1	Missing GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs3		
Expected result 3. DUT accepts GOOSE message as specified in the PIXIT, resulting in a report or published GOOSE message		
Test description 1. Test engineer configures the DUT as specified 2. Publisher sends correct GOOSE message with no value changes (same stNum) 3. Publisher sends GOOSE message with data value change with incremented stNum, starting with sqNum=1 (simulating a missing sqNum=0)		
Comment		

sGosN2	Double GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs5		
Expected result 3. DUT accepts first GOOSE message with sqNum=0, resulting in published GOOSE messages and ignores the second message with sqNum=0		
Test description 1. Test engineer configures the DUT as specified 2. Publisher sends correct GOOSE message with no value changes (same stNum) 3. Publisher sends GOOSE message with data value change with incremented stNum, and with sqNum=0 two times (simulating a double sqNum=0)		
Comment		

sGosN3	Delayed GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 PIXIT: Gs2, Gs3		
Expected result 3. DUT behaves as specified in the PIXIT		

Test description

1. Test engineer configures the DUT as specified
2. Publisher sends correct GOOSE message with no value changes (same stNum)
3. Publisher sends GOOSE message with data value change with incremented stNum, and with sqNum=0, but outside the TimeAllowedtoLive interval of the previous GOOSE message. The following GOOSE messages with sqNum>0 are transmitted inside the TAL of the previous message.

Comment

sGosN4	Out-of-order GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1, PIXIT: Gs4		
Expected result 3. DUT behaves as specified in the PIXIT		
Test description 1. Test engineer configures the DUT as specified 2. Publisher sends correct GOOSE message with no value changes (same stNum) 3. Publisher sends GOOSE message with data value change with incremented stNum, and with sqNum=1, sqNum=0, sqNum=2,3 etc.		
Comment		

sGosN5	No GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1, PIXIT: Gs2		
Expected result 3. DUT indicates that subscribed GOOSE message isn't received (PIXIT) 4. DUT indicates that subscribed GOOSE message is received again (PIXIT) 5. DUT indicates that subscribed GOOSE message isn't received (PIXIT) 6. DUT shall process new state value(s)		
Test description 1. Test engineer configures the DUT as specified 2. Publisher sends correct GOOSE message with no value changes (same stNum) 3. Publisher is disconnected from the network, continues to send GOOSE messages for 30 seconds with no state change (e.g. same stNum as step 2). 4. Publisher is reconnected to the network and continues to send GOOSE messages (same stNum) 5. Publisher is disconnected from the network, continues to send GOOSE messages for 30 seconds with no state change (e.g. same stNum as step 2). 6. Publisher is reconnected to the network and continues sends GOOSE messages indicating a state change (incremented stNum, sqNum other than 0)		
Comment		

sGosN6	**Invalid GOOSE message**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 18.2.1, 18.2.3
IEC 61850-8-1 Subclause 18.1, Annex C, PIXIT: Gs1

Expected result
DUT responds as specified in the PIXIT

Test description
Test engineer configures the DUT as specified below and Publisher sends several GOOSE message with data value change with correct status & sequence numbers with:

a GoCB reference = mismatch with SCL, NULL
b timeAllowedtoLive = 0
c datSet reference = mismatch with GoCB from SCL, NULL
d goID reference = mismatch with GoCB from SCL, NULL
e timestamp of status change = plus one hour, minus one hour, 0
f confRev = mismatching with GoCB from SCL
g numDatSetEntries = mismatch with the expected number of DataSet element members from SCL. The confRev remains as expected, but the numDatSetEntries changes +1 and then -1 and the allData matches the number of numDatSetEntries (+1 add one value at the end and -1 remove last value)
h values of allData entries (same DatSetReference, same expected ConfRev) = data type values out-of-order
i APPID = mismatch from GoCB from SCL and 0

Comment

sGosN7	**Verify that the DUT rejects/discards GOOSE with inconsistent or invalid length**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 18.2.3
IEC 61850-8-1 Subclause 18.1, Annex C

Expected result
1.,2. DUT discards the “ping” value changes and does not send GOOSE “pong” messages with changed status value

Test description
Test engineer configures the DUT with subscribed GOOSE (ping-pong mechanism)

1. Publisher sends GOOSE messages with incorrect Length value: (m+8) +1 and value changes
2. Publisher sends GOOSE messages with incorrect Length value: (m+8) -1 and value changes

Comment
m = length of the APDU

A4.9c GOOSE Management

Abstract test cases

Test case	Test case description
sGom1	Verify GOOSE management respond; Client requests service with legal parameters and check DUT respond (IEC 61850-7-2 Subclause 15.2.2) – GetGoReference (IEC 61850-7-2 Subclause 18.2.2.3) – GetGOOSEElementNumber (IEC 61850-7-2 Subclause 18.2.2.4)
sGom2	Verify GOOSE management request: Check DUT request service with valid parameters and simulate valid respond (IEC 61850-7-2 Subclause 15.2.2) – GetGoReference (IEC 61850-7-2 Subclause 18.2.2.3) – GetGOOSEElementNumber (IEC 61850-7-2 Subclause 18.2.2.4)

Test case	Test case description
sGomN1	Client request GOOSE management services with illegal parameters and verify DUT response- service error (IEC 61850-7-2 Subclause 18.2.2), Verify that NULL for MemberReference in GetGOOSEElementNumber indicates that no member of the referenced data set is defined. (IEC 61850-7-2 Subclause 18.2.2.4.2.2)

Detailed test procedures

sGom1	**GetGoReference, GetGOOSEElementNumber respond**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.2.3+4 IEC 61850-8-1 Subclause 18		
Expected result 1. DUT sends a GetGoReference response+ with the member reference 2. DUT sends a GetGOOSEElementNumber response+ with the same member offset as the GetGoReference request		
Test description 1. Client requests a GetGoReference for first member offset 2. Client requests a GetGOOSEElementNumber for responded member reference 3. Repeat 1 and 2 for next member offset in the GoCB		
Comment		

sGom2	**GetGoReference, GetGOOSEElementNumber request**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.2.3+4 IEC 61850-8-1 Subclause 18		
Expected result 1. Goose Simulator sends a GetGoReference response+ with the member reference 2. Goose Simulator sends a GetGOOSEElementNumber response+ with the same member offset as the GetGoReference request		
Test description 1. DUT requests a GetGoReference for first member offset 2. DUT requests a GetGOOSEElementNumber for responded member reference		
Comment		

sGomN1	**Wrong parameters**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.2.3, 18.2.2.4 IEC 61850-8-1 Subclause 18.1		
Expected result 1. DUT sends a GetGoReference response- 2. DUT sends a GetGoReference response+ with a NULL reference and 2 correct references 3. DUT sends a GetGoReference response+ with 2 correct references and a NULL reference 4. DUT sends a GetGOOSEElementNumber response+ with 2 correct MemberOffset and a NULL offset- 5. DUT sends a GetGOOSEElementNumber response+ with a NULL reference 6. DUT sends a GetGOOSEElementNumber response-		
Test description 1. Client requests a GetGoReference with unknown GoCBReference and MemberOffset 1 2. Client requests a GetGoReference with MemberOffset 0, 1 and 2 3. Client requests a GetGoReference with MemberOffset n-1, n, n+1 (n is the number of elements in the dataset) 4. Client requests a GetGOOSEElementNumber with 2 known and 1 unknown GoCBReference 5. Client requests a GetGOOSEElementNumber with unknown MemberReference 6. Client requests a GetGOOSEElementNumber with unknown GocbRef		
Comment		

A4.11a Sampled Values Publish

At least one of the backwards compatible configurations (F4000S1I4U4, F4800S1I4U4, F5760S1I4U4) and at least one of the preferred sample rates specified in IEC 61869-9 shall be supported.

The test lab shall change the applicable SV configuration parameters using the SCT or ICT (when a SmvSettings option is fix), to verify the DUT uses the configured values and not the default values.

The test lab chooses a random or the maximum configuration to perform each test case, with the following exceptions:

- sSvp1 shall be performed using the maximum configuration
- sSvp3 and sSvp5 shall be executed with a preferred configuration and also with a backwards compatible configuration
- sSvp10 and sSvp13 shall be executed with a backwards compatible configuration

Note: The derived quality bit is not specified in IEC 61850-7-3, IEC 61850-9-2 and IEC 61869-9. The derived quality bit will be ignored.

Test ID	Test Case
sSvp1	Verify that the maximum delay time from taking the (first, oldest) sample to sending the corresponding message is within the limit of the application class (table 901) and within the limit of LPHD.MaxDl and LPHD.NamMaxDlRtg
sSvp2	Verify the format of the link layer: destination MAC, TPID=0x8100, VLAN, Ethertype=0x88BA, APPID, Length - MSVCB01 has APPID = 0x4000, Reserved1=0, Reserved2=0 - MSVCB02 has APPID = 0x4000, Reserved1=0, Reserved2=0 - Other MSVCB has APPID as configured in the SCL, Reserved1=0, Reserved2=0
sSvp3	Verify optional fields, confRev, nofASDU - MSVCB01 has only optional field sampleSynchronized, confRev=1 and nofAsdu=1 - MSVCB02 has only optional fields sampleSynchronized, confRev=1 and nofAsdu=8 - Other MSVCB has optional field sampleSynchronized and optionally synchSourceId, confRev and nofAsdu as configured in the SCL, refresh-time shall be false
sSvp4	Verify the format of the ASDU matches the SCL configuration
sSvp5	Verify the data set matches the configured/required data set definition - MSVCB01 has data set PhsMeas1 and elements - MSVCB02 has data set PhsMeas1 and elements - Other MSVCB have dataset as configured in the SCL, Current values shall precede any voltage values, phase order shall be A-B-C-N, shall not exceed the maximum number of elements
sSvp6	Verify the sample and message rate matches with the MSVCBxx - MSVCB01 samples are transmitted with 80 messages per cycle - MSVCB02 samples are transmitted with 32 (256/8) messages per cycle - Other MSVCB samples are transmitted with the configured sample and message rate
sSvp7	Verify that the size for encoding the Length field (TLV) of the variable size elements shall always use minimum length encoding (tissue #1720)

sSvp8	Verify that the sampled values match with the analogue signals and quality
sSvp9	Verify that when the DUT is synchronised with PTP time source and that in case the PTP signal is lost the SmpSynch in the SV message shall be changed from 2 to 0. "SmpCnt" shall wrap as if a synchronization would be present Verify that the DUT is synchronised with PTP time source and that in case the GPS signal is lost the SmpSynch in the SV message shall be changed from 2 to 1. "SmpCnt" shall wrap as if a synchronization would be present.
sSvp10	Verify that when the DUT is synchronised with PPS time source and that in case the PPS signal is lost the SmpSynch in the SV message shall be changed from 2 to 0. "SmpCnt" shall wrap as if a synchronization pulse would be present
sSvp11	Verify that after restoring the power the DUT shall publish valid/plausible SV messages within specified time (PIXIT). It is allowed that SmpSynch=0 when DUT is not yet synchronised Condition: when DUT is not test equipment
sSvp12	If the DUT can produce simulated SV streams verify that in SIMULATION mode the Reserved1 flag Simulate=set (IEC 61850-9-2 $5.3.4.4.4). Note 1: Simulation is expected to be implemented for test equipment.
sSvp13	Signals that are not measured or calculated shall have the corresponding Quality bit = Invalid Condition: when DUT does measure less then 3 currents and 3 voltages or the DUT supports Quality = invalid
sSvp14	Verify the DUT supports max length MsvID by configuration. - MSVCB01 has MsvID as defined in 9-2LE (max length 32) - MSVCB02 has MsvID as defined in 9-2LE (max length 32) - Other MSVCB has MsvID as configured in the SCL (max length 129)
sSvp15	Verify that synchSourceId matches the GMC ID. Condition: This test is applicable if PTP is declared.
sSvp16	Verify that in TEST mode the quality.test=set in each sample Condition: when Mod = Test is supported
sSvp17	When clipping occurs the detailed Quality “out-of-range” is set Condition: This test is applicable if SAMU device

sSvp20	Request GetLogicalNodeDirectory(MSVCB) and request GetMSVCBValues (IEC 61850-7-2 Subclause 19.2.2.3)
sSvp21	Request SetMSVCBValues to disable a MSVCB, verify that no SV messages are transmitted anymore (IEC 61850-7-2 Subclause 19.2.2.4)
sSvp22	No attributes of the MSVCB control block can be set except for SvEna. (IEC 61850-9-2 Table 9)
sSvp23	Verify LPHD data objects and attributes have a value

Detailed test procedures

sSvp1	**Verify that the maximum delay time from taking the sample to sending the corresponding message is within the limit**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**

IEC 61869-9 Table 901, 6.903.2
PIXIT Svp1

Expected result

2. DUT samples the signals as configured
3. DUT sends sampled value messages. The computed delay time shall be less than specified for the application class ms (+0%, -100%). The computed delay time is defined as the fraction of second of the capture time of the message with SmpCnt=0 (when SmpCnt is the first, oldest sample in the message, otherwise add sample time for each additional sample in the message).
   The maximum delay does not exceed value specified in LPHD.NamMaxDlRtg and also LPHD.MaxDl

Test description

Use the maximum SV configuration, i.e. with the biggest number of quantities that can be configured for a SV stream, without exceeding the sum of quantities limits specified in IEC 61869-9 Clause 6.903.2; in that case, the max configuration will follow: half of channels will be allocated to voltages and half to currents.

When PTP is supported

1. Configure the DUT with PTP and wait till DUT is synchronized
2. Generate current and/or voltage signals
3. Capture the sampled values messages for 1 minute
4. Repeat step 2 to 3 five times using PTP

When PTP is not supported

5. Configure the DUT with PPS and wait till DUT is synchronized
6. Repeat step 2 to 3 five times using PPS

Comment

The maximum measured delay is:
- PTP/PPS Configuration X = <max delay>

sSvp2	Verify the format of the link layer	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-9-2		
Expected result 3. DUT sends sampled value messages with the following format of the link layer: - destination MAC address = 01-0C-CD-04-xx-xx, as configured - TPID = 0x8100 - VLAN priority as configured (default = 4) - VLAN ID as configured - Ethertype = 0x88BA - APPID = 0x4000 for MSVCB01 and MSVCB02, otherwise as configured - reserved 1 = 0x0000 - reserved 2 = 0x0000		
Test description 1. Configure the DUT a random configuration, VLAN ID = 0x100 and APPID <> 0x4000 in case of a preferred configuration 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X		

sSvp3	Verify optional fields, confRev and nofAsdu	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61869-9 Clause 6.903.11

Tissue #1692

Expected result

3. DUT sends sampled value messages with
- MSVCB01 has only optional field sampleSynchronized, confRev=1 and nofAsdu=1
- MSVCB02 has only optional fields sampleSynchronized, confRev=1 and nofAsdu=8
- Other MSVCB has optional field sampleSynchronized; optional fields: refreshTime, sampleRate, dataSet and security shall be false; Optional field synchSourceId and confRev as configured in SCL

4. The frame contains the synchSourceId service parameter.
5. The frame does not contain the synchSourceId service parameter.

Test description

1. Configure the DUT with a random preferred configuration
2. Generate current and/or voltage signals
3. Capture the sampled values messages for 1 minute
4. If PTP is supported, configure synchSourceId to TRUE.
5. If PTP is supported, configure synchSourceId to FALSE.
6. Repeat the test for a backwards compatible configuration

Comment

Note: confRev=1 is specified in 9-2LE

Tested with configuration: X and Y

sSvp4	Verify the format of the ASDU matches the SCL configuration	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-9-2 Clause 8.5, Table 14		
Expected result 3. DUT sends sampled value messages as configured in SCL		
Test description 1. Configure the DUT with a random configuration 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X		

sSvp5	Verify the ASDU dataset elements	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause 6.903.10 PIXIT Svp4		
Expected result 3. DUT sends sampled value messages with the correct data set elements matching the variant code under test - MSVCB01 has data set PhsMeas1 and elements - MSVCB02 has data set PhsMeas1 and elements - Other MSVCB have dataset as configured in the SCL, Current values shall precede any voltage values, phase order shall be A-AB-B-BC-C-CA-N, shall not exceed the maximum number of elements		
Test description 1. Configure the DUT with a random preferred configuration 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second 4. Repeat the test for a backwards compatible configuration		
Comment Tested with configuration: X and Y		

sSvp6	Verify the sample rate	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause 6.903.11		
Expected result 2. DUT samples the signals as configured 3. In one minute DUT sends 60 x samples per seconds / numAsdu ±1 sampled value messages - MSVCB01 samples are transmitted with 80 messages per cycle - MSVCB02 samples are transmitted with 32 (256/8) messages per cycle - Other MSVCBxx samples are transmitted with the configured sample and message rate		
Test description 1. Configure the DUT with a random configuration and the applicable 50 or 60 Hz nominal frequency 2. Generate current and/or voltage signals 3. Capture the sampled values messages for 1 minute 4. Repeat step 1 to 3 five times 5. For the preferred variant repeat step 1 to 4 for the other nominal frequency (when supported)		
Comment Note: • F4000S1I4U4 = 50Hz only, F4800S1I4U4 and F5760S1I4U4 = 60Hz only • For the preferred variants the sample rate shall be independent from the nominal frequency. Tested with configuration: X		

sSvp7	Verify that the size for encoding the Length field (TLV) of the variable size elements shall always use minimum length encoding	☐ Passed ☐ Failed ☐ Inconclusive
Tissue #1720		
Expected result 2. DUT sends sampled value messages with following length encoding for SV message length, ASDU length, MsvID length and Dataset length: - Length <128: <Type> <Length one byte> <Value> - Length 128..255: <Type> 0x81 <Length one byte> <Value> - Length >255: <Type> 0x82 <Length 2 bytes> <Value>		
Test description 1. Configure the DUT with a random configuration with small (<127) variable size elements 2. Capture the sampled values messages for at least 1 second 3. Configure the DUT with a random configuration with large (from 128 to 255) variable size elements 4. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X and Y		

sSvp8	**Verify plausibility that the sampled values match with the analogue signals and quality**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**

IEC 61869-9 Clause 6.903.9

PIXIT: Svp5, Svp12

Expected result

3. Voltages
   - If VN is calculated, check that VN is equal to the magnitude of VA, VB, VC when applying 1 phase voltage and near zero when no signal is applied.
   - For measured channels, verify match with signal source

   Currents
   - If IN is calculated, check that IN is equal to the magnitude of IA, IB, IC (ignoring the sign) when applying 1 phase current and near zero when no signal is applied.
   - For measured channels, verify match with signal source

   Quality
   - The validity is good when the signal is measured or calculated
   - The overflow, badReference, oscillatory, oldData, inconsistent and operatorBlocked flags shall be set to false
   - The source shall be process
   - For backward compatible MSVCB it is permissible to set the “derived” bit (bit 13) when the value is calculated

Test description

1. Configure the DUT with a random configuration and the correct parameters and frequency
2. Apply current and/or voltage signals to each phase 1 at-a-time for at least 5 seconds each then apply no signal for 10 seconds
3. Capture the sampled values messages

Comment

This is a plausibility check not an accuracy test.

Tested with configuration: X

sSvp9	Verify that the DUT is synchronized with PTP time source	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61869-9 Clause 6.904, 6.904.7
IEC 61850-9-2 Ed2 Amd1 Clause 9
PIXIT Svp6, Svp7

Expected result

3. When PTP is connected DUT sends sampled value messages with SmpSynch = 2 within 30 seconds
4. DUT sends sampled value messages with SmpSynch = 1. The maximum processing delay does not change by more than ±100 µs from the value measured during the 1 min synchronized state test (sSvp1).
5. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 2
6. When DUT has left the hold-over mode it sends messages with SmpSynch = 0.
   SmpCnt shall wrap as if a PTP master would be present.
   The maximum processing delay does not change by more than ±100 µs from the value measured during the 1 min synchronized state test
7. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 2. The values of SmpCnt and SmpSynch shall in all cases correspond to the time scale and source used for the samples in that ASDU. The sample following a jump have the adjusted values of both SmpCnt and SmpSynch

Test description

1. Configure the DUT with a preferred configuration and connect PTP grand master
2. Generate current and/or voltage signals
3. Capture the sampled values messages
4. Force the global PTP master to local (clockClass not 6 and not 7), then wait 30 seconds, by for example disconnecting the GPS antenna
5. Restore the PTP grand master from local to global, by for example connecting the GPS antenna, and wait till the samples are synchronized
6. Disconnect all PTP grand masters and wait the holdover time (TVTR/TCTR.HoldTmms) plus 30 seconds
7. Connect the PTP grand master and wait till the samples are synchronized

Comment

Note: This test may not be practical for devices with holdover mode exceeding 24 h. Such devices are exempt from step 6 and are expected to ensure compliance by design

Tested with configuration: X

sSvp10	Verify that the DUT is synchronized with PPS time source	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause 6.904, 6.904.7 PIXIT: Svp6, Svp7		
Expected result 3. When PPS is connected DUT sends sampled value messages with SmpSynch = 2 within 30 seconds 4. When DUT has left the hold-over mode it sends messages with SmpSynch = 0. SmpCnt shall wrap as if a synchronization pulse would be present When SmpSynch = 0 the maximum processing delay does not change by more than ±100 µs from the value measured during the 1 min synchronized state test 5. Within the maximum resynch time (PIXIT Svp7) the SmpSynch = 2. The values of SmpCnt and SmpSynch shall in all cases correspond to the time scale and source used for the samples in that ASDU. The sample following a jump have the adjusted values of both SmpCnt and SmpSynch		
Test description 1. Configure the DUT with a backwards compatible configuration and PPS 2. Generate current and/or voltage signals 3. Capture the sampled values messages 4. Disconnect the PPS after 10 seconds and wait the holdover time (TCTR/TVTR.HoldTmms) plus 30 seconds 5. Connect the PPS		
Comment Note: This test may not be practical for devices with holdover mode exceeding 24 h. Such devices are exempt from step 4 and are expected to ensure compliance by design Tested with configuration: X		

sSvp11	Verify that after restoring the power the DUT shall publish valid 9-2 messages within specified time (PIXIT).	☐ Passed ☐ Failed ☐ Inconclusive
PIXIT Svp8, Svp10		
Expected result 3. DUT sends synchronized and valid sampled value messages within the PIXIT specified time after restoring the power; DUT may send values with validity=invalid during the start-up		
Test description 1. Configure the DUT with a random configuration 2. Generate current and/or voltage signals, after 10 seconds disconnect and restore the power supply 3. Capture the sampled values messages until valid samples are transmitted		
Comment Tested with configuration: X		

sSvp12	Verify that in SIMULATION the Reserved1.Simulate=set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-9-2 Clause 5.3.4.4.4 PIXIT Svp3		
Expected result 3. DUT sends sampled value messages with Reserved1.Simulate=set for each message		
Test description 1. Configure the DUT with a random configuration and enable SIMULATION 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X		

sSvp13	Signals that are not measured or calculated shall have the corresponding Quality bit = Invalid (PIXIT)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause 6.903.9 IEC 61850-9-2 Amd1 Table 17, Annex C.3.5 PIXIT Svp9		
Expected result 3. Signals that are not measured or calculated or as specified in the PIXIT shall have the corresponding Quality bit Invalid (0x0002). Any derived values shall have quality bit invalid as well		
Test description 1. Configure the DUT with a backwards compatible configuration as specified in the PIXIT to force quality invalid 2. Generate current and/or voltage signals and force quality invalid 3. Capture the sampled values messages for at least 1 second		
Comment IEC 61850-9-2 Ed2 Amd1 Annex C.3.5 states: Servers compliant with the current standard shall not use the formerly "Reserved" value. As such Invalid value 0x0001 is not allowed Tested with configuration: X		

sSvp14	Verify minimum & maximum length MsvID	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause 6.903.11		
Expected result 3. DUT sends sampled value messages with maximum length MsvID for each sample 5. DUT sends sampled value messages with 1 char length MsvID for each sample		
Test description 1. Configure the DUT with a random configuration and maximum length MsvID (32 char for the backwards compatible and 129 for the preferred configuration) 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second For the preferred variant 4. Configure the DUT a preferred configuration and 1 char length MsvID 5. Capture the sampled values messages for at least 1 second		

Comment Tested with configuration: X and Y

sSvp15	**Verify synchSourceId matches the GMC ID**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61850-6 Ed2 Amd1 Table 30 SCL Services.SMVSettings.synchSrcId=true		
Expected result 3. DUT sends sampled value messages with synchSourceId matching the GMC ID		
Test description 1. Configure the DUT with a random configuration and enable the optional field synchSourceId and synchronize it to a PTP master clock 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X		

sSvp16	**Verify that in TEST mode the quality bit TEST is set for each sample (PIXIT)**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61850-9-2 Clause 6 PIXIT Svp2		
Expected result 3. DUT sends sampled value messages with quality bit TEST (0x0800) for each sample		
Test description 1. Configure the DUT with a random configuration and set Mod = Test 2. Generate current and/or voltage signals 3. Capture the sampled values messages for at least 1 second		
Comment Tested with configuration: X		

sSvp17	**When clipping occurs the detailed Quality “out-of-range” is set**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61869-9 Clause 5.901. 6.903.9, Table 905, Table 907 IEC 61850-9-2 Amd1 Table 17, Annex C.3.5 PIXIT: Svp13		
Expected result 4. Some but not all Current and Voltage samples have set detailQuality bit out-of-range and validity questionable.		
Test description 1. Configure the DUT with a random configuration to force clipping 2. Generate current signals with peak exceeding the clipping limits: TCTR.NamClipRtg, TCTR.Clip 3. Generate voltage signals with peak exceeding the clipping limits: TVTR.NamClipRtg, TVTR.Clip 4. Capture the sampled values messages		
Comment Note: it might be reasonable impossible to force clipping. If so the result is Inconclusive Tested with configuration: X		

sSvp20	GetLogicalNodeDirectory(MSVCB) and GetMSVCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 19 IEC 61850-9-2 Subclause 8.2.2		
Expected result 1. DUT sends GetLogicalNodeDirectory(MSVCB) response+ with a list of MSVCB's. The MSVCB shall be located in LLN0. 2. DUT sends GetMSVCBValues response+, the returned values match with the SCL configured values		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(MSVCB) 2. For each MSVCB Client requests GetMSVCBValues		
Comment		

sSvp21	SetMSVCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 19 IEC 61850-9-2 Table 9		
Expected result 1. DUT sends SV messages 2. DUT sends a SetMSVCBValues response+ and stops publishing SV messages 3. DUT sends a SetMSVCBValues response+ and initializes/starts publishing SV messages		
Test description 1. Configure DUT to publish SV messages 2. Client requests a SetMSVCBValues with SvEna set to FALSE 3. Client requests a SetMSVCBValues with SvEna set to TRUE		
Comment SvEna is the only attribute that may be written according to part 9-2.		

sSvp22	Verify that MSVCB attributes are read-only	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Clause 19.2.3.4 IEC 61850-9-2 Table 9		
Expected result 1. When SetMSVCBValues supported DUT sends a SetMSVCBValues response+ otherwise response- 2. DUT sends a SetMSVCBValues response- 3. DUT sends a SetMSVCBValues response- 4. DUT sends a SetMSVCBValues response- 5. DUT sends a SetMSVCBValues response- 6. When SetMSVCBValues supported DUT sends a SetMSVCBValues response+ otherwise response-		
Test description 1. Client requests a SetMSVCBValues to disable SvEna 2. Client requests a SetMSVCBValues with valid MsvID 3. Client requests a SetMSVCBValues with valid DatSet 4. Client requests a SetMSVCBValues with valid DstAddress 5. Client requests a SetMSVCBValues with valid OptFlds 6. Client requests a SetMSVCBValues to enable SvEna		
Comment		

sSvp23	Verify LPHD data objects and attributes value	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 Clause 7.8.2 IEC 61869-9 Clause 6.903.5 PIXIT: sSvp11		
Expected result 1. The PhyNam attributes: vendor, model, hwRev, swRev are not empty. PhyNam.serNum shall include the date of manufacture when not implicit in the serial number (PIXIT: Svp11) 2. The NamVariant, NamHzRtg, NamAuxVRtg (optional), NamHoldRtg and NamMaxDlRtg val attributes have a value according to table 903		
Test description 1. Client requests a GetDataValues of LPHD.PhyNam 2. Client requests GetDataValues of the LPHD data objects: NamVariant, NamHzRtg, NamAuxVRtg (optional), NamHoldRtg and NamMaxDlRtg		
Comment		

A4.11b Sampled Values Subscribe

At least one of the backwards compatible configurations (F4000S1I4U4, F4800S1I4U4, F5760S1I4U4) and at least one of the preferred configurations shall be supported.

The starting point for the subscriber communication test is that the SV publishers do conform to the standard, taking into account backwards and forward compatibility. Negative testing is to verify the behaviour on a mismatching configuration and ethernet network issues (e.g. dropped packets).

The following applicable test cases need to be executed for a random supported configuration, chosen by the test lab, with maximum number of currents (x) and voltages (y) as specified in PIXIT unless specified otherwise in the test case.

Abstract test cases

Test ID	Test Case
sSvs1	Verify that the DUT subscribes to one supported SV stream - with a matching VLAN ID and priority - with a mismatching VLAN ID - with a mismatching VLAN priority - without VLAN - with VLAN ID = 0 - with a MAC-address inside and outside the recommended MAC address range - with the Reserved1: R>0
sSvs2	Verify that the DUT subscribes to one supported SV stream with and without optional field synchSourceId (preferred variant only)
sSvs3	When nr of Samples (noASDU) > 1, verify that the DUT subscribes to one supported SV stream with the sample with smpCnt=0 is not first sample in the packet
sSvs4	Verify that the DUT subscribes to the real SV stream and ignores the simulated SV stream when LPHD.Sim is False or not present Verify that the DUT subscribes to the simulated SV stream and ignores the real SV stream when LPHD.Sim is True Verify LSVS behaviour when supported
sSvs5	Verify that the DUT ignores the quality derived when set (backwards variant only)
sSvs6	Verify the DUT subscribes to the specified maximum (SCL ClientServices.maxSMV) number of SV streams
sSvs7	Verify the DUT subscribes to the specified maximum (PIXIT) number of dataset elements (volt and current signals)
sSvs8	Verify that the DUT subscribes to one SV stream with the minimum length SVID (4 chars) and one SV stream with maximum length SVID (129 chars)
sSvs9	Verify the DUT subscribes to one SV stream with jitter caused by other network traffic; hold SV packets for 1 ms within the maximum delay limit of the supported application class
sSvs10	Verify the DUT subscribes to one SV stream with maximum delay for the supported application class (this does not include the delay caused by the network)

sSvs11	Verify the behaviour of the DUT when the quality = INVALID for each sample in one SV stream (PIXIT)
sSvs12	Verify the logical node LSVS data object attribute values on receiving valid SV messages, no SV messages and SV messages with mismatching ConfRev
sSvs13	If security is not supported on subscriber, then test that it ignores security and accepts the message. (9-2 Am1 Clause 5.3.3.4.5)
sSvs14	Verify that SV with future extensions '…' are tolerated
sSvs15	Verify processing of SV samples with quality.test

Test ID	**Test Case**
sSvsN1	Verify that the DUT behaves as specified in the PIXIT on a configuration mismatch: - Mismatching MAC address - Mismatching APPID - ConfRev+1 and ConfRev-1 - synchSourceId present when not expected, synchSourceId absent when expected
sSvsN2	Verify that the DUT behaves as specified in the PIXIT on a mismatching data set element: - extra element(s) with ConfRev+1 - missing last element (s) with ConfRev-1 (preferred variant only)
sSvsN3	Verify that the DUT behaves as specified in the PIXIT on a broken path ("disconnect the cable between 2 switches", without PRP/HSR)
sSvsN4	Verify that the DUT behaves as specified in the PIXIT when smpSynch is 0, 1 or 5..255
sSvsN5	Verify that the DUT behaves as specified in the PIXIT when missing 1, 3, 5, 10 consecutive packets
sSvsN6	Verify that the DUT behaves as specified in the PIXIT when the packet with smpCnt=0 is missing

Detailed test procedures

sSvs1	Verify that the DUT subscribes to one supported SV stream	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a		
Expected result 1-6. DUT subscribes to the sampled values and exposes the values according to PIXIT.		
Test description Configure DUT to subscribe to a random SV stream with a recommended destination MAC address 1. SIMULATOR publishes SV stream with matching VLAN ID and priority 2. SIMULATOR publishes SV stream with mismatching VLAN ID and mismatching VLAN priority 3. SIMULATOR publishes SV stream without VLAN tag 4. SIMULATOR publishes SV stream with VLAN ID = 0 5. SIMULATOR publishes SV stream with Reserved1: R value >0 Configure the DUT to subscribe to a random SV stream with a destination MAC address outside the recommended range. 6. SIMULATOR publishes SV stream with the destination MAC address outside the recommended range		
Comment Tested with configuration: X and Y		

sSvs2	Verify that the DUT subscribes to one supported SV stream with and without optional field synchSourceId	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 Clause PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a preferred SV stream with optional field synchSourceId 1. SIMULATOR publishes SV stream with synchSourceId Configure the DUT to subscribe to a backwards compatible SV stream without optional field synchSourceId 2. SIMULATOR publishes SV stream without synchSourceId		
Comment Note: synchSourceID mismatch is tested in sSvsN1 Tested with configuration: X and Y		

sSvs3	When nr of Samples (noASDU) > 1, verify that the DUT subscribes to one supported SV stream with the sample with smpCnt=0 is not first sample in the packet	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream with noASDU>1 1. SIMULATOR publishes SV stream with the sample with smpCnt=0 is the first sample in the packet 2. SIMULATOR publishes SV stream with the sample with smpCnt=0 is not the first sample in the packet		
Comment Tested with configuration: X		

sSvs4	Verify that the DUT subscribes to the real SV stream and ignores the simulated SV stream when LPHD.Sim is False or not present and when LPHD.Sim is True	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b, Svs3		
Expected result 1. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE 2. DUT ignores the simulated sampled values, LSVS.St = TRUE, LSVS.SimSt=FALSE 3. DUT indicates loss of SV stream according to PIXIT, LSVS.St changes to FALSE (LSVS.SimSt = FALSE) 4. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE 5-7. DUT subscribes to the simulated sampled values according to PIXIT, LSVS.SimSt changes to TRUE 8. DUT indicates loss of SV stream according to PIXIT, LSVS.St changes to FALSE 9. DUT subscribes the real sampled values according to PIXIT, LSVS.St = TRUE, LSVS.SimSt=FALSE		
Test description Configure the DUT to subscribe to a random SV stream Test engineer forces LPHD.Sim=False or LPHD.Sim is absent 1. SIMULATOR publishes SV stream with the simulation bit not set 2. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set 3. SIMULATOR publishes only SV stream with the simulation bit set When LPHD.Sim is present, test engineer forces LPHD.Sim=True and perform steps 4-9: 4. SIMULATOR publishes SV stream with the simulation bit not set 5. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set 6. SIMULATOR publishes only SV stream with the simulation bit set 7. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set 8. SIMULATOR publishes only SV stream with the simulation bit not set Test engineer forces LPHD.Sim=False 9. SIMULATOR publishes one SV stream with the simulation bit set and another SV stream with the simulation bit not set		

Comment Note: LSVS is optional and only verified when available. When LSVS is available the LSVS.SimSt is optional Tested with configuration: X

sSvs5	**Verify that the DUT ignores the quality derived when set (backwards variant only)**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61869-9 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a backwards compatible SV stream 1. SIMULATOR publishes SV stream with quality derived not set 2. SIMULATOR publishes SV stream with quality derived set		
Comment Tested with configuration: X		

sSvs6	**Verify the DUT subscribes to the specified maximum (SCL ClientServices.maxSMV) number of SV streams for this variant**	☐ **Passed** ☐ **Failed** ☐ **Inconclusive**
IEC 61869-9 PIXIT Svs1a, Svs1b SCL ClientServices.maxSMV		
Expected result 1. DUT subscribes the sampled values of each real SV stream		
Test description Configure the DUT to subscribe to the maximum number of SV streams, with at least one preferred stream and at least one backwards compatible stream 1. SIMULATOR publishes maximum number of real SV streams plus the maximum number of simulated streams		
Comment Tested with configuration: X, Y, Z etc.		

sSvs7	Verify the DUT subscribes to the specified minimum and maximum (PIXIT) number of dataset elements	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs2b		
Expected result 1. DUT subscribes to all the sampled values in the SV stream		
Test description Configure the DUT to a random SV stream with the maximum number dataset elements 1. SIMULATOR publishes the SV stream with the maximum number of volts and amps		
Comment Tested with configuration: X		

sSvs8	Verify that the DUT subscribes to one SV stream with the minimum length SVID (4 chars) and one with maximum length SVID (129 chars)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream with minimum length SVID (4 chars) 1. SIMULATOR publishes SV stream with the SVID as configured Configure the DUT to subscribe to a preferred SV stream with maximum length SVID (129 chars) 2. SIMULATOR publishes SV stream with the SVID as configured		
Comment Tested with configuration: X and Y		

sSvs9	Verify the DUT subscribes to one SV stream with jitter caused by other network traffic; hold SV packets for 1 ms	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream 1. SIMULATOR publishes SV stream with a normal/minimum jitter 2. SIMULATOR publishes SV stream and holds (once per second) the samples for 1ms, and then flushes the samples as fast as possible. The total delay shall not exceed the maximum delay limit of the protection application class		
Comment Note: the subscriber does not have an application class Tested with configuration: X		

sSvs10	Verify the DUT subscribes to one SV stream with maximum delay for the supported application class (this does not include the delay caused by the network)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b, Svs11		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values 3. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream and most precise time synchronization system if supported. 1. SIMULATOR publishes SV stream with normal delay 2. SIMULATOR publishes SV stream with maximum delay for the supported application class 3. SIMULATOR publishes SV stream with maximum total delay		
Comment Tested with configuration: X		

sSvs11	Verify the behaviour of the DUT when the quality = INVALID for each sample in one SV stream (PIXIT)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs9		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values and quality according to PIXIT 3. DUT subscribes the sampled values and quality according to PIXIT		
Test description Configure the DUT to subscribe to a random SV stream 1. SIMULATOR publishes SV stream with quality valid 2. SIMULATOR publishes SV stream with one value quality invalid 3. SIMULATOR publishes SV stream with all values quality invalid		
Comment Tested with configuration: X		

sSvs12	LSVS data object values	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs1a, Svs1b		
Expected result 1. LSVS.St.stVal=TRUE, LSVS.ConfRevNum.stVal (when available), LSVS.RxConfRevNum.stVal (when available) and LSVS.GoCBRef.setSrcRef match with the subscribed GOOSE message 2. LSVS.St.stVal=FALSE 3. LSVS.St.stVal=TRUE 4. LSVS.St.stVal=FALSE; LSVS.RxConfRevNum.stVal (when available) does contain the SV message ConfRev value		
Test description Configure the DUT to subscribe to a random SV stream 1. Publisher sends normal SV messages 2. Publisher stops sending SV messages for one minute 3. Publisher sends normal SV messages without data change 4. Publisher only sends SV messages with a mismatching ConfRev value		
Comment Tested with configuration: X		

sSvs13	Subscribe to “secure” SV message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 IEC 61850-9-2 Clause 5.3.3.4.5 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream 1. Publisher sends SV messages with Reserved1: S=0, R=0, Security bits all 1, Reserved 2 bits all 1 and several tailing non-zero bytes		
Comment Tested with configuration: X		

sSvs14	**Subscribe to SV message with future extensions**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 IEC 61850-9-2 Table 14 PIXIT Svs1a, Svs1b		
Expected result 1. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream 1. Publisher sends SV messages with an extra fields after “IMPLICIT SEQUENCE OF ASDU” and an extra field after SynchSrcID		
Comment Table 14 indicates ASN.1 “…” in 2 places; this means that the SV message can be extended in a next version and that these tags shall be ignored in the current version Tested with configuration: X		

sSvs15	Verify that the DUT process sampled values with quality test is true when the device is in test, and ignores such values when device is not in test	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-4 Annex A PIXIT Sr5, Svs1a		
Expected result 2. and 5. DUT does not process the test samples flagged values with quality test true. Verify according to PIXIT that the samples are NOT consumed. Other steps. DUT processes the samples according to PIXIT		
Test description Configure the DUT to subscribe to a random SV stream Force DUT into Mode = on 1. SIMULATOR publishes SV stream with samples flagged quality test false 2. SIMULATOR publishes SV stream with samples flagged quality test true 3. SIMULATOR publishes SV stream with samples flagged quality test false Force DUT into Mode = blocked (when supported) 4. SIMULATOR publishes SV stream with samples flagged quality test false 5. SIMULATOR publishes SV stream with samples flagged quality test true 6. SIMULATOR publishes SV stream with samples flagged quality test false Force DUT into Mode = test (when supported) 7. SIMULATOR publishes SV stream with samples flagged quality test false 8. SIMULATOR publishes SV stream with samples flagged quality test true 9. SIMULATOR publishes SV stream with samples flagged quality test false Force DUT into Mode = test/blocked (when supported) 10. SIMULATOR publishes SV stream with samples flagged quality test false 11. SIMULATOR publishes SV stream with samples flagged quality test true 12. SIMULATOR publishes SV stream with samples flagged quality test false		
Comment		

sSvsN1	Verify that the DUT behaves as specified in the PIXIT on a configuration mismatch	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs4		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values according to PIXIT-Svs4 3. DUT subscribes the sampled values according to PIXIT-Svs4 4. DUT subscribes the sampled values according to PIXIT-Svs4 5. DUT subscribes the sampled values according to PIXIT-Svs4 6. DUT subscribes the sampled values according to PIXIT-Svs4 7. DUT subscribes the sampled values according to PIXIT-Svs4 8. DUT subscribes the sampled values 9. DUT subscribes the sampled values according to PIXIT-Svs4		
Test description Configure the DUT to subscribe to a backward compatible SV stream without synchSourceId 1. SIMULATOR publishes SV stream as configured 2. SIMULATOR publishes SV stream with mismatching destination MAC-address 3. SIMULATOR publishes SV stream with mismatching APPID 4. SIMULATOR publishes SV stream with mismatching SVID 5. SIMULATOR publishes SV stream with ConfRev+1 (same dataset) 6. SIMULATOR publishes SV stream with ConfRev-1 (not 0, same dataset) 7. SIMULATOR publishes SV stream with synchSourceId Configure the DUT to subscribe to a preferred SV stream with synchSourceId 8. SIMULATOR publishes SV stream as configured 9. SIMULATOR publishes SV stream without synchSourceId		
Comment Tested with configuration: X and Y		

sSvsN2	Verify that the DUT behaves as specified in the PIXIT on a mismatching data set element (preferred variant only)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 6.903.10 PIXIT Svs5		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values according to PIXIT-Svs5 3. DUT subscribes the sampled values according to PIXIT-Svs5		
Test description Configure the DUT to subscribe to a preferred SV stream 1. SIMULATOR publishes SV stream with synchSourceId 2. SIMULATOR publishes SV stream with ConfRev+1, with an extra dataset element pair at the end 3. SIMULATOR publishes SV stream with ConfRev-1, with missing last dataset element pair		
Comment A pair is the sample plus quality Tested with configuration: X		

sSvsN3	Verify that the DUT behaves as specified in the PIXIT on a broken path	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs6		
Expected result 1. DUT subscribes the sampled values 2. DUT behaves as specified in PIXIT-Svs6 3. DUT subscribes the sampled values		
Test description Configure the DUT to subscribe to a random SV stream (without link redundancy) 1. SIMULATOR publishes SV stream 2. Disconnect the link between publisher and the subscriber by for example disconnect the ethernet cable between 2 ethernet switches for 10 seconds 3. Connect the link between publisher and the subscriber		
Comment Tested with configuration: X		

sSvsN4	Verify that the DUT behaves as specified in the PIXIT when smpSynch is 0, 1 or 5..255	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs8		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values according to PIXIT-Svs8 3. DUT subscribes the sampled values according to PIXIT-Svs8 4. DUT subscribes the sampled values according to PIXIT-Svs8 5. DUT subscribes the sampled values according to PIXIT-Svs8 6. DUT subscribes the sampled values according to PIXIT-Svs8		
Test description Configure the DUT to subscribe to a random SV stream 1. SIMULATOR publishes SV stream with smpSynch=2 2. SIMULATOR publishes SV stream with smpSynch=0 3. SIMULATOR publishes SV stream with smpSynch=1 with the same synchSourceId 4. SIMULATOR publishes SV stream with smpSynch=1 with another synchSourceId 5. SIMULATOR publishes SV stream with smpSynch=5 6. SIMULATOR publishes SV stream with smpSynch=255		
Comment Note: in case smpSynch=1 it may have the same or different synchSourceId this is out-of-scope for conformance Tested with configuration: X		

sSvsN5	Verify that the DUT behaves as specified in the PIXIT when missing 1, 3, 5, 10 consecutive packets	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs7		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values according to PIXIT-Svs7 3. DUT subscribes the sampled values according to PIXIT-Svs7 4. DUT subscribes the sampled values according to PIXIT-Svs7 5. DUT subscribes the sampled values according to PIXIT-Svs7		
Test description Configure the DUT to subscribe to a random SV stream (without link redundancy) 1. SIMULATOR publishes SV stream 2. SIMULATOR publishes SV stream with 1 missing packet (not SmpCnt=0) 3. SIMULATOR publishes SV stream with missing 3 consecutive packets 4. SIMULATOR publishes SV stream with missing 5 consecutive packets 5. SIMULATOR publishes SV stream with missing 10 consecutive packets		
Comment Tested with configuration: X		

sSvsN6	Verify that the DUT behaves as specified in the PIXIT when the packet with smpCnt=0 is missing	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61869-9 PIXIT Svs7		
Expected result 1. DUT subscribes the sampled values 2. DUT subscribes the sampled values according to PIXIT-Svs7		
Test description Configure the DUT to subscribe to a random SV stream (without link redundancy) 1. SIMULATOR publishes SV stream 2. SIMULATOR publishes SV stream with missing one packet with SmpCnt=0		
Comment Tested with configuration: X		

A4.12 Control

Abstract test cases

Test case	Test case description
sCtl1	Force and check each path in control state machine for several control objects with control models a direct with normal security (IEC 61850-7-2 Subclause 20.2.1) b SBO-control with normal security (IEC 61850-7-2 Subclause 20.2.2) c direct with enhanced security (IEC 61850-7-2 Subclause 20.3.2) d SBO-control with enhanced security (IEC 61850-7-2 Subclause 20.3.3) e Compare detailed test cases for each control model
sCtl2	Change control model using online services and verify that the control object responds according to the new control model
sCtl3	Time Operate a second enhanced security control object before the activation time of the first control object (PIXIT)
sCtl4	Verify that the stSeld attribute value is set/reset as specified in the state machines
sCtl5	Verify test flag in SelectWithValue/Operate and Beh = test (IEC 61850-7-4 Annex A Table A.1) • When LN Beh is "on" the control Requests are rejected with AddCause "Blocked-by-mode" • When LN Beh is “test/blocked” the control requests are accepted • When LN Beh is "test" the control requests are accepted • When LN Beh is “blocked” the control Requests are rejected with AddCause "Blocked-by-mode"
sCtl6	Select all SBO control objects and cancel them in opposite order. In case a control action is blocked because another control is already running the AddCause shall be "1-of-n-control"
sCtl7	Verify that with interlock condition the check is performed and the command is blocked accordingly (IEC 61850-7-2 Subclause 20.5.2.5) • When the interlock check fails, the control request is rejected with AddCause "Blocked-by-interlocking" • When the interlock check is ok, the control request is accepted
sCtl8	Operate (without select) a SBO control object and verify that the request is rejected with AddCause "Object-not-selected" (IEC 61850-7.2 Table 47)
sCtl9	Select the same control object twice, verify that the second select request is rejected with AddCause "Object-already-selected" (IEC 61850-7-2 Table 47) and the object remains in selected state (Operate.req is accepted)
sCtl10	Operate control value is the same as the actual status value (On-On or Off-Off) and verify that the control request is rejected with AddCause "Position-reached" (IEC 61850-7-2 Table 47, PIXIT)
sCtl11	Select the same control object from 2 different clients. Verify that the control requests from the second client are rejected with AddCause "Locked-by-other-client" (IEC 61850-7-2 Table 47)
sCtl12	Select / Operate an unknown control object and verify that the control requests are rejected with AddCause "Unknown" (IEC 61850-7-2 Table 47)
sCtl13	Verify that the Select request on a direct operate control object is rejected with AddCause "Not-supported" (IEC 61850-7-2 Table 47)
sCtl14	Operate the same direct control object twice from 2 clients (IEC 61850-7-2 Table 54, PIXIT) and verify that the last control request is rejected with AddCause "Command-already-in-execution"
sCtl15	Verify that on LN behaviour off control requests are rejected with AddCause "Blocked-by-Mode" (IEC 61850-7-4 Annex A)

Test case	Test case description
sCtl16	Verify that when Loc is set remote control requests are rejected with AddCause "Blocked-by-switching-hierarchy"
sCtl17	Verify that with station level control authority (LocSta=T) remote control requests are rejected with AddCause "Blocked-by-switching-hierarchy".
sCtl18	Verify that on CmdBlk.stVal is set the control requests are rejected with AddCause "Blocked-by-command" (IEC 61850-7-2 Table 54)
sCtl19	Verify that when the blkEna is set the control requests are terminated with AddCause "Time-limit-over" Deprecated, tested by sSrv11
sCtl20	Verify that when parameters are changed after the select respond, the operate request is rejected with AddCause "Parameter-change-in-execution" (IEC 61850-7-2 Table 54)
sCtl21	Verify that when tap changer has reached the limit (EndPosR or EndPosL in YLTC) control requests are rejected with AddCause "Step-limit" (IEC 61850-7-2 Table 54)
sCtl22	Verify that with insufficient access authority control requests are rejected with AddCause "No-access-authority". (IEC 61850-7-2 Table 54)
sCtl23	Verify that when an APC control action end position has overshoot the command terminates with AddCause "Ended-with-overshoot". (IEC 61850-7-2 Table 54)
sCtl24	Verify that when an APC control action is aborted due to deviation between the command value and the measured value the control terminates with AddCause "Abortion-due-to-deviation". (IEC 61850-7-2 Table 54)
sCtl25	Verify that a cancel request is successful when the control object is in the unselected state (IEC 61850-7-2 Table 47)
sCtl26	Verify that when the control object is in the WaitForChange state the cancel or SelectWithValue request is rejected with AddCause "Command-already-in-execution" (IEC 61850-7-2 Table 54)
sCtl27	Verify that the SelectWithValue request on a SBOns control object is rejected with AddCause "Not-supported" (IEC 61850-7-2 Table 54)
sCtl28	Verify that the FC=OR attributes opRcvd and opOk are updated correctly

Note: sCtl12 and sCtl22 are not applicable for part 8-1

Detailed test procedures

sCtl2	**Change control model**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.4
IEC 61850-8-1 Subclause 20, PIXIT: Ct2

Expected result

a DUT sends SetDataValues - Operate response+
b DUT sends SetDataValues - Select - Operate response+
c DUT sends SetDataValues - Operate response+ and CommandTermination
d DUT sends SetDataValues - SelectWithValue - Operate response+ and CommandTermination

Test description

a Client sends SetDataValues request to change control model to "direct-with-normal-security" and Client sends valid Operate request
b Client sends SetDataValues request to change control model to "SBO-with-normal-security" and Client sends valid Select and Operate request
c Client sends SetDataValues request to change control model to "direct-with-enhanced-security" and Client sends valid Operate request
d Client sends SetDataValues request to change control model to "SBO-with-enhanced-security" and Client sends valid SelectWithValue and Operate request

Comment

sCtl3	**Activate second time activated control object**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20
IEC 61850-8-1 Subclause 20

Expected result

a) DUT sends TimeActivatedOperate response+ on first and second control object; At operTm DUT will execute the command and send TimeActivatedOperateTermination+ and send TimeActivatedOperateTermination with AddCause "1-of-n control"
b) DUT sends Select response- on second control object OR DUT sends Select and TimeActivatedOperate response+ on second control object; At operTm DUT sends TimeActivatedOperateTermination+ on first control object and sends TimeActivatedOperateTermination- with AddCause "1-of-n control" on second control object
c) DUT sends TimeActivatedOperate response+ on first and second control object; At operTm DUT will execute the command and sends TimeActivatedOperateTermination+ plus CommandTermination+ on first control object and sends TimeActivatedOperateTermination- with AddCause "1-of-n control" on second control object
d) DUT sends SelectWithValue response- on second control object OR DUT sends SelectWithValue and TimeActivatedOperate response+ on second control object; At operTm DUT sends TimeActivatedOperateTermination+ plus CommandTermination+ on first control object and sends TimeActivatedOperateTermination- with AddCause "1-of-n control" on second control object

Test description

a) Client sends valid TimeActivatedOperate request on first control object and a second control object with the same operTm
b) Client sends valid Select and TimeActivatedOperate request on first control object and Select and on response+ request TimeActivatedOperate on second control object
c) Client sends valid TimeActivatedOperate request on first control object and a second control object with the same operTm
d) Client sends valid SelectWithValue and TimeActivatedOperate request on first control object and SelectWithValue and on response+ request TimeActivatedOperate on second control object

Comment

sCtl4	**stSeld**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2 and 20.3 IEC 61850-8-1 Subclause 20		
Expected result b) DUT sends Select and Operate response+ and set/reset stSeld as specified in the state machine. Data changes are reported d) DUT sends SelectWithValue and Operate response+ and set/reset stSeld as specified in the state machine. Data changes are Reported. The stSeld is reset after receiving the command termination		
Test description b) Client sends valid Select and Operate request d) Client sends valid SelectWithValue and Operate request Client requests GetDataValues(stSeld) after each control request and after command termination		
Comment		

sCtl5	**Operate with test flag and mode test, test/blocked and blocked**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2 and 20.3 IEC 61850-7-4 Annex A IEC 61850-8-1 Subclause 20		
Expected result 1. Commands are not accepted with AddCause = blocked-by-mode 2. Commands are accepted and executed 3. Commands are accepted and executed 4. Commands are not accepted with AddCause = blocked-by-mode 5. Commands are accepted and executed 6. Commands are accepted, output is blocked, DUT sends CommandTermination with AddCause = blocked-by-mode 7. Commands are not accepted with AddCause = blocked-by-mode 8. Commands are accepted and executed 9. Commands are not accepted with AddCause = blocked-by-mode 10. Commands are accepted, output is blocked, DUT sends CommandTermination with AddCause = blocked-by-mode 11. Control commands are accepted and executed For normal security, the AddCause is optional		

Test description

a) DOns
1. LN.Beh = on and client sends correct control command with test flag set
2. LN.Beh = on and client sends correct Mod control command with test flag set (when supported)

If Beh = test is supported perform steps 3, 4 and 5
3. LN.Beh = test and client sends correct control command with test flag set
4. LN.Beh = test and client sends correct control command without test flag set
5. LN.Beh = test and client sends correct Mod control command without test flag set (when supported)

If Beh = test/blocked is supported perform step 6, 7 and 8
6. LN.Beh = test/blocked and client sends correct control command with test flag set
7. LN.Beh = test/blocked and client sends correct control command without test flag set
8. LN.Beh = test/blocked and client sends correct Mod control command without test flag set (when supported)

If Beh = blocked is supported perform step 9, 10 and 11
9. LN.Beh = blocked and client sends correct control command with test flag set
10. LN.Beh = blocked and client sends correct control command without test flag set
11. LN.Beh = blocked and client sends correct Mod control command without test flag set (when supported)

b) Repeat steps 1 to 11 for SBOns
c) Repeat steps 1 to 11 for DOes
d) Repeat steps 1 to 11 for SBOes

Comment

Note 1: Step 1 is mandatory

Note 2: To change the Beh the client can operate the Mod.

Note 3: The Mod.Operate.Test attribute value shall be ignored by the DUT see step 2, 5, 8 and 11

sCtl6	**Select/Cancel multiple SBO control objects**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20

IEC 61850-8-1 Subclause 20, PIXIT: Ct9, Ct21

Expected result

b) SBOns
1. DUT sends response+ for non-interlocked objects and response- for interlocked objects
2. DUT sends Cancel response+

d) SBOes
3. DUT sends response+ for non-interlocked objects and response- with AddCause “1-of-n control" for interlocked objects (PIXIT)
4. DUT sends Cancel response+

Test description

b) SBOns
1. Client request Select for multiple SBOns control objects
2. Client request Cancel for the successful selected control object(s) in reverse order

d) SBOes
3. Client requests SelectWithValue for multiple SBOes control objects
4. Client request Cancel for the successful selected control object(s) in reverse order

Comment

sCtl7	Check conditions	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.5
IEC 61850-8-1 Subclause 20
PIXIT: Ct8

Expected result

1. DUT returns
   a) DOns: Operate response- with optional AddCause = “Blocked-by-interlocking”
   b) SBOns: Select response+ and Operate response- with optional AddCause = “Blocked-by-interlocking”
   c) DOes: Operate response- with AddCause = “Blocked-by-interlocking”
   d) SBOes: SelectWithValue response- with AddCause = “Blocked-by-interlocking” OR
      SelectWithValue response+ and Operate response- with AddCause = “Blocked-by-interlocking”
2. DUT returns Select/SelectWithValue/Operate response+ OR (PIXIT)
   a) DOns: Operate response- with optional AddCause = “Not-supported” or “Blocked-by-interlocking”
   b) SBOns: Select response+ and Operate response- with optional AddCause = “Not-supported” or “Blocked-by-interlocking”
   c) DOes: Operate response- with AddCause = “Not-supported” or “Blocked-by-interlocking”
   d) SBOes: SelectWithValue response- with AddCause = “Not-supported” or “Blocked-by-interlocking” OR
      SelectWithValue response+ and Operate response- with AddCause = “Not-supported” or
      “Blocked by interlocking”
3. DUT returns Select/SelectWithValue/Operate response+

Test description

1. Test engineer forces CILO.EnaOpn/EnaCls = FALSE
   a) DOns: Client sends correct Operate request with Check Interlock set
   b) SBOns: Client sends correct Select and Operate request with Check Interlock set
   c) DOes: Client sends correct Operate request with Check Interlock set
   d) SBOes: Client sends correct SelectWithValue and on response+ Operate with Check Interlock set
2. Test engineer forces CILO.EnaOpn/EnaCls = FALSE
   a) DOns: Client sends correct Operate request with Check Interlock not set
   b) SBOns: Client sends correct Select and Operate request with Check Interlock not set
   c) DOes: Client sends correct Operate request with Check Interlock not set
   d) SBOes: Client sends correct SelectWithValue and Operate with Check Interlock not set
3. Test engineer forces CILO.EnaOpn/EnaCls = TRUE
   a) DOns: Client sends correct Operate request with Check Interlock set
   b) SBOns: Client sends correct Select and Operate request with Check Interlock set
   c) DOes: Client sends correct Operate request with Check Interlock set
   d) SBOes: Client sends correct SelectWithValue and Operate with Check Interlock set

Comment

sCtl8	**Direct operate a SBO control object**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result b) DUT responds with Operate response- with optional AddCause “object-not-selected” and the stSeld=F or the DUT sends Select response+ or Operate response- with AddCause “object-not-selected d) DUT responds with Operate response- with AddCause “object-not-selected” and the stSeld=F or the DUT sends SelectWithValue response+ or Operate response- with AddCause “object-not-selected		
Test description b) Client sends correct Operate request of an unselected SBOns object d) Client sends correct Operate request of an unselected SBOes object To verify the unselected state client requests either GetDataValues(stSeld) or Select resp. SelectWithValue		
Comment		

sCtl9	**Select a SBO control object twice**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result b) SBOns: 1. DUT responds with Select response+ 2. DUT responds with Select response- 3. DUT responds with Operate response+ d) SBOes: 1. DUT responds with SelectWithValue response+ 2. DUT responds with SelectWithValue response- with AddCause = object-already-selected 3. DUT responds with Operate response+ 4. DUT sends CommandTermination+		
Test description b) SBOns: 1. Client sends correct Select request of an unselected SBOns object 2. Same client sends correct Select request of the same SBOns object before the sboTimeout 3. Client sends correct Operate request before the sboTimeout of step 1 d) SBOes: 1. Client sends correct SelectWithValue request of an unselected SBOes object 2. Same client sends correct SelectWithValue request of the same SBOes object before the sboTimeout 3. Client sends correct Operate request before the sboTimeout of step 1 4. EQUIPMENT SIMULATOR moves to the new position (when supported)		
Comment		

sCtl10	SelectWithValue or Operate value is same as actual value	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20

IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

PIXIT: Ct15

Expected result

a) DUT responds as specified in PIXIT
b) DUT responds as specified in PIXIT
c) DUT responds as specified in PIXIT
d) DUT responds as specified in PIXIT

In case PIXIT Ct15 states “N” the allowed AddCause values are "position-reached" or "time-limit-over".

In case PIXIT Ct15 states “Y” the DUT sends a CommandTermination+ for enhanced security

Test description

a) DOns: Client sends Operate request with actual value of a DOns object
b) SBOns: Client sends Select and Operate request with actual value of a SBOns object
c) DOes: Client sends Operate request with actual value of a DOes object
d) SBOes: Client sends SelectWithValue request with actual value of a SBOes object, on response+ request Operate with actual value

Comment

sCtl11	Select a SBO control object twice from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.3.3 Table 47

IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, Table 82

PIXIT: Ct21

Expected result

b) SBOns:
1. DUT responds with Select response+
2. DUT responds with Select response-
3. DUT responds with Cancel response- with optional AddCause “locked-by-other-client”
4. DUT responds with Operate response+

d) SBOes:
1. DUT responds with SelectWithValue response+
2. DUT responds with SelectWithValue response- with AddCause “object-already-selected” (compare Table 47)
3. DUT responds with Operate response- with AddCause “locked-by-other-client”
4. DUT responds with Cancel response- with AddCause “locked-by-other-client”
5. DUT responds with Operate response+ and CommandTermination+

Test description

b) SBOns:
1. Client1 sends correct Select request of an unselected SBOns object
2. Client2 sends correct Select request of the same SBOns object before the sboTimeout
3. Client2 sends correct Cancel request of the same SBOns object before the sboTimeout
4. Client1 sends correct Operate request before the sboTimeout

d) SBOes:
1. Client1 sends correct SelectWithValue request of an unselected SBOes object
2. Client2 sends correct SelectWithValue request of the same SBOes object before the sboTimeout
3. Client2 sends correct Operate request of the same SBOes object before the sboTimeout
4. Client2 sends correct Cancel request of the same SBOes object before the sboTimeout
5. Client1 sends correct Operate request before the sboTimeout

Comment

sCtl13	Select a direct control object	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.4 IEC 61850-8-1 Subclause 20 SCL – direct control object has SBO and/or SBOw data attributes		
Expected result a) DUT sends Select response- and SelectWithValue response- with optional AddCause “not-supported” c) DUT sends Select response- and SelectWithValue with AddCause "not-supported"		
Test description a) If DOns control object in the datamodel has SBO data attribute, client requests Select If DOns control object in the datamodel has SBOw data attribute, client requests SelectWithValue b) If DOes control object in the datamodel has SBO data attribute, client requests Select If DOes control object in the datamodel has SBOw data attribute, client requests SelectWithValue		
Comment		

sCtl14	Operate a direct control object twice from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8 PIXIT: Ct16, Ct30		
Expected result c) DOes 1. DUT responds with Operate response+ 2. DUT responds as specified in PIXIT In case of Operate response- the AddCause = command-already-in-execution or AddCause = locked-by-other-client		
Test description c) DOes 1. Client1 sends correct Operate request of a DOes object 2. Client2 sends correct Operate request of the same DOes object within the operate timeout		
Comment		

sCtl15	**Control an object when the associated Logical Node is not operable**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.2.2, 20.3.3
IEC 61850-7-4 page 122, Table A.2
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

a) DUT responds with Operate response- with optional AddCause “Blocked-by-Mode”
b) DUT responds with Select response-
c) DUT responds with Operate response- with AddCause “Blocked-by-Mode”
d) DUT responds with SelectWithValue response- with AddCause “Blocked-by-Mode”

Test description

Force the logical node Beh = Off, for example by setting the Mod=Off or LLN0.Mod=Off

a) Client sends DOns – Operate request
b) Client sends SBOns – Select request
c) Client sends DOes – Operate request
d) Client sends SBOes – SelectWithValue request

Comment

Compare IEC 61850-7-2 20.2.3: *On receipt of a Select request, the control object shall determine if the client has appropriate access authority, shall check that the control object is not currently selected by a different client, and that the device represented by the associated logical-node is operable and is not tagged so as to restrict operation*

sCtl16	**Control an object when the IED is in Local operation**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-7-4 Table B.1
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8
PIXIT: Ct13, Ct20, Ct21, Ct29

Expected result

a) DOns
   1,3 DUT sends Operate response- with optional AddCause “Blocked-by-switching-hierarchy” or “Not-supported”
   2. DUT behaves according to the PIXIT
b) SBOns
   1,7. DUT sends Select response- or Operate response- with optional AddCause “Blocked-by-switching-hierarchy” or “Not-supported”
   3. DUT sends Select response+
   5. DUT sends Operate response- with optional AddCause “Blocked-by-switching-hierarchy” or “Object-not-selected”
   6. DUT behaves according to the PIXIT
c) DOes
   1,3. DUT sends Operate response- with AddCause “Blocked-by-switching-hierarchy” or “Not-supported”
   2. DUT behaves according to the PIXIT
d) SBOes
   1,7. DUT sends SelectWithValue or Operate response- with AddCause “Blocked-by-switching-hierarchy” or “Not-supported”
   3. DUT sends SelectWithValue response+

5. DUT sends Operate response- with AddCause “Blocked-by-switching-hierarchy” or “Object-not-selected”
6. DUT behaves according to the PIXIT

Test description

Test engineer changes the DUT to “Local”; (LLN0.Loc=True or CSWI.Loc=True) and XCBR/XSWI.Loc=True if supported

a) DOns
   1. Client sends multiple Operate request with following values of orCat = 1, 2, 3, 4, 5, 6

   When supported change XCBR/XSWI.Loc from True to False, keep LLN0/CSWI.Loc=True and perform steps 2,3
   2. The matching client sends Operate request with orCat = 1, 4
   3. The matching client sends Operate request with orCat = 2, 3, 5, 6
b) SBOns
   1. Client sends multiple Select request, on respond+ Client sends Operate with following values of orCat = 1, repeat for orCat = 2, 3, 4, 5, 6
   2. Test engineer sets the local/remote switch on the DUT to “Remote”
   3. Client sends Select request
   4. Test engineer sets the local/remote switch on the DUT to “Local”
   5. Client sends Operate request with orCat=2 within the select timeout

   When supported change XCBR/XSWI.Loc from True to False, keep LLN0/CSWI.Loc=True and perform steps 6,7
   6. Repeat step 1 with orCat = 1, 4 with a matching client
   7. Repeat step 1 with orCat = 2, 3, 5, 6 with a matching client
c) DOes
   1. Client sends multiple Operate request with following values of orCat = 1, 2, 3, 4, 5, 6

   When supported change XCBR/XSWI.Loc from True to False, keep LLN0/CSWI.Loc=True and perform steps 2,3
   2. The matching client sends Operate request with orCat = 1, 4
   3. The matching client sends Operate request with orCat = 2, 3, 5, 6
d) SBOes
   1. Client sends multiple SelectWithValue request, on respond+ Client sends Operate with orCat=1, repeat for orCat = 2,3,4,5,6
   2. Test engineer sets the local/remote switch on the DUT to “Remote”
   3. Client sends SelectWithValue request with orCat=2
   4. Test engineer sets the local/remote switch on the DUT to “Local”
   5. Client sends Operate request with orCat=2 within the select timeout

   When supported change XCBR/XSWI.Loc from True to False, keep LLN0/CSWI.Loc=True and perform steps 6,7
   6. Repeat step 1 with orCat = 1, 4 with a matching client
   7. Repeat step 1 with orCat = 2, 3, 5, 6 with a matching client

Comment

Note: “matching” client means a client that is allowed by the server to issue control

sCtl17 DOns	Control authority on station level (LocSta)	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-7-4 Table B.1
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, PIXIT: Ct13

Expected result
2.6.8.9. DUT sends Operate response+
3.5. DUT sends Operate response- with optional AddCause “Blocked-by-switching-hierarchy”

Test description
1. Test engineer sets the control authority on the DUT to station level: <LN>.Loc=False and <LN>.LocSta=True
2. Client sends DOns – Operate request with orCat=station
3. Client sends DOns – Operate request with orCat=remote
4. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=False or not present
5. Client sends DOns – Operate request with orCat=station
6. Client sends DOns – Operate request with orCat=remote

When MltLev is present continue with

7. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=True
8. Client sends DOns – Operate request with orCat=station
9. Client sends DOns – Operate request with orCat=remote

Comment
Tested with <LN>: …

sCtl17 SBOns	Control authority on station level (LocSta)	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-7-4 Table B.1
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, PIXIT: Ct13

Expected result
2.6.8.9. DUT sends Select response+ and Operate response+
3.5. DUT sends Select response- or Operate response- with optional AddCause “Blocked-by-switching-hierarchy”.
The control object will return to the unselected state

Test description
1. Test engineer sets the control authority on the DUT to station level: <LN>.Loc=False and <LN>.LocSta=True
2. Client sends SBOns – Select – Operate request with orCat=station
3. Client sends SBOns – Select – Operate request with orCat=remote
4. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=False or not present
5. Client sends SBOns – Select – Operate request with orCat=station
6. Client sends SBOns – Select – Operate request with orCat=remote

When MltLev is present continue with

7. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=True
8. Client sends SBOns – Select – Operate request with orCat=station
9. Client sends SBOns – Select – Operate request with orCat=remote

Comment Tested with <LN>: …

sCtl17 DOes	**Control authority on station level (LocSta)**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, Table 54 IEC 61850-7-4 Table B.1 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, PIXIT: Ct13		
Expected result 2.6.8.9. DUT sends Operate response+ 3.5. DUT sends Operate response- with AddCause “Blocked-by-switching-hierarchy”		
Test description 1. Test engineer sets the control authority on the DUT to station level: <LN>.Loc=False and <LN>.LocSta=True 2. Client sends DOes – Operate request with orCat=station 3. Client sends DOes – Operate request with orCat=remote 4. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=False or not present 5. Client sends DOes – Operate request with orCat=station 6. Client sends DOes – Operate request with orCat=remote When MltLev is present continue with 7. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=True 8. Client sends DOes – Operate request with orCat=station 9. Client sends DOes – Operate request with orCat=remote		
Comment Tested with <LN>: …		

sCtl17 SBOes	**Control authority on station level (LocSta)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-7-4 Table B.1
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, PIXIT: Ct13

Expected result

2.6.8.9. DUT sends SelectWithValue response+ and Operate response+

3.5. DUT responds with SelectWithValue response- with AddCause “Blocked-by-switching-hierarchy”. Or DUT responds with SelectWithValue response+ and Operate response- with AddCause “Blocked-by-switching-hierarchy”. The control object will return to the unselected state

Test description

1. Test engineer sets the control authority on the DUT to station level: <LN>.Loc=False and <LN>.LocSta=True
2. Client sends SBOes – SelectWithValue and Operate request with orCat=station
3. Client sends SBOes – SelectWithValue with orCat=remote and on response+ continue Operate request with orCat=remote
4. Test engineer changes <LN>LocSta=False and LLN0.MltLev=False or not present
5. Client sends SBOes – SelectWithValue with orCat=station and on response+ continue Operate request with orCat=station
6. Client sends SBOes – SelectWithValue and Operate request with orCat=remote

When MltLev is present continue with

7. Test engineer changes <LN>.LocSta=False and LLN0.MltLev=True
8. Client sends SBOes – SelectWithValue and Operate request with orCat=station
9. Client sends SBOes – SelectWithValue and Operate request with orCat=remote

Comment

Tested with <LN>: …

sCtl18	**Control an object when the command is blocked**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

a) DUT responds with Operate response- with optional AddCause “Blocked-by-command”.
b) DUT responds with Select response- Operate response- with optional AddCause “Blocked-by-command”
c) DUT responds with Operate response- with AddCause “Blocked-by-command”.
d) DUT responds with SelectWithValue or Operate response- with AddCause “Blocked-by-command”

Test description

Test engineer blocks a command (CmdBlk.stVal=TRUE, Mod.stVal = on) on a DO except CmdBlk

a) Client sends DOns – Operate request
b) Client sends SBOns – Select request, on response+ request Operate
c) Client sends DOes – Operate request
d) Client sends SBOes – SelectWithValue request, on response+ request Operate

Comment

sCtl20	**Parameters change after select**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.9, Table 54
IEC 61850-8-1 Subclause 20.11
PIXIT: Ct22

Expected result

b) DUT sends Operate response- with optional AddCause “Parameter-change-in-execution”

d) DUT sends Operate response- with AddCause “Parameter-change-in-execution”

Test description

b) SBOns:

1. Client sends Select request
2. Test engineer or Client changes a parameter in DUT, not in the Operate request (PIXIT)
3. Client sends Operate request

d) SBOes:

1. Client sends SelectWithValue request
2. Test engineer or Client changes a parameter in DUT, not in the Operate request (PIXIT)
3. Client sends Operate request

Comment

sCtl21	**Tap changer has reached the limit**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.5.2.6, Table 54
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

When the end position is reached (EndPosR.stVal or EndPosL.stVal is set) the next TapChg expected result is or for TapPos the expected result is:

a) DUT responds with Operate response- with optional AddCause “Step-limit”

b) DUT responds with Select response+ and Operate response- with optional AddCause “Step-limit”

c) DUT responds with Operate response- with AddCause “Step-limit”.

d) DUT responds with SelectWithValue or Operate response- with AddCause “Step-limit”

Test description

TapPos:

a) DOns: Client sends Operate request with position outside the limit
b) SBOns: Client sends Select request and Operate request with position outside the limit
c) DOes: Client sends Operate request with position outside the limit
d) SBOes: Client sends SelectWithValue request and when accepted the Operate request with position outside the limit

TapChg:

a) DOns: Client sends several Operate requests with higher or lower till end-position is reached; Client sends one more Operate request
b) SBOns: Client send several Select requests and Operate requests with higher or lower till end-position is reached; Client sends one more Select and Operate request
c) DOes: Client sends several Operate requests with higher or lower till end-position is reached; Client sends one more Operate request
d) SBOes: Client sends several SelectWithValue requests and Operate requests with higher or lower till end-position is reached; Client sends one more SelectWithValue and when accepted Operate request

Comment

sCtl23	APC overshoot	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, Table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result a) DUT responds with Operate response+ b) DUT responds with Operate response+ c) DUT responds with Operate response+ and CommandTermination- with AddCause “Ended-with-overshoot” d) DUT responds with Operate response+ and CommandTermination- with AddCause “Ended-with-overshoot”		
Test description Force EQUIPMENT SIMULATOR to overshoot the APC operate request a) Client sends APC DOns – Operate request b) Client sends APC SBOns – Select and Operate request c) Client sends APC DOes – Operate request d) Client sends APC SBOes – SelectWithValue and Operate request		
Comment		

sCtl24	APC measured value deviation	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, Table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result a) DUT responds with Operate response+ b) DUT responds with Operate response+ c) DUT responds with Operate response+ and CommandTermination- with AddCause “Abortion-due-to-deviation”. d) DUT responds with Operate response+ and CommandTermination- with AddCause “Abortion-due-to-deviation”		
Test description Force EQUIPMENT SIMULATOR to deviate the measured value a) Client sends APC DOns – Operate request b) Client sends APC SBOns – Select and Operate request c) Client sends APC DOes – Operate request d) Client sends APC SBOes – SelectWithValue and Operate request		
Comment		

sCtl25	**Cancel unselected object**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, Table 47 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result b) DUT responds with Cancel response+ d) DUT responds with Cancel response+		
Test description b) Client sends a Cancel request to an unselected SBOns control object d) Client sends a Cancel request to an unselected SBOes control object		
Comment		

sCtl26	**Cancel at WaitForChange state**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, Table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result c) DUT responds with Operate response+ and Cancel response- with AddCause “Command-already-in-execution”. d) SBOes 1. DUT responds with SelectWithValue and Operate response+ and Cancel response- with AddCause “Command-already-in-execution” 2. DUT responds with SelectWithValue and Operate response+ and SelectWithValue response- with AddCause “Command-already-in-execution”		
Test description Force EQUIPMENT SIMULATOR to keep the position c) Client sends DOes – Operate and Cancel request before Operate timeout d) SBOes 1. Client sends SelectWithValue, Operate and Cancel request before Operate timeout 2. Client sends SelectWithValue, Operate and SelectWithValue request before Operate timeout		
Comment Note: in case operate timeout is very short (e.g.: internal control points) this test can’t be executed		

sCtl27	**SelectWithValue on a SBOns**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.5.2.9, Table 54 IEC 61850-8-1 Subclause 20.6, 20.11		
Expected result b) DUT responds with SelectWithValue response- with optional AddCause “not-supported”		
Test description b) Client sends SelectWithValue request to a control object with ctlModel=SBOns and SBOw attribute		
Comment		

sCtl28 DOns **sCtl28 DOes**	**Verify the FC=OR attributes opOk, opRcvd, tOpOk**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2 and 20.3 IEC 61850-7-3 Subclause 8 “opRcvd” IEC 61850-7-4 Annex A IEC 61850-8-1 Subclause 20 TISSUE #1676 (multiple figures for control)		
Expected result 1.2.3.4. Operate is accepted, DUT sends reports/GOOSE with opRcvd=T, opRcvd=F, opOk=T and opOk=F		
Test description Configure a dataset with the opOk, opRcvd, tOpOk with FC=OR and enable a GOOSE control block (when supported) or a report control block with this dataset and trigger data-change. Equipment simulator does not change the position. Beh = on 1. Client sends correct Operate with test=false Change Beh = test (when supported) 2. Client sends correct Operate with test=true Change Beh = test/blocked (when supported) 3. Client sends correct Operate with test=true Change Beh = blocked (when supported) 4. Client sends correct Operate with test=false		
Comment		

sCtl28 SBOns	**Verify FC=OR attributes opOk, opRcvd, tOpOk**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2 and 20.3 IEC 61850-7-4 Annex A IEC 61850-8-1 Subclause 20 TISSUE #1676 (multiple figures for control)		
Expected result 1.2.3.4. Select and Operate are accepted, DUT sends reports/GOOSE with opRcvd=T, opRcvd=F, opOk=T and opOk=F		
Test description Configure a dataset with the opOk, opRcvd, tOpOk with FC=OR and enable a GOOSE control block (when supported) or a report control block with this dataset and trigger data-change. Equipment simulator does not change the position. Beh = on 1. Client sends Select and Operate with test=false Change Beh = test when supported 2. Client sends Select and Operate with test=true Change Beh = test/blocked when supported 3. Client sends Select and Operate with test=true Change Beh = blocked when supported 4. Client sends Select and Operate with test=false		
Comment		

sCtl28 SBOes	**Verify FC=OR attributes opOk, opRcvd, tOpOk**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.2 and 20.3
IEC 61850-7-4 Annex A
IEC 61850-8-1 Subclause 20
TISSUE #1676 (multiple figures for control)

Expected result

1.2.3.4. SelectWithValue and Operate are accepted, DUT sends reports/GOOSE with opRcvd=T, opRcvd=F, opOk=T and opOk=F

Test description

Configure a dataset with the opOk, opRcvd, tOpOk with FC=OR and enable a GOOSE control block (when supported) or a report control block with this dataset and trigger data-change. Equipment simulator does not change the position.

Beh = on

1. Client sends SelectWithValue and Operate with test=false

Change Beh = test (when supported)

2. Client sends SelectWithValue and Operate with test=true

Change Beh = test/blocked (when supported)

3. Client sends SelectWithValue and Operate with test=true

Change Beh = blocked (when supported)

4. Client sends SelectWithValue and Operate with test=false

Comment

A4.12a Control DOns

Abstract test cases

Test case	Test case description
sDOns1	Send a correct Operate request
sDOns2	Send an Operate request, resulting in 'Test not ok'
sDOns3	Send an TimeActivatedOperate, request resulting in response-
sDOns4	Send a correct TimeActivatedOperate request Verify the TimeActivatedOperateTermination+
sDOns5	Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: – Force‘a 'Test not’ok' – Send a correct Cancel request

Detailed test procedures for Dons

sDOns1	**Operate**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7		
Expected result 1. DUT responds with Operate response+		
Test description 1. Client sends correct Operate request		
Comment		

sDOns2	**Operate response-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7, PIXIT: Ct12		
Expected result 1. DUT responds with Operate response-		
Test description 1. Client requests Operate forcing a “test not ok” as specified in PIXIT		

Comment

sDOns4	**TimeActivatedOperateTermination+**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7		
Expected result 1. DUT responds with TimeActivatedOperate response+ and TimeActivatedOperateTermination+		
Test description 1. Client sends TimeActivatedOperate request		
Comment		

sDOns5	**TimeActivatedOperateTermination-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7		
Expected result 1. DUT responds with TimeActivatedOperate response+ and TimeActivatedOperateTermination- with a valid AddCause 2. DUT responds with TimeActivatedOperate response+, Cancel response+ TimeActivatedOperateTermination- with AddCause "Abortion-by-cancel"		
Test description 1. Client sends TimeActivatedOperate request, resulting in TimeActivatedOperateTermination- as specified in PIXIT 2. Client sends correct TimeActivatedOperate and a Cancel request before operTm		
Comment		

A4.12b Control SBOns

Abstract test cases

Test case	Test case description
sSBOns1	Send a correct Select request Send correct Operate request
sSBOns2	Send a correct Select request Verify each of these paths will return the device to the Unselected state: – Send a correct Cancel request – Wait for select timeout – Send a Release request – Send an Operate request, resulting in 'Test not ok'
sSBOns3	Send a correct Select request Send an incorrect TimeActivatedOperate request resulting in response-
sSBOns4	Send a correct Select request Send a TimeActivatedOperate request, thereby making sure the device will generate a 'Test Ok'. Verify the TimeActivatedOperateTermination+
sSBOns5	Send a correct Select request Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: – Force a 'Test not ok' – Send correct Cancel request
sSBOns6	Send a Select request resulting in response-. Verify the device returns to the Unselected state.
sSBOns7	Send a correct Select request Verify that sending multiple Operate Many requests will return the device to the Ready state Verify that sending a Cancel request will return the device to the Unselected state

Detailed test procedures for SBOns

sSBOns1	**Select and Operate**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.2 IEC 61850-8-1 Subclause 20.3, 20.4, 20.5 and 20.7		
Expected result 1. DUT sends Select response+ with <CO_ CtrlObjectRef> (without $SBO nor $Oper) 2. DUT sends Operate response+ 3. The control object returns to the “Unselected” state: stSeld=False or DUT sends Select response+		
Test description 1. Client sends correct Select request 2. Client sends correct Operate request 3. Client requests either GetDataValues(stSeld) or Select		
Comment		

sSBOns2	**Select followed by Cancel, timeout or Operate reponse-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.2 IEC 61850-8-1 Subclause 20.4 and 20.7		
Expected result 1. DUT responds with Cancel response+ 2. DUT sends nothing 3. DUT responds with an Operate response- with optional AddCause 4. DUT sends no control respond In all cases the control object returns to the “Unselected” state: stSeld=False or DUT sends Select response+ or Operate response- with optional AddCause “object-not-selected”		
Test description Client sends correct Select request followed by: 1. Client sends correct Cancel request 2. Or Client waits for sbo timeout 3. Or force EQUIPMENT SIMULATOR that the Client Operate request results in “Test not ok” 4. Or Client sends Release request and Associate request Client requests either GetDataValues(stSeld) or Select		
Comment		

sSBOns4	TimeActivatedOperateTermination+	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.2 IEC 61850-8-1 Subclause 20.4 and 20.7		
Expected result 1. DUT responds with Select response+ 2. DUT responds with TimeActivatedOperate response+ and TimeActivatedOperateTermination+ 3. The control object returns to the “unselected” state: stSeld=False or DUT sends Select response+ or Operate response- with optional AddCause “object-not-selected”		
Test description 1. Client sends correct Select request 2. Client sends correct TimeActivatedOperate request 3. Client requests either GetDataValues(stSeld), Select or Operate		
Comment		

sSBOns5	TimeActivatedOperateTermination-	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7, PIXIT		
Expected result 1. DUT responds with TimeActivatedOperate response+ and TimeActivatedOperateTermination- 2. DUT responds with TimeActivatedOperate and Cancel response+ and TimeActivatedOperateTermination- with AddCause "Abortion-by-cancel"		
Test description Client sends Select request followed by 1. Client sends TimeActivatedOperate request, resulting in TimeActivatedOperateTermination- as specified in PIXIT 2. Or client sends TimeActivatedOperate request and a Cancel request before operTm		
Comment		

sSBOns6	Incorrect Select	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.2 IEC 61850-8-1 Subclause 20.4 and 20.7, PIXIT: Ct11		
Expected result 1. DUT sends an ASCI Select response- (mapped on MMS read response+ with SBO null value)		
Test description 1. Client sends Select request resulting in ASCI Select response-		
Comment		

sSBOns7	**Select, Operate many and Cancel**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.2.2
IEC 61850-8-1 Subclause 20.4 and 20.7

Expected result

1. The control object returns to the “Unselected” state: stSeld=F or Select response+
2. The control object returns to the “Unselected” state: stSeld=F or Select response+
3. The control object returns to the “Ready” state: stSeld=T or Select response-
4. The control object returns to the “Unselected” state: stSeld=F or Select response+

Test description

Client sends Select request to a control object with sboClass "operate-many" followed by:

1. Client waits for sbo timeout
2. Or force EQUIPMENT SIMULATOR that the Operate request results in “Test not ok”
3. Or Client sends correct Operate request
4. Client sends correct Cancel request

To verify the Unselected/Ready state client requests either GetDataValues(stSeld) or Select after each step.

Comment

A4.12c Control DOes

Abstract test cases

Test case	Test case description
sDOes1	Send a correct Operate request Verify each of these paths will return the device to the Ready state and verify the CommandTermination: – force the equipment simulator to move to the requested new state – force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) – force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sDOes2	Send an Operate request, resulting in 'Test not ok'.
sDOes3	Send a TimeActivatedOperate request, resulting in response-
sDOes4	Send a correct TimeActivatedOperate request Verify the TimeActivatedOperateTermination+ Verify each of these paths will return the device to the Ready state and verify the CommandTermination: – force the equipment simulator to move to the requested new state – force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) – force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sDOes5	Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: – Force a 'Test not ok' – Send a correct Cancel request

Detailed test procedures for DOes

sDOes1	**Operate and CommandTermination**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.2 IEC 61850-8-1 Subclause 20.7 and 20.8 PIXIT Ct27		
Expected result 1. DUT responds with Operate response+ 2. DUT reports CommandTermination+ 3. After timeout DUT reports CommandTermination- with AddCause “Invalid-position” or “Time-limit-over” 4. After timeout DUT reports CommandTermination- with AddCause “Invalid-position”		
Test description 1. Client sends correct Operate request followed by 2. Force EQUIPMENT SIMULATOR to go to the new state If the DUT supports external control objects for this control model execute step 3 and 4: 3. Or force EQUIPMENT SIMULATOR to keep the old state (when possible) 4. Or force EQUIPMENT SIMULATOR to go to the in between state (when DPC is supported)		
Comment		

sDOes2	**Operate response-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.7 and 20.8 PIXIT: Ct12		
Expected result 1. DUT responds with Operate response- and AddCause (PIXIT)		
Test description 1. Client sends incorrect Operate once request as specified in the PIXIT		
Comment		

sDOes4	**TimeActivatedOperateTermination+**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.7 and 20.8		
Expected result 1. DUT responds with TimeActivatedOperate response+ 2. DUT reports TimeActivatedOperateTermination+ and CommandTermination+ 3. After timeout DUT reports TimeActivatedOperateTermination+ and CommandTermination- with AddCause “Invalid-position” or “Time-limit-over” 4. DUT reports TimeActivatedOperateTermination+ and after operate timeout DUT reports CommandTermination- with AddCause “Invalid-position”		
Test description 1. Client sends correct TimeActivatedOperate request and after operTm expiration 2. Force EQUIPMENT SIMULATOR to go to the new state If the DUT supports external control objects for this control model execute step 3 and 4: 3. Client requests TimeActivatedOperate and after operTm expiration force EQUIPMENT SIMULATOR to keep the old state (when possible) 4. Client requests TimeActivatedOperate and after operTm expiration force EQUIPMENT SIMULATOR to go to the in between state (when DPC is supported)		
Comment		

sDOes5	**TimeActivatedOperateTermination-**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7		
Expected result 1. DUT responds with TimeActivatedOperate response+ and TimeActivatedOperateTermination- with an AddCause 2. DUT responds with TimeActivatedOperate response+, Cancel response+ and TimeActivatedOperateTermination- with AddCause "Abortion-by-cancel"		
Test description 1. Client sends TimeActivatedOperate request as specified in the PIXIT 2. Client sends TimeActivatedOperate request and a Cancel request before operTm		
Comment		

A4.12d Control SBOes

Abstract test cases

Test case	Test case description
sSBOes1	Send a correct SelectWithValue and Operate request Verify each of these paths will return the device to the Unselected state and verify the CommandTermination: – force the equipment simulator to move to the requested new state – force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) – force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sSBOes2	Send a correct SelectWithValue request Verify each of these paths will return the device to the Unselected state: – Send a correct Cancel request – Wait for select timeout – Send a Release request – Send an Operate request resulting in 'Test not ok'
sSBOes3	Send a correct SelectWithValue and TimeActivatedOperate request, resulting in response-
sSBOes4	Send a correct SelectWithValue request Send a correct TimeActivatedOperate Once request Verify the TimeActivatedOperateTermination+ Verify each of these paths will return the device to the Unselected state and verify the CommandTermination: – force the equipment simulator to move to the requested new state – force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) – force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sSBOes5	Send a correct SelectWithValue request Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: – Force a 'Test not ok' – Send a correct Cancel request
sSBOes6	Select device using SelectWithValue with improper access rights. Access shall be denied (IEC 61850-7-2 Subclause 20.2.2) or send incorrect SelectWithValue request
sSBOes7	Send a correct SelectWithValue request Verify that sending multiple Operate Many requests will return the device to the Ready state Verify that sending a Cancel request will return the device to the Unselected state
sSBOes8	Verify that the Operate or Cancel request with different control parameters than the SelectWithValue is rejected with AddCause: Inconsistent-parameters

Detailed test procedures for SBOes

sSBOes1	SelectWithValue, Operate and CommandTermination	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.3.3

IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

PIXIT: Ct26, Ct27

Expected result

1. DUT responds with SelectWithValue response+
2. DUT responds with Operate response+
3. DUT reports CommandTermination+
4. The control object returned to the “Unselected” state: stSeld=F or DUT sends SelectWithValue response+ or Operate response- with AddCause “Object-not-selected”
5. After operate timeout DUT reports CommandTermination- with AddCause “Invalid-position” or “Time-limit-over”
6. After operate timeout DUT reports CommandTermination- with AddCause “Invalid-position”

Test description

1. Client sends correct SelectWithValue request
2. Client sends correct Operate request followed by
3. If the DUT supports external control objects for this control model, force EQUIPMENT SIMULATOR to go to the new state
4. To verify the control object returned to the unselected state Client requests either GetDataValues(stSeld), SelectWithValue + Cancel or Operate

If the DUT supports external control objects for this control model execute step 5 and 6:

5. Repeat steps 1 to 4 but at step 3 force EQUIPMENT SIMULATOR to keep the old state (when possible)
6. Repeat steps 1 to 4 but at step 3 force EQUIPMENT SIMULATOR to go to the intermediate state (when DPC is supported)

Comment

sSBOes2	SelectWithValue followed by Cancel, timeout or Operate response-	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.3.3

IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

1. DUT responds with Cancel response+
2. DUT sends nothing
3. DUT sends Operate response- with a valid AddCause
4. DUT sends no control respond

The control object returns to the “Unselected” state: stSeld=F or DUT sends SelectWithValue response+ or Operate response- with AddCause “object-not-selected”

Test description

Client sends correct SelectWithValue request followed by:

1. Client sends correct Cancel request
2. Or Client waits for select timeout
3. Or Client forces an Operate request resulting in “Test not ok”
4. Or Client releases and associates again

Client requests either GetDataValues(stSeld) or SelectWithValue to verify the unselected state

Comment

sSBOes4	TimeActivatedOperateTermination+	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.3.3
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

1. DUT responds with SelectWithValue response+
2. DUT responds with TimeActivatedOperate response+
3. DUT reports TimeActivatedOperateTermination+
4. DUT reports command termination+
5. After operate timeout DUT reports CommandTermination- with AddCause “Invalid- position” or “Time-limit-over”
6. After operate timeout DUT reports CommandTermination- with AddCause “Invalid- position”
7. The control object returns to the “Unselected” state: stSeld=F or DUT sends SelectWithValue response+ or Operate response- with AddCause “object-not-selected”

Test description

1. Client sends correct SelectWithValue request
2. Client sends correct TimeActivatedOperate request
3. Wait activation wait, followed by
4. Force EQUIPMENT SIMULATOR to go to the new state

If the DUT supports external control objects for this control model execute step 5 and 6:

5. Or force EQUIPMENT SIMULATOR to keep the old state (when possible)
6. Or force EQUIPMENT SIMULATOR to go to the in between state (when DPC is supported)
7. Client requests either GetDataValues(stSeld) or SelectWithValue or Operate

Comment

sSBOes5	TimeActivatedOperateTermination-	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 20.3.3
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

1. DUT responds with SelectWithValue response+
2. DUT responds with TimeActivatedOperate response+
3. After wait time DUT reports TimeActivatedOperateTermination- with AddCause “Blocked-by-interlocking”
4. DUT responds with Cancel response+ and TimeActivatedOperateTermination- with AddCause “Abortion-by-cancel”
5. The control object returns to the “Unselected” state: stSeld=F or DUT sends SelectWithValue response+ or Operate response- with AddCause “object-not-selected”

Test description

1. Client sends correct SelectWithValue request
2. Client sends correct TimeActivatedOperate request
3. During wait for activation time force EQUIPMENT SIMULATOR to create an interlock
4. Or Client sends correct Cancel request before operTm
5. Client requests either GetDataValues(stSeld), SelectWithValue or Operate

Comment

sSBOes6	**Incorrect SelectWithValue**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3, 20.5.2.9 IEC 61850-8-1 Subclause 20.6 and 20.11, PIXIT: Ct10, Ct14		
Expected result 1. DUT sends SelectWithValue response- with AddCause “Select-failed” or “Not-supported”		
Test description 1. Client sends SelectWithValue request with an “out-of-range” originator category value (for example orCat = 9)		
Comment		

sSBOes7	**SelectWithValue, Operate many and Cancel**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result 1. The control object returns to the “Unselected” state: stSeld=F or SelectWithValue response+ or Operate response- with AddCause “object-not-selected” 2. The control object stays in the "Ready” state (stSeld=TRUE) 3. The control object returns to the "Unselected” state: stSeld=F or SelectWithValue response+ or Operate response- with AddCause “object-not-selected” 4. The control object returns to the “Unselected” state: stSeld=F or SelectWithValue response+ or Operate response- with AddCause “object-not-selected”		
Test description Client sends correct SelectWithValue request for a control object with sboClass “operate-many” followed by: 1. Client waits for sbo timeout 2. Or client sends correct Operate request and EQUIPMENT SIMULATOR moves to the control value, Client sends second correct Operate request and EQUIPMENT SIMULATOR moves to the control value 3. Client sends Operate request resulting operate response- by for example out-of-range control value OR 4. Client sends correct Cancel request To verify the Unselected/Ready state client requests either GetDataValues(stSeld) or SelectWithValue after each step.		
Comment		

sSBOes8	**Operate with different value then the SelectWithValue of a SBOes control object**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue response+ 2. DUT responds with Operate response- with AddCause “Inconsistent-parameters”, or when Operate.test=T with AddCause “blocked-by-mode" 3. The control object will return to the unselected state: stSeld=F or SelectWithValue response+ or Operate response- with AddCause “object-not-selected”		
Test description 1. Client sends correct SelectWithValue request of an unselected SBOes object with it’s logical node Beh=on 2. Client sends Operate request of the selected object changing one of the following attributes to another value than the SelectWithValue: ctlVal, origin, ctlNum, test and Check 3. Wait until control object returns to the “unselected state”, client requests either GetDataValues(stSeld) or SelectWithValue or Operate 4. Repeat step 1-3 for the other attributes in step 2		
Comment		

A4.13a Time synchronization with SNTP

Abstract test cases

Test case	Test case description
sTm1	Verify the DUT supports and executes the SCSM time synchronisation as configured in SCL
sTm2	Check report/logging timestamp accuracy and leap seconds known matches the documented timestamp quality of the server
sTm3	Verify that when the device supports time zones and daylight saving the time stamp of events and disturbance records are UTC time
sTm4	Verify the time management settings in logical node LTIM
sTm5	Verify the time server supervision in logical node LTMS
sTm6	SNTP root dispersion > 0
sTm7	Process a leap second

sTm6 is not applicable because it's not clearly defined in the standard

Test case	Test case description
sTmN1	Verify that when time synchronisation communication lost is detected after a specified period
sTmN2	On synchronisation error, deviation beyond time stamp tolerance shall be detected

Detailed test procedures

sTm1	SCSM time synchronisation (SNTP)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-8-1 Subclause 21 and 6.4.2 PIXIT: Tm3, Tm8		
Expected result 3. DUT sends the base UTC time value in the report timestamp or GOOSE timestamp or GetDataValues respond data value timestamp. Verify that the timestamp value is accurate +/-10 seconds compared to the time in the time server 5.,7. DUT sends the new UTC time value in the report data value timestamp or GOOSE timestamp or GetDataValues respond data value data value timestamp. Sending reports or GOOSE shall not be delayed by a time change.		

Test description

1. Configure
   - One SNTP time server
   - A non-zero UTC offset (when time zone is supported).
   - An URCB or BRCB with all optional fields with trigger option data-change and BufTm = 0 with FCD dataset elements or with FCDA (including the value, q and t) controllable by the EQUIPMENT SIMULATOR
   - Or a GoCB with adataset element controllable by the EQUIPMENT SIMULATOR
   - Or Client requests GetDataValues after each event (when reporting or GOOSE is not supported and when GetDataValues is supported)
2. Wait until DUT is completely synchronized to SNTP time server
3. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)
4. Test engineer changes the time at least +2 minutes in the TIME MASTER and wait till DUT takes over the new time (PIXIT)
5. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)
6. Test engineer changes the time at least -2 minutes in the TIME MASTER and wait till DUT takes over the new time (PIXIT)
7. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)

Comment

sTm2	**Time stamp quality**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3

IEC 61850-8-1 Subclause 21 and 6.4.2, Table 32

Expected result

3. The TimeStamp – TimeQuality – TimeAccuracy matches with the documented resolution (PICS-T2), TimeQuality.ClockNotSynchronized is FALSE and the TimeStamp – TimeQuality – LeapSecondsKnown is TRUE

Test description

1. Synchronize DUT clock using external SNTP server
2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message
3. Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change

Comment

Verifying the timestamp accuracy is out-of-scope for the conformance test.

sTm3	**Time in disturbance records**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3

IEC 61850-8-1 Subclause 21, 6.4.2 and 23.1

PIXIT: Tm9

Expected result

3. The start/stop time stamp of the COMTRADE.cfg is UTC or local time (PIXIT)

Test description

1. Configure DUT with a non-zero UTC offset (when time zone is supported)
2. Force the creation of a disturbance record
3. Client gets the disturbance record files

Comment

sTm4	LTIM data values	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3
IEC 61850-7-4 Subclause 5.3.8
IEC 61850-8-1 Subclause 21 and 6.4.2

Expected result

3. TmUseDT=T and TmDT=T during the daylight-saving period
5. TmUseDT=T and TmDT=F outside the daylight-saving period
8. TmUseDT=F and TmDT=F during the daylight-saving period
10. TmUseDT=F and TmDT=F outside the daylight-saving period

Test description

1. Test engineer sets TmUseDT to T
2. Test engineer changes the date in the TIME MASTER and wait till DUT takes over the new time (PIXIT) during the daylight-saving period
3. Client requests GetDataValues of the LTIM data objects
4. Test engineer changes the date in the TIME MASTER and wait till DUT takes over the new time (PIXIT) outside the daylight-saving period
5. Client requests GetDataValues of the LTIM data objects
6. Test engineer changes TmUseDT to F.
7. Test engineer changes the date in the TIME MASTER and wait till DUT takes over the new time (PIXIT) during the daylight-saving period
8. Client requests GetDataValues of the LTIM data objects
9. Test engineer changes the date in the TIME MASTER and wait till DUT takes over the new time (PIXIT) outside the daylight-saving period
10. Client requests GetDataValues of the LTIM data objects

Comment

sTm5	LTMS data values	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3
IEC 61850-7-4 Subclause 5.3.9
IEC 61850-8-1 Subclause 21 and 6.4.2

Expected result

2. The LTMS.TmSrc match with the dotted IP-address of the time server, the LTMS.TmSrcTyp=SNTP, the TmSrc value matches one of the optional TmSrcSetX values and the corresponding optional LTMS.TmChStX=TRUE, the optional TmAcc matches the actual accuracy and the optional TmSynLkd=Locked
3. DUT will send SNTP requests to the configured time source(s)
4. The corresponding LTMS.TmChStX=FALSE (when available)
6. The corresponding LTMS.TmChStX=TRUE (when available)

Test description

1. Connect one SNTP time server and configure DUT with (at least) this time source
2. Client requests GetDataValues of the LTMS data objects
3. Disconnect the time server and wait till DUT detected time server is lost
4. Client requests GetDataValues of the LTMS data objects
5. Reconnect the time server and wait till DUT is connected to time server
6. Client requests GetDataValues of the LTMS data objects

Comment
Update test procedure when Tissue #1726 TmSyn becomes “In Force”

sTm7	**Process a leap second**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Clause 6.2.3.7 and Table 9 IEC 61850-8-1 Annex F.2.3 PIXIT: Tm3, Tm5		
Expected result 1. DUT sends SNTP requests 2. DUT sends SNTP requests 3. DUT updates the event 4. DUT sends GetDataValues response+ or Reports/GOOSE’s. The events have time quality • Before the leap second: ClockNotSynchronized=F and LeapSecondsKnown=T, timestamp without leap second • After the leap second: ClockNotSynchronized=F and LeapSecondsKnown=T, timestamp processed the leap second		
Test description 1. Test engineer connects SNTP time server and changes the date & time to the next occurrence of June 30 or December 31 about one hour before midnight. The SNTP master announces a positive leap second (LI=1) to the DUT 2. Test engineer disconnects the SNTP time server at a time such that the holdover time will not expire at 00:00:10 3. Force events using the EQUIPMENT SIMULATOR or subscribed GOOSE messages before and after the leap second 4. Client requests GetDataValues of the events or waits for the Report/GOOSE messages with the state change		
Comment Note 1: (ITU-R) CCIR 460-4:1986 clause 2.1: “A positive or negative leap-second should be the last second of a UTC month, but first preference should be given to the end of December and June, and second preference to the end of March and September”. Note 2: Step 1 ensures that the LI has been distributed to the DUT and therefore at a disconnection before UTC Midnight, the DUT remembers the LI it has seen before the time server disconnection.		

sTmN1	Lost time synchronisation (SNTP)	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 and table 9
IEC 61850-8-1 Subclause 21 and 6.4.2
PIXIT: Tm5

Expected result

1. DUT detects the lost time synch
2. DUT updates the event and sends GetDataValues response+ or Report/GOOSE. The events before the holdover period have time quality ClockNotSynchronized=F and LeapSecondsKnown=T and may have a decreasing time accuracy. The events after the holdover period have time quality ClockNotSynchronized=T and LeapSecondsKnown=F (TimeAccuracy can have any value)
4. DUT sends GetDataValues response+ or Report/GOOSE. When synchronised the events shall have time quality ClockNotSynchronized=F, LeapSecondsKnown=T and the time accury may increase

Test description

1. Test engineer disconnects all time servers
2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message and Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change multiple times during and after the HoldOver period
3. Connect one time server
4. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message and Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change multiple times during and also after the DUT synchronisation period

Comment

The HoldOver period (LTMS.HoldTms) can be pretty long when the DUT supports dynamic TimeAccuracy and waits tills the accuracy has reached the value “unspecified”.

sTmN2	ClockFailure	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3
IEC 61850-8-1 Subclause 21 and 6.4.2
PIXIT: Tm1, Tm4

Expected result

3. DUT sends GetDataValues response+ or Report/GOOSE with time quality “ClockFailure”

Test description

1. Test engineer forces a ClockFailure as specified in the PIXIT
2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message
3. Client requests GetDataValues of the event or waits for Report/GOOSE message with the state change

Comment

A4.13b Time Synch (PTP)

Test case	Test case description
sTmP1	Verify the DUT supports and executes the PTP time synchronisation
sTmP2	Check report/logging timestamp accuracy and leap seconds known matches the documented timestamp quality of the server
sTmP5	Verify the time master supervision in logical node LTMS

Test case	Test case description
sTmPN1	Verify that when time synchronisation communication lost is detected after a specified period

sTmP1	**SCSM time synchronisation (PTP)**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3
IEC 61850-8-1 Subclause 21 and 6.4.2
PIXIT: Tm3, Tm8

Expected result

3. DUT sends the base UTC time value in the report timestamp or GOOSE timestamp or GetDataValues respond data value timestamp. Verify that the timestamp value is accurate +/-10 seconds compared to the time in the time server
5.,7. DUT sends the new UTC time value in the report data value timestamp or GOOSE timestamp or GetDataValues respond data value data value timestamp. Sending reports or GOOSE shall not be delayed by a time change.

Test description

1. Configure
   - One PTP time master
   - A non-zero UTC offset (when time zone is supported).
   - An URCB or BRCB with all optional fields with trigger option data-change and BufTm = 0 with FCD dataset elements or with FCDA (including the value, q and t) controllable by the EQUIPMENT SIMULATOR
   - Or a GoCB with a dataset element controllable by the EQUIPMENT SIMULATOR
   - Or Client requests GetDataValues after each event (when reporting or GOOSE is not supported and when GetDataValues is supported)
2. Wait until DUT is completely synchronized to PTP time master
3. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)
4. Test engineer disconnects the time master, wait and changes the time at least +2 minutes in the TIME MASTER, connects the time master and wait till DUT takes over the new time (PIXIT)
5. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)
6. Test engineer disconnects the time master, wait changes the time at least -2 minutes in the TIME MASTER, connects the time master and wait till DUT takes over the new time (PIXIT)
7. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)

Comment

ClockAccuracy / ClockClass is inside in PTP packet and should be good “GM”. Slaves are allowed to ignore the grand master and go in hold-over mode when ClockAccuracy is “upgrading” or “downgrading”.

sTmP2	Time stamp quality	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-8-1 Subclause 21 and 6.4.2, Table 32 PIXIT: Tm1		
Expected result 3. The TimeStamp – TimeQuality – TimeAccuracy matches with the documented resolution (PICS-T2), TimeQuality.ClockNotSynchronized is FALSE and the TimeStamp – TimeQuality – LeapSecondsKnown is TRUE		
Test description 1. Synchronize DUT clock using external PTP master 2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message 3. Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change		
Comment Verifying the timestamp accuracy is out-of-scope for the conformance test.		

sTmP5	LTMS data values	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-7-4 Subclause 5.3.9 IEC 61850-8-1 Subclause 21 and 6.4.2		
Expected result 2. The LTMS.TmSrc = the Grandmaster clock ID, the LTMS.TmSrcTyp = PTP (3), one of the optional TmSrcSetX values = “1588” and the corresponding optional LTMS.TmChStX=TRUE, the optional TmAcc matches the actual accuracy and the optional TmSynLkd=Locked 4. The corresponding LTMS.TmChStX=FALSE (when available) 6. The corresponding LTMS.TmChStX=TRUE (when available)		
Test description 1. Connect one PTP time master and configure DUT with (at least) this time source 2. Client requests GetDataValues of the LTMS data objects 3. Disconnect the PTP time master and wait the DUT time master lost timeout 4. Client requests GetDataValues of the LTMS data objects 5. Reconnect the PTP time master and wait the DUT connected to the PTP time master 6. Client requests GetDataValues of the LTMS data objects		
Comment Update test procedure when tissue 1726 LTMS.TmSyn becomes “In Force”		

sTmPN1	**Lost time synchronisation**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 21 and 6.1.2.9.3

IEC 61850-8-1 Subclause 21 and 6.4.2

PIXIT: Tm2, Tm5

Expected result

1. DUT detects the lost time synch
2. ~~2.~~ DUT updates the event and sends GetDataValues response+ or Report/GOOSE. The events before the holdover period (LTMS.HoldTms) have time quality ClockNotSynchronized=F and LeapSecondsKnown=T and may have a decreasing TimeAccuracy. The events after the holdover period have time quality ClockNotSynchronized=T, LeapSecondsKnown=F (TimeAccuracy can have any value)
4. DUT sends GetDataValues response+ or Report/GOOSE. When synchronised the events shall have time quality ClockNotSynchronized=F and LeapSecondsKnown=T and the time accury may increase

Test description

1. Test engineer disconnects all time masters
2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message and Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change multiple times during and after the HoldOver period
3. Connect one time master
4. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message and Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change multiple times during and also after the DUT synchronisation period

Comment

The HoldOver period (LTMS.HoldTms) can be pretty long when the DUT supports dynamic TimeAccuracy and waits tills the accuracy has reached the value “unspecified”.

A4.14 File transfer

Abstract test cases

Test case	Test case description
sFt1	Request a GetServerDirectory(FILE) with correct parameters and verify the response (IEC 61850-7-2 Subclause 7.2.2, PIXIT)
sFt2	For each responded file: – request a GetFile with correct parameters and verify the response (IEC 61850-7-2 Subclause 23.2.1) – request a GetFileAttributeValues with correct parameters and verify the response (IEC 61850-7-2 Subclause 23.2.4) – request a DeleteFile with correct parameters and verify the response (IEC 61850-7-2 Subclause 23.2.3)
sFt3	Verify the SetFile service with a small and large file and the maximum number of maximum sized file
sFt4	Request a GetFile from two clients simultaneously if more than one client association is supported (PIXIT)
sFt5	Request a GetServerDirectory(FILE) with the wildcard parameter and verify the response (IEC 61850-7-2 Subclause 7.2.2)

Test case	Test case description
sFtN1	Request following file transfer services with an unknown file name and verify the appropriate response-service error – GetFile (IEC 61850-7-2 Subclause 23.2.1) – GetFileAttributeValues (IEC 61850-7-2 Subclause 23.2.4) – DeleteFile (IEC 61850-7-2 Subclause 23.2.3)

Detailed test procedures

sFt1	**GetServerDirectory(FILE)**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 7.2.2, 23.1.1 IEC 61850-8-1 Subclause 23 PIXIT: Ft2, Ft3, Ft4		
Expected result 1. DUT sends GetServerDirectory(FILE) response+ with a listOfDirectoryEntry, each entry contains a file name and file attributes. The file name length is limited to 255 characters. 2. DUT sends GetServerDirectory(FILE) response+ with a listOfDirectoryEntry, continuing after the file name specified in the request. The first response has moreFollows=T, the last response has moreFollows=F or moreFollows is absent		
Test description 1. Client requests GetServerDirectory(FILE) with empty file specification 2. Force segmented list of files, for example by reducing the PDU size and creating many files. Client requests GetServerDirectory(FILE) with empty file specification, when the response contains moreFollows=T client request GetServerDirectory(FILE) with the continueAfter of the last file name in the respond		
Comment		

sFt2ab	GetFile, GetFileAttributeValues	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 23.2.1, 23.2.4
IEC 61850-8-1 Subclause 23.2.1, 23.2.4
PIXIT: Ft4

Expected result

1. DUT sends GetFile response+ for at least one file with received length >0
2. DUT sends GetFileAttributeValues response+

Test description

For each File Name in the listOfDirectoryEntry as returned by GetServerDirectory(FILE) using an empty file specification:

1. Client requests GetFile with correct File Name parameter
2. Client requests GetFileAttributeValues with correct File Name parameter

Comment

sFt2c	DeleteFile	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 23.2.3
IEC 61850-8-1 Subclause 23.2.3
PIXIT: Ft9

Expected result

1. DUT sends GetServerDirectory(FILE) response+ with at least one deletable file
2. DUT sends DeleteFile response+
3. DUT sends DeleteFile response-

Test description

1. Client requests GetServerDirectory(FILE) with empty file specification
2. For a File Name specified in the PIXIT to be deletable, issue a DeleteFile using the FileName as responded by the GetServerDirectory(FILE)
3. When supported, for a File Name specified in the PIXIT to be non-deletable, issue a DeleteFile using the FileName as responded by the GetServerDirectory(FILE)

Comment

sFt3	SetFile	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 23.2.2 IEC 61850-8-1 Subclause 23.2.2 PIXIT: Ft5		
Expected result 1. DUT sends SetFile response+ and requests GetFile 2. DUT stores contents of file 3. DUT stores files 4. DUT stores all files		
Test description 1. Client requests SetFile with a small file 2. Client sends contents of the file 3. repeat steps 1 and 2 with a large (maximum) size file 4. repeat step 3 10 times with unique file names		
Comment		

sFt4	Simultaneous GetFile from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 23.2.1 IEC 61850-8-1 Subclause 23.2.1 PIXIT: Ft8		
Expected result 1. DUT sends GetFile response+ 2. DUT sends GetFile response+ or response- "file busy" (PIXIT) 3. DUT sends GetFile response+ 4. DUT sends GetFile response+ or response- "file busy" (PIXIT)		
Test description 1. Client1 requests GetFile 2. Client2 requests GetFile of the same file while the step 1 GetFile is still in progress 3. Client1 requests GetFile 4. Client2 requests GetFile of a different file while the step 3 GetFile is still in progress		
Comment		

sFt5	GetServerDirectory(FILE) with wildcard	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 7.2.2 IEC 61850-8-1 Subclause 9.3, 23		
Expected result 1. DUT sends GetServerDirectory(FILE) response+ with a list of all files		
Test description 1. Client requests GetServerDirectory(FILE) with file specification "*"		
Comment		

sFtN1	GetFile, GetFileAttributeValues, DeleteFile with unknown file name	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 23.2.1, 23.2.4, 23.2.3 IEC 61850-8-1 Subclause 8.1.3.4.6.6 23.2 PIXIT: Ft9		
Expected result a) DUT sends GetFile response- with MMS service error "file file-non-existent" in all 3 cases. b) DUT sends GetFileAttributeValues response- with MMS service error "file file-non-existent" c) 1. DUT sends DeleteFile response- with MMS service error "file file-access-denied" or “file file-non-existent” 2. DUT sends DeleteFile response+ and then DeleteFile response- with MMS service error “file file-non-existent”		
Test description a) Client requests GetFile with unknown file by requesting a non-existing file whose name is created from a server-existing file name and changing the extension. Repeat by changing the file name part before the extension. Repeat by changing the directory name. b) Client requests GetFileAttributeValues with unknown file by requesting a non-existing file whose name is created from a server-existing file name and changing the extension. Repeat by changing the file name part before the extension. Repeat by changing the directory name. c) 1. Client requests DeleteFile on an existing “non-deletable” file when available (PIXIT) 2. Client requests DeleteFile on a deletable file twice		
Comment		

A4.15 Service Tracking

Abstract test cases

Test case	Test case description
sTrk1	Verify the tracking of control block services: Buffered reporting
sTrk2	Verify the tracking of control block services: Unbuffered reporting
sTrk3	Verify the tracking of control block services: Log control block
sTrk4	Verify the tracking of control block services: GOOSE control block
sTrk5	Verify the tracking of control block services: Multicast sampled values control block
sTrk6	Verify the tracking of control block services: Unicast sampled values control block
sTrk7	Verify the tracking of control block services: Setting group control block
sTrk8	Verify the tracking of control services: Single point control
sTrk9	Verify the tracking of control services: Double point control
sTrk10	Verify the tracking of control services: Integer control
sTrk11	Verify the tracking of control services: Enumerated control
sTrk12	Verify the tracking of control services: Integer step control
sTrk13	Verify the tracking of control services: Binary step control
sTrk14	Verify the tracking of control services: Analogue process value control with float command
sTrk15	Verify the tracking of control services: Analogue process value control with integer command
sTrk16	Verify the tracking of control services: Binary analogue process value control
sTrk17	Verify the tracking of other supported services (PIXIT)

Detailed test procedures

Note: The notation xxx.yyy[FC] means the entire functionally constrained Data. Attributes of the tracking object shall not be specified in the SCD file for these tests.

Note: The object reference is ACSI (not MMS), object reference as defined in part 7-2 clause 11.2.

sTrk1	**Tracking of Buffered reporting control block**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 14.1 and 15.3.2.2

IEC 61850-8-1 Subclause 15.3

Expected result

1. DUT sends SetBRCBValues response+
2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the BrcbTrk data value with ServiceType = SetBRCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value.
3. DUT sends report to containing the tracking dataset member object Client 1 or creates a log entry with the BrcbTrk data value with ServiceType = InternalChange and reason-for-inclusion (if supported) indicating data-update (dupd).

Test description

1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or a LCB (if available) referencing a data set with the LTRK.BrcbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported)
2. Client 2 configures and reserves another BRCB trigger option and optional fields, enables the reporting and requests GI
3. Client 2 releases the association

Comment

Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used

sTrk2	**Tracking of Unbuffered reporting control block**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 15.3.2.3

IEC 61850-8-1 Subclause 15.4

Expected result

1. DUT sends SetURCBValues response+
2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the UrcbTrk data value with ServiceType = SetURCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value.
3. DUT sends report containing the tracking dataset member object to Client 1 or creates a log entry with the UrcbTrk data value with ServiceType = InternalChange and reason-for-inclusion (if supported) indicating data-update (dupd).

Test description

1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or a LCB (if available) referencing a data set with the LTRK.UrcbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported)
2. Client 2 configures and reserves another URCB trigger option and optional fields, enables the reporting and requests GI
3. Client 2 releases the association

Comment

Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used

sTrk3	**Tracking of logging control block**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 15.3.2.4 IEC 61850-8-1 Subclause 15.5 and 15.6		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the LocbTrk data values value with ServiceType = SetLCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.LocbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 configures an LCB and enables the logging		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk4	**Tracking of GOOSE control block**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 15.3.2.6 IEC 61850-8-1 Subclause 15.7		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the GocbTrk data value with ServiceType = SetGoCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.GocbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 disables and enables a GoCB		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk5	**Tracking of Multicast sampled values control block**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 15.3.2.7 IEC 61850-8-1 Subclause 15.9		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the MsvcbTrk data value with ServiceType = SetMSVCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.MsvcbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 disables and enables a MSVCB		
Comment Tested with URCB/BRCB/QueryLog		

sTrk6	**Tracking of Unicast sampled values control block**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 15.3.2.8 IEC 61850-8-1 Subclause 15.10		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the corresponding NTS data values with ServiceType = SetUSVCBValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.UsvcbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 disables and enables a USVCB		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk7	Tracking of Setting group control block	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 15.3.2.9 IEC 61850-8-1 Subclause 15.8		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the SgcbTrk data value with ServiceType = SelectActiveSG, SelectEditSG or ConfirmEditSGValues and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested value(s) and when not in the request it mirrors the actual value		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.SgcbTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 changes the active setting group and when supported selects a setting group for editing and sends a SetEditSGValue and ConfirmEditSGValues requests		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk8	Tracking of single point control	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the SpcTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.SpcTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on a single point control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk9	**Tracking of double point control**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the DpcTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.DpcTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on a double point control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk10	**Tracking of integer control**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the IncTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.IncTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on an integer control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk11	**Tracking of enumerated control**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the EncTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.EncTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on an enumerated control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk12	**Tracking of integer step control**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the IscTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.IscTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on a integer step control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk13	**Tracking of binary step control**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the BscTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.BscTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on a binary step control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk14	**Tracking of analogue set point control with float command**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the ApcFTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or anLCB (if available) referencing a dataset with the LTRK.ApcFTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on an analogue set point control with float command control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk15	**Tracking of analogue set point control with integer command**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the ApcIntTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.ApcIntTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on an analogue set point control with float command control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk16	**Tracking of binary controlled analogue set point**	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1		
Expected result 2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the BacTrk data value with ServiceType = Select, SelectWithValue, Cancel, Operate or CommandTermination and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.		
Test description 1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.BacTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported) 2. Client 2 request control services on a binary controlled analogue set point control object		
Comment Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used		

sTrk17	**Tracking of other supported services**	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 Subclause 14.2
IEC 61850-8-1 Subclause 15.2
PIXIT: Tr1

Expected result

2. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the GenTrk data value and reason-for-inclusion (if supported) indicating data-update (dupd). The tracked values do match the requested values.
3. DUT sends reports containing the tracking dataset member object to Client 1 or creates a log entry with the GenTrk with ServiceError and reason-for-inclusion (if supported) indicating data-update (dupd)

Test description

1. Client 1 reserves and configures an URCB (if available) or a BRCB (if available) or an LCB (if available) referencing a dataset with the LTRK.GenTrk[SR] member with trigger option data-update and optional-fields including reason-for-inclusion (if supported)
2. Client 2 requests valid general tracked services (PIXIT)
3. When possible, Client 2 requests general tracked services (PIXIT) resulting in a service error

Comment

Tested with URCB/BRCB/QueryLog. Client 1 requests QueryLog when logging service is used

ANNEX B DETAILED DESCRIPTION OF TEST RESULTS

This appendix contains detailed comments on test results, for instance when a defect is detected or to explain an inconclusive test result, including the actual message flow if appropriate.

<Test procedure identifier X>
<Additional extra information, e.g. a trace dump>

<Test procedure identifier Y>
<Additional extra information, e.g. a trace dump>

ANNEX C PICS TEMPLATE FOR SERVER

The PICS template document is located at:
http://www.ucaiug.org/org/TechnicalO/Testing/Shared%20Documents/Templates/

The most recent PICS template should be used.

ANNEX D TICS TEMPLATE FOR SERVER

The TICS template document will be located at:
http://www.ucaiug.org/org/TechnicalO/Testing/Shared%20Documents/Templates/

At the time of publication, no Edition 2 Amendment 1 tissues are “in force”.

ANNEX E PIXIT template for Server

Protocol Implementation eXtra Information for Testing (PIXIT)
for the IEC 61850 <<First Edition or Edition 2>> server interface in
<Device>

Version <<vendor version of the PIXIT document to be declared by product vendor>> Date <<date PIXIT released by vendor>>

Based Upon UCAIug Server PIXIT Template version 21

<<Vendor should remove the remainder of text on this page>>

UCA International Users Group
Testing Sub Committee

PIXIT template for Server Test Procedures
for Edition 1 and Edition 2
Revision 21

Date: January 19, 2021

PIXIT for Server

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in <device> with firmware version <version>.

Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10. The PIXIT entries contain information which is not available in the PICS, MICS, TICS documents or SCL file.

Each table specifies the PIXIT for applicable ACSI service model as structured in IEC 61850-10. The “Ed” column indicates if the entry is applicable for IEC 61850 Edition 1 and/or Edition 2. A hyphen (“-“) in the Ed column indicates the PIXIT entry is not applicable for any version.

PIXIT for Documentation

ID	Ed	Description	Value / Clarification
Do1	2	How to expose required firmware versions not present in the datamodel	…
		<additional items>	

PIXIT for Configuration

ID	Ed	Description	Value / Clarification
Cf1	2	Can IED tool export ICD file or IID file (SICS I12)	ICD: Y/N IID: Y/N
		<additional items>	

PIXIT for Association model

ID	Ed	Description	Value / Clarification
As1	1	Maximum number of clients that can set-up an association simultaneously	…
As2	1,2	TCP_KEEPALIVE value. The recommended range is 1..20s	… seconds
As3	1,2	Lost connection detection time	… seconds
As4	-	Authentication is not supported yet	

ID	Ed	Description	Value / Clarification
As5	1,2	What association parameters are necessary for successful association: Called values: Calling values:	Transport selector Y/N Session selector Y/N Presentation selector Y/N AP Title Y/N AE Qualifier Y/N other Transport selector Y/N Session selector Y/N Presentation selector Y/N AP Title Y/N AE Qualifier Y/N other
As6	1,2	If association parameters are necessary for association, describe the correct Called values: e.g. Calling parameters: e.g.	Transport selector 0001 Session selector 0001 Presentation selector 00000001 AP Title 1,3,9999,106 AE Qualifier 106 other Transport selector 0001 Session selector 0001 Presentation selector 00000001 AP Title 1,3,9999,106 AE Qualifier 106 other
As7	1,2	What is the maximum and minimum MMS PDU size	Max MMS PDU size … Min MMS PDU size …
As8	1,2	What is the maximum start up time after a power supply interrupt	… seconds
As9	1,2	Does this device function only as test equipment? (test equipment need not have a non-volatile configuration; but it cannot be part of the substation automation system)	Y/N
As10	2	How does the server behave when the associate request fails	E.g. retry X times
		<additional items>	

PIXIT for Server model

ID	Ed	Description	Value / Clarification
Sr1	1,2	Which analogue value (MX) quality bits are supported (can be set by server)	Validity: Y/N Good, Y/N Invalid, Y/N Reserved, Y/N Questionable Detail Quality Y/N Overflow Y/N OutofRange Y/N BadReference Y/N Oscillatory Y/N Failure Y/N OldData Y/N Inconsistent Y/N Inaccurate Miscellaneous: Y/N Source Y/N Test Y/N OperatorBlocked
Sr2	1,2	Which status value (ST) quality bits are supported (can be set by server)	Validity: Y/N Good, Y/N Invalid, Y/N Reserved, Y/N Questionable Detail Quality Y/N BadReference Y/N Oscillatory Y/N Failure Y/N OldData Y/N Inconsistent Y/N Inaccurate Miscellaneous: Y/N Source Y/N Test Y/N OperatorBlocked
Sr3	-	What is the maximum number of data object references in one GetDataValues request	Deprecated
Sr4	-	What is the maximum number of data object references in one SetDataValues request	Deprecated

ID	Ed	Description	Value / Clarification
Sr5	1	Which Mode values are supported [1]	On Y/N [On-]Blocked Y/N Test Y/N Test/Blocked Y/N Off Y/N
		<additional items>	

PIXIT for Data set model

ID	Ed	Description	Value / Clarification
Ds1	1	What is the maximum number of data elements in one data set (compare ICD setting)	
Ds2	1	How many persistent data sets can be created by one or more clients (this number includes predefined datasets)	
Ds3	1	How many non-persistent data sets can be created by one or more clients	
		<additional items>	

PIXIT for Substitution model

ID	Ed	Description	Value / Clarification
Sb1	1	Are substituted values stored in volatile memory	Y/N
		<additional items>	

PIXIT for Setting group control model

ID	Ed	Description	Value / Clarification
Sg1	1	What is the number of supported setting groups for each logical device	See SGCB value
Sg2	1,2	What is the effect of when and how the non-volatile storage is updated (compare IEC 61850-8-1 §16.2.4)	
Sg3	1	Can multiple clients edit the same setting group	Y/N

[1] IEC 61850-6:2009 clause 9.5.6 states that if only a subrange of the enumeration value set is supported, this shall be indicated within an ICD file by an enumeration type, where the unsupported values are missing

ID	Ed	Description	Value / Clarification
Sg4	1	What happens if the association is lost while editing a setting group	e.g. The SE values changes are lost, the EditSG is reset to 0
Sg5	1	Is EditSG value 0 allowed	Y/N
Sg6	2	When ResvTms is not present how long is an edit setting group locked	… seconds
		<additional items>	

PIXIT for Reporting model

ID	Ed	Description	Value / Clarification
Rp1	1	The supported trigger conditions are (compare PICS)	integrity Y/N data change Y/N quality change Y/N data update Y/N general interrogation Y/N
Rp2	1	The supported optional fields are	sequence-number Y/N report-time-stamp Y/N reason-for-inclusion Y/N data-set-name Y/N data-reference Y/N buffer-overflow Y/N entryID Y/N conf-rev Y/N segmentation Y/N
Rp3	1,2	Can the server send segmented reports (when not supported the device shall refuse an association request with a smaller than minimum PDU size)	Y/N
Rp4	1,2	Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 Ed2 §17.2.2.9)	Send report immediately OR Replace analogue value in pending report
Rp5	1	Multi client URCB approach (compare IEC 61850-7-2:2003 §14.2.1)	Each URCB is visible to one client only OR Each URCB is visible to all clients
Rp6	-	What is the format of EntryID	Deprecated
Rp7	1,2	What is the buffer size for each BRCB or how many reports can be buffered	<number of bytes or typical number of dataset members or reports>

ID	Ed	Description	Value / Clarification
Rp8	-	Pre-configured RCB attributes that are dynamic, compare SCL report settings	Deprecated
Rp9	1	May the reported data set contain: - structured data objects - data attributes	 Y/N Y/N
Rp10	1,2	What is the scan cycle for binary events Is this fixed, configurable	…. Ms Fixed or Configurable or event-driven
Rp11	1	Does the device support to pre-assign a RCB to a specific client in the SCL	Y/N
Rp12	2	After restart of the server is the value of ConfRev restored from the original configuration or retained prior to restart	Restored from original configuration OR retained prior to restart
Rp13	1,2	Does the server accept any client to configure / enable an RCB with BRCB.ResvTms=-1 or URCB.Resv=T? What fields are used to do the identification?	Y/N IP-address Y/N AP-Title Y/N AE-Qualifier Y/N <other field> Y/N
Rp14	1,2	When BRCB.ResvTms is exposed, what is the default value for BRCB.ResvTms if client does not write (must be > 0) or When BRCB.ResvTms is not exposed, what is the internal reservation time (must be >= 0) Note: for Amd1 the client shall always write ResvTms and ResvTms is mandatory	____ seconds or N/A ____ seconds or N/A (note: both cannot be N/A)
Rp15	2	Is data model db=0 supported	Y/N
		<additional items>	

PIXIT for Logging model

ID	Ed	Description	Value / Clarification
Lg1	1,2	What is the default value of LogEna (Compare IEC 61850-8-1 §17.3.3.2.1, the default value should be FALSE)	TRUE/FALSE
Lg2	-	What is the format of EntryID	Deprecated
Lg3	1,2	Are there multiple Log Control Blocks that specify the Journaling of the same MMS	Single Journal Entry (specify the event condition)

		NamedVariable and TrgOps and the Event Condition (Compare IEC 61850-8-1 §17.3.3.3.2)	OR Multiple Journal Entries
Lg4	-	Pre-configured LCB attributes that cannot be changed online	Deprecated, the information is already available in SCL
Lg5	1	Which TrgOps are supported for logging (note Ed2 and up requires support for all TrgOps)	dchg Y/N qchg Y/N dupd Y/N integrity Y/N
		<additional items>	

PIXIT for GOOSE publish model

ID	Ed	Description	Value / Clarification
Gp1	1,2	Can the test (Ed1) / simulation (Ed2) flag in the published GOOSE be set Note: simulation is intended for test equipment	Y/N
Gp2	1	What is the behaviour when the GOOSE publish configuration is incorrect	NdsCom=T DUT keeps GoEna=F
Gp3	1,2	Published FCD supported common data classes are	<list of common data classes> Arrays are [not] supported
Gp4	1,2	What is the maximum value of TAL (maxTime) Is it fixed or configurable	Fixed at … ms or Configured by SCL or by ICT or GoCB MaxTime
Gp5	1,2	What is the fastest retransmission time	… ms
Gp6	-	Can the GOOSE publish be turned on / off by using SetGoCBValues(GoEna)	Deprecated See PICS – SetGoCBValues
Gp7	1,2	What is the initial GOOSE sqNum after restart	sqNum = 0 or 1
Gp8	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y/N Y/N
Gp9	1,2	Does Server or ICT refuse GOOSE payload dataset length greater than SCSM supports?	Y/N
		<additional items>	

PIXIT for GOOSE subscribe model

ID	Ed	Description	Value / Clarification
Gs1	1,2	What elements of a subscribed GOOSE message are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions. Notes: • the VLAN tag may be removed by an Ethernet switch and shall not be checked • the simulation flag shall always be checked (Ed2) • the ndsCom shall always be checked	Y/N destination MAC address Y/N APPID Y/N gocbRef Y/N timeAllowedtoLive Y/N datSet Y/N goID Y/N T Y/N stNum Y/N sqNum Y simulation / test Y/N confRev Y/N numDatSetEntries Y/N out-of-order dataset members
Gs2	1,2	When is a subscribed GOOSE marked as lost (TAL = time allowed to live value from the last received GOOSE message)	a) message does not arrive prior to TAL b) message does not arrive by 2x TAL c) message does not arrive by TAL plus configurable time d) other (describe)
Gs3	1,2	What is the behaviour when one or more subscribed GOOSE messages is not received or syntactically incorrect (missing GOOSE)	
Gs4	1,2	What is the behaviour when a subscribed GOOSE message is out-of-order	
Gs5	1,2	What is the behaviour when a subscribed GOOSE message is duplicated	
Gs6	1	Does the device subscribe to GOOSE messages with/without the VLAN tag	Y, with the VLAN tag Y, without the VLAN tag
Gs7	1	May the GOOSE data set contain: - structured data objects (FCD) - timestamp data attributes	 Y/N Y/N
Gs8	1,2	Subscribed FCD supported common data classes are	<list of common data classes> Arrays are [not] supported

ID	Ed	Description	Value / Clarification
Gs9	1	Are subscribed GOOSE with test=T (Ed1) / simulation=T (Ed2) accepted in test/simulation mode	Y/N
Gs10	1,2	Max number of dataset members	Unlimited or count
Gs11	1	Is Fixed-length encoded GOOSE supported	Note: Ed2 Am1 requires support
Gs12	Amd1	How does the subscriber handle incoming data flagged as test when the destination LN.Beh is On or Blocked? Is this behavior:	For example: keep last non test value, substitute to a configured value etc. fixed/configurable
		<additional items>	

PIXIT for GOOSE performance

ID	Ed	Description	Value / Clarification	
Gf1	1,2	Performance class	P1 = 3 ms P2 = 10 ms P3 = 20 ms P4 = 100 ms P5 = 500 ms P6 = 1000 ms	
Gf2	1,2	GOOSE ping-pong processing method	Event driven based OR Scan cycle based	
Gf3	1,2	Application logic scan cycle (ms)	Max.	…. Ms
			Min.	…. Ms
Gf4	1	Maximum number of data attributes in GOOSE dataset (value and quality has to be counted as separate attributes)		
		<additional items>		

PIXIT for IEC 61869-9 publisher

ID	Description	Value / Clarification
Svp1	Supported application class (compare table 901)	Quality metering Protective and measuring Time critical low bandwidth DC control High bandwidth DC control

Svp2	Support behaviour = test Support behaviour = off	Y/N Y/N
Svp3	Support simulation mode - Backwards rates - Preferred rates When supported how to enable simulation mode Note: simulation mode is intended for test equipment	 Y/N Y/N <description>
Svp4	Are neutral sampled values calculated	Y/N/Configurable
Svp5	How are the CT/VT ratios configured (only applicable for MU connected to conventional CT/VT)	
Svp6	Support time synchronization method	Y/N PTP Y/N PPS
Svp7	What is the maximum time required to achieve synchronization after restoring the time synch	… seconds
Svp8	What is the maximum time required to achieve synchronization after power up	… seconds
Svp9	In which conditions is the quality field Validity set to Invalid	For example a MU without voltage inputs the voltage samples have quality invalid
Svp10	What is the maximum time to start-up the device	… seconds
Svp11	How can the date of manufacture be derived from PhyNam.serNum?	Explain
Svp12	Calculated IN = (Ia, Ib, Ic). = -(Ia, Ib, Ic)	 Y/N Y/N
Svp13	Is detail quality “out-of-range” supported? How to force out-of-range?	Y/N e.g. exceeding the clipping limit
	<additional items>	

PIXIT for IEC 61869-9 subscriber

ID	Description	Value / Clarification
Svs1a	How does the subscriber process subscribed sampled **values** (one is mandatory) Telco 21jul: how to observe that …	MMXU Y/N MMTR Y/N Pxxx Y/N Web interface Y/N Display Y/N File Y/N Other Y/N and describe
Svs1b	How does the subscriber **supervise** subscribed sampled values (optional)	LSVS Y/N LCCH Y/N Web interface Y/N Error log Y/N Display Y/N Other Y/N and describe
Svs2a	Which backwards compatible variants can be subscribed to (at least one shall be supported)	F4000S1I4U4 Y/N F4800S1I4U4 Y/N F5760S1I4U4 Y/N F12800S8I4U4 Y/N F15360S8I4U4 Y/N
Svs2b	Which preferred variants can be subscribed to (at least one shall be supported)	F4800S2IxUy Y/N F14400S6IxUy Y/N F96000S1IxUy Y/N Supported values for x … Supported values for y … Maximum value for x+y …
Svs3	Support simulation mode - Preferred rates - Backwards compatible rates How to enable simulation mode	 Y/N Y/N LPHD.Sim or describe

Svs4	Which element of the SV header are verified (when yes the SV packets are ignored)	MAC-address Y/N APPID Y/N SVID Y/N ConfRev > Y/N ConfRev < Y/N smpSynch compare entry Svs8 synchSourceId
Svs5	What will happen in case an extra element pair is added to the data set What will happen in case an element pair of the data set is missing	Message is ignored Y/N Extra element is ignored Y/N <describe>
Svs6	How does the subscriber behave in case a broken path is detected	<describe for LSVS, MMXU, LCCH, Web interface, error log, display> Timeout(s) = … msec (<application>)
Svs7	How does the subscriber behave in case packets are missing - 1 packet - 3 consecutive packets - 5 consecutive packets - 10 consecutive packets - Packet with smpCnt = 0	<describe for LSVS, MMXU, LCCH, Web interface, error log, display>
Svs8	How does the subscriber behave in case - smpSynch = 0 - smpSynch = 1 - smpSynch = 3..255	<describe for LSVS, MMXU, LCCH, Web interface, error log, display>
Svs9	How does the subscriber behave in case - one sample value continuously has quality invalid - all sample values continuously have quality invalid	The corresponding application data will have quality invalid <other>
Svs10	Declare smallest value of publisher maximum processing delay time that the subscriber requires (per Table 901).	10 ms, 2ms, 100µs, 25µs

Svs11	What is the total delay that can be tolerated (Svs10 processing time + maximum network delay)	
	<additional items>	

PIXIT for Control model

ID	Ed	Description	Value / Clarification
Ct1	1	What control models are supported (compare ICD file for Ed2)	DOns: Y/N SBOns: Y/N DOes: Y/N SBOes: Y/N
Ct2	1,2	Is the control model fixed, configurable and/or dynamic	Fixed / Configurable / Dynamic
Ct3	-	Is TimeActivatedOperate supported (compare PICS or SCL)	Deprecated
Ct4	-	Is “operate-many” supported (compare sboClass)	Deprecated, see sboClass in datamodel (ICD)
Ct5	1	Will the DUT activate the control output when the test attribute is set in the SelectWithValue and/or Operate request (when N test procedure Ctl2 is applicable)	Y/N
Ct6	-	What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request	Deprecated
Ct7	-	Is pulse configuration supported (compare pulseConfig)	Deprecated
Ct8	1,2	What is the behaviour of the DUT when the check conditions are not set This behaviour is:	DUT ignores the check value and always perform the check (allowed for Ed1 only) or DUT refuses to bypass the check with “Not supported” or “Blocked-by-interlocking” (All Ed) or DUT bypasses the interlocking check (All Ed) Fixed / Configurable / Dynamic

ID	Ed	Description	Value / Clarification
Ct9	1,2	Which additional cause diagnosis are supported	Y/N Unknown Y/N Not-supported Y/N Blocked-by-switching-hierarchy Y/N Select-failed Y/N Invalid-position Y/N Position-reached Y/N Step-limit Y/N Blocked-by-Mode Y/N Blocked-by-process Y/N Blocked-by-interlocking Y/N Blocked-by-synchrocheck Y/N Command-already-in-execution Y/N Blocked-by-health Y/N 1-of-n-control Y/N Abortion-by-cancel Y/N Time-limit-over Y/N Abortion-by-trip Y/N Object-not-selected **Edition 1 specific values:** Y/N Parameter-change-in-execution (Ed1 semantics) **Edition 2 specific values:** Y/N Object-already-selected N No-access-authority Y/N Ended-with-overshoot Y/N Abortion-due-to-deviation Y/N Abortion-by-communication-loss Y/N Blocked-by-command Y/N None Y/N Inconsistent-parameters Y/N Locked-by-other-client Y/N Parameter-change-in-execution (Ed2 semantics)
Ct10	1,2	How to force a “test-not-ok” respond with SelectWithValue request	e.g. invalid orCat value

ID	Ed	Description	Value / Clarification
Ct11	1,2	How to force a “test-not-ok” respond with Select request	
Ct12	1,2	How to force a “test-not-ok” respond with Operate request	DOns: SBOns: DOes: SBOes:
Ct13	1,2	Which origin categories are accepted in control direction	Y/N bay-control (1) Y/N station-control (2) Y/N remote-control (3) Y/N automatic-bay (4) Y/N automatic-station (5) Y/N automatic-remote (6) Y/N maintenance (7) Y/N process (8)
Ct14	1,2	What happens if the orCat value is not supported or invalid	DOns: SBOns: DOes: SBOes:
Ct15	1,2	Does the IED accept a SelectWithValue / Operate with the same control value as the current status value Is this behaviour configurable	DOns: Y/N SBOns: Y/N DOes: Y/N SBOes: Y/N Configurable Y/N
Ct16	1	Does the IED accept a select/operate on the same control object from 2 different clients at the same time	DOns: Y/N (default Y) SBOns: Y/N (default N) DOes: Y/N (default Y) SBOes: Y/N (default N)
Ct17	1	Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (Tissue #334)	SBOns: Y/N SBOes: Y/N
Ct18	1	Deprecated	
Ct19	-	Can a control operation be blocked by Mod=Off or [On-]Blocked (Compare PIXIT-Sr5)	Deprecated
Ct20	1,2	Does the IED support local / remote operation	Y/N

ID	Ed	Description	Value / Clarification
Ct21	1,2	Does the IED send an InformationReport with LastApplError as part of the Operate response- for control with normal security	SBOns: Y/N DOns: Y/N
Ct22	2	How to force a “parameter-change-in-execution”	SBOns: SBOes:
Ct23	1,2	How many SBOns/SBOes control objects can be selected at the same time?	SBOns: n = “N/A“ or “1” or “multiple” SBOes: n = “N/A” or “1” or “multiple”
Ct24	1,2	Can a controllable object be forced to keep its old state e.g. Internal Controllable Objects may not be accessible to force this, whereas a switch like Circuit Breaker outside the DUT can?	Y/N
Ct25	1,2	When CDC=DPC is supported, is it possible to have DPC (Controllable Double Point) go to the intermediate state? (00)	Y/N or “N/A”
Ct26	1,2	Name an enhanced security control point (if any) with a finite operate timeout Specify the operate timeout (in milliseconds)	DOes: <reference> or N/A SBOes: <reference> or N/A DOes: … ms SBOes: … ms
Ct27	2	Does the IED support control objects with external signals?	DOns: Y/N SBOns: Y/N DOes: Y/N SBOes: Y/N
Ct28		Deprecated, kept as placeholder	
Ct29	Amd1	Does the IED support XCBR/XSWI.Loc=False and LLN0/CSWI.Loc=True When yes, does the IED accept the control when orCat=1 or 4 Local	DOns: Y/N, orCat 1-4: Y/N SBOns: Y/N, orCat 1-4: Y/N DOes: Y/N, orCat 1-4: Y/N SBOes: Y/N, orCat 1-4: Y/N

ID	Ed	Description	Value / Clarification
Ct30	2	What is the Operate timeout?	operTimeout in datamodel or fixed: xxx ms or configurable

PIXIT for Time synchronisation model

ID	Ed	Description	Value / Clarification
Tm1	1	What time quality bits are supported (may be set by the IED) Note: Ability to set ClockNotSynchronized and LeapSecondKnown is mandatory in Ed2	Y/N LeapSecondsKnown Y/N ClockFailure Y/N ClockNotSynchronized
Tm2	1,2	Describe the behaviour when all time server(s) cease to respond What is the time server lost detection time	Immediately assert CNS or Assert CNS after lost detection time .. seconds
Tm3	1,2	How long does it take to take over the new time from time server	.. seconds
Tm4	1,2	When is the time quality bit “ClockFailure” set	“Never set” or “set when …” Tested by …or “cannot be tested”
Tm5	1	When is the time quality bit “Clock not Synchronized” set	When connection to all time servers is lost (see PIXIT-Tm2) or other (specify) Note: For Ed2 and up, CNS is set according to PIXIT Tm2
Tm6	-	Is the timestamp of a binary event adjusted to the configured scan cycle	Deprecated
Tm7	1	Does the device support time zone and daylight saving	Y/N

ID	Ed	Description	Value / Clarification
Tm8	1,2	Which attributes of the SNTP response packet are validated	Y/N Leap indicator not equal to 3 Y/N Mode is equal to SERVER Y/N OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp Y/N RX/TX timestamp fields are checked for reasonableness Y/N SNTP version 3 and/or 4 Y/N other (describe)
Tm9	1,2	When COMTRADE files are supported do these have local time or UTC time and is this configurable	Supported Y/N Local / UTC Y/N Configurable
		<additional items>	

PIXIT for File transfer model

ID	Ed	Description	Value / Clarification
Ft1	1	What is the structure of files and directories Where are the COMTRADE files stored Are COMTRADE files zipped and what files are included in each zip file	<Flat file system with pseudo folders (Ed2) or file system with folders> /COMTRADE/ OR /LD/<IED+LD>/COMTRADE Not zipped and/or Zipped <Zip includes: .cfg and .dat>
Ft2	1,2	Directory names are separated from the file name by	"/" or "\"
Ft3	1	The maximum file name size including path (recommended 64 chars)	255 chars
Ft4	1,2	Are directory/file name case sensitive	[Not] Case sensitive
Ft5	1,2	Maximum file size for SetFile	
Ft6	1	Is the requested file path included in the MMS fileDirectory respond file name	Y/N (Ed2: always complete path)
Ft7	1	Is the wild card supported in the MMS fileDirectory request	Yes, wild card = * No
Ft8	1,2	Is it allowed that 2 clients get a file at the same time	Y/N same file Y/N different files
Ft9	1,2	Which files can be deleted	
		<additional items>	

PIXIT for Service tracking model

ID	Ed	Description	Value / Clarification
Tr1	2	Which ACSI services are tracked by LTRK.GenTrk	<list of ACSI services>

Instruction and comments on using the PIXIT template

Note: This is NOT part of the PIXIT file

Comments

The template should be used for devices compliant to Edition 1 or Edition 2:

- Questions and comments can be e-mailed to: helpdesk@ucausersgroup.org

Instructions

- format of the document may be changed into your company format
- enter the applicable IED name and firmware version
- update the Y/N values, enter statements
- remove the instructions, comments and revision history
- remove the specified text on the front page

PIXIT Revision History

Version	Date	Who	Why
Original	2015-05-05	BAM	Merge Ed1 and Ed2 PIXIT
_rev1	2015-05-18	BAM	Add Ct23, Ct24 (from Ed1 2.3 TPCL 1.7.6 Add Ct25 (during Ed1 3.0 development)
_rev2	2015-05-29	BAM	Add As9 (Test Equipment)
_rev3	2015-09-17	PP	Changed Tm1 to Ed.1 only (Ed2 requires all 3 bits).
_rev4	2015-10-26	PP	Changed the entry Ct1 to Ed.1 only.
_rev5	2016-01-26	BAM	Replace Ct23-Ct26 with version from Ed1 TP/Ed2 TPCL
_rev6	2016-05-10	BAM	Add Gs10, clarify Tm4
_rev7	2016-07-05	BAM	Clarify Ct1 that ICD file enums specifies control models
_rev8	2016-08-02	BAM	Revised Ct9 Clarify Ct24 to specify the operate timeout value Add Ct25 .. Ct28, Ft9
_rev9	2017-04-18	BAM	Editorial changes Rp10: Add event-driven option for report scan cycle Gp4: Change description from slow re-transmission time to maximum Time-Allowed-to-Live value Gs11: Add (Ed1) “Is Fixed GOOSE supported?” Ct18: Change to applicable only to Ed1. (Ed2 requires that validation be performed in both steps) Tm1: Allow Ed1 devices to NOT support CNS Tm2: Alow more options on when CNS is asserted
_rev10	2017-09-15	BAM	Add new entries Do1 and Rp14
_rev11	2017-11-26	BAM	Added Gp9
_rev12	2017-12-06	BAM	Many editorial changes, deprecated CT28

_rev13	2018-01-23	BAM	Deprecated Ct18.
_rev14	2018-11-13	BAM	Deprecate Lg4 – values are already in SCL file
_rev15	2019-03-xx	BAM	Add Lg5 from Ed1 Server TP 3.3; Add As1 footnote.
_rev16	201906-18	BAM	Add calling parameters to As5 and As6
_rev17	20191022	RS	Modify Rp14 for exposed/not exposed ResvTms
_rev18	20200211	BAM	Revise title page to _rev18
_rev19	20200618	RS	Merge changes from TP2.0.2 PIXIT - Gs9 only applicable for Ed1 - Rp4 change 7-2 clause from 14 to 17 - Rp14 added “or” - Gf1 specified the ms - Ct26 editorial improvement - Tm5 moved the Note to the end
_rev20	20200702	BAM	Add entries Rp15 and Gs12
_rev21	20201216	RS	Add entries As9, Ct29, Ct30 Updated Ct13 “orCat in control direction” Removed Svs10 Updated Tm1, Rp13, Svp13

ANNEX F MICS TEMPLATE FOR SERVER

Introduction

This model implementation conformance statement is applicable for <device ID and name>, with firmware <version> and data model name space <2007B3>

This MICS document specifies the modelling extensions compared to IEC 61850 Edition 2. For the exact details on the standardized model please compare the ICD substation configuration file: "<filename.icd>", version <version>.

Clause 2 contains the list of implemented logical nodes.
Clause 3 describes the new and extended logical nodes (if any).
Clause 4 describes the new and extended enum types (if any).
<note – remove the non-applicable clauses>

Logical Nodes List

The following table contains the list of logical nodes implemented in the device:
e.g.

L: System Logical Nodes	**Name space when not <2007B3>**
LPHD (Physical device information)	
LLN0 (Logical node zero)	
P: Logical Nodes for protection functions	
PIOC (Instantaneous overcurrent)	
PTOC (Time overcurrent)	
PTOF (Overfrequency)	
PTOV (Overvoltage)	
PTUV (Undervoltage)	
PTUF (Underfrequency)	
R: Logical nodes for protection related functions	
RDIR (Directional element)	
RREC (Autoreclosing)	

G: Logical Nodes for generic references	
GGIO (Generic process I/O)	
M: Logical Nodes for metering and measurement	
MMTR (Metering)	
MMXU (Measurement)	
X: Logical Nodes for switchgear	
XCBR (Circuit breaker)	
XSWI (Switch)	

Logical Node Extensions

The following table use

- M: Data object is mandatory in the IEC 61850-7-4 Ed2 Amd1.
- O: Data object is optional in the IEC 61850-7-4 Ed2 Amd1 and is used in the device.
- E: Data object is an extension to the IEC 61850-7-4 Ed2 Amd1.

New Logical Nodes

Newly created logical nodes are listed in this clause, with lnNs attribute in the Name plate.

<LN> <description>

<New LN description and usage>

<LN> class				
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
<LN>		<explanation>	M	
Data Objects				
Common Logical Node Information				
Status Information				

Settings				

Extended Logical Nodes

The following logical nodes have been extended with extra data. All extra data has been highlighted in the tables and marked as “E” (Extended).
NOTE: If the extended data object is already used in other logic nodes in IEC 61850-7-4 Ed.2 Amd1, dataNs is not mandatory, but it’s still recommended.

<LN> <description>

Following is an example of extending PIOC with a few extra data object.

PIOC class				
Data object name	**Common data class**	**Explanation**	**M/O/E**	**Remarks**
PIOC		Instantaneous overcurrent		
Data objects				
Common Logical Node Information				
Mod	INC	Mode	M	Status-only
Beh	INS	Behaviour	M	
Health	INS	Health	M	
NamPlt	LPL	Name plate	M	
Status Information				
Str	ACD	Start	O	
Op	ACT	Operate	M	
<newDO>	<CDC>	<explanation>	E	
Settings				
StrVal	ASG	Start value	O	Pickup Level (0,05 – 160)

			E	
			E	
			E	
			E	

Enum types Extensions

New Enum types

New enum types are listed in this clause.

<New Enum type>

Value	Description	Remarks
0		
1		
2		
3		
4		

Extended Enum types

Enum types with extended negative values are listed in this clause. Semantic of these negative values are described.

<Extended Enum type>

Value	Description	Remarks
-3		
-2		
-1		

ANNEX H SERVER CERTIFICATE TEMPLATE

IEC 61850 Certificate Level A/B[1]

No. << certificate number>>

Issued to:
<TEST INITIATOR>
<FULL ADDRESS>

For the server product:
<PRODUCT ID and NAME>
<IEC 61850 software/firmware version: <VERSION>>
[Hardware version: xxxxx]
[S/N: xxxx, yyyy (in case of multiple samples)]

Issued by: <<test lab>>

The server product has not been shown to be non-conforming to:

IEC 61850 Edition 2 with Amendment 1 Parts 6, 7-1, 7-2, 7-3, 7-4, 8-1 [, 9-2 and IEC 61869 First Edition Part 9]

Communication networks and systems for power utility automation

The conformance test has been performed according to IEC 61850-10, the UCA International Users Group Edition 2 with Amendment 1 Server Test Procedures version 1.1 with product's protocol, model implementation conformance statements: "<<PICS>>", "<<MICS>>" and product's extra information for testing: "<<PIXIT>>".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test):

1a Basic Exchange (../29)	11a SV publish (../21)
1b Associate with IPv6 (../12)	11b SV subscribe (../21)
2 Data Sets (../7)	12a Direct Control (../18)
2+ Data Set Definition (../24)	12b SBO Control (../27)
3 Substitution (../3)	12c Enhanced Direct Control (../20)
4 Setting Group Selection (../4)	12d Enhanced SBO Control (../28)
4+ Setting Group Definition (../13)	13a Time Synchronization with SNTP(../8)
5 Unbuffered Reporting (../26)	13b Time Synchronization with PTP (../4)
6 Buffered Reporting (../36)	14 File Transfer (../8)
7 Logging (../14)	15 Service Tracking (../17)
9a GOOSE Publish (../13)	
9b GOOSE Subscribe (../27)	
9c GOOSE Management (../3)	

This certificate includes a summary of the test results as carried out at <<CITY>> in <<COUNTRY>> with <<CLIENT SIMULATOR> <<VERSION>> with test suite <<VERSION>> and <<ANALYZER>> <<VERSION>>. This document has been issued for information purposes only, and the original [paper/archived] copy of the <<TESTLAB>> report: No. <<TESTREPORT NUMBER>> will prevail.

The test has been carried out on the specimen[s] of the product as referred above and submitted to <<TESTLAB>> by <<TEST INITIATOR>>. The manufacturer's production process has not been assessed. This certificate does not imply that <<TESTLAB>> has certified or approved any product other than the specimen tested.

<<CITY>>, <<DATE>>

<<Manager NAME>>
<<JOB TITLE>>

<<Tester NAME>>
<<JOB TITLE>>

[1] Level A - Independent Test lab with certified [ISO 9001] [ISO/IEC 17025] Quality System
Level B - Test lab [at least following ISO 9001] [with certified ISO 9001] [with certified ISO/IEC 17025]

Applicable Server Test Procedures from the UCA International Users Group Edition 2 Amendment 1 Server Test Procedures version 1.1

Conformance Block	Mandatory	Conditional
1a: Basic Exchange	sAss1, sAss2, sAss3, sAss4, sAssN2, sAssN3, sAssN4, sAssN5, sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrv8, sSrvN1abcdf, sSrvN4	sAss5, sAssN6, sAssN7, sSrv6, sSrv9, sSrv10, sSrv11, sSrv12, sSrv13, sSrv15 sSrvN1e, sSrvN2, sSrvN3
1b: Associate with IPv6	sAss61, sAss62, sAss63, sAss64, sAss66, sAss6N2, sAss6N3, sAss6N4, sAss6N5	sAss65, sAss6N6, sAss6N7
2: Data Sets	sDs1, sDs10a, sDsN1ae	sDs10b, sDs15, sDsN1b, sDsN13
2+: Data Set Definition	sDs2, sDs3, sDs4, sDs5, sDs6, sDs7, sDs8, sDs9, sDs13, sDs14, sDsN1cd, sDsN2, sDsN3, sDsN4, sDsN5, sDsN6, sDsN7, sDsN8, sDsN9, sDsN10	sDs11, sDs12, sDsN11, sDsN12
3: Substitution	sSub1, sSub2, sSub3	
4: Setting Group Selection	sSg1, sSg3, sSgN1	sSg11
4+: Setting Group Definition	sSg2, sSg4, sSg6, sSg7, sSg8, sSg10, sSg12, sSgN2, sSgN3, sSgN4, sSgN5	sSg5, sSg9
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp16, sRp23, sRpN1, sRpN2, sRpN3, sRpN4, sRpN5, sRpN7, sRpN8, sRpN9	sRp6, sRp7, sRp8, sRp10, sRp11, sRp12, sRp13, sRp15, sRp17
6: Buffered Reporting	sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr16, sBr20, sBr21, sBr22, sBr23, sBr24, sBr25, sBr26, sBr27, sBr28, sBr29, sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN7, sBrN8, sBrN9, sBrN10	sBr6, sBr7, sBr8, sBr10, sBr11, sBr12, sBr13, sBr15, sBr17
7: Logging	sLog2, sLog3, sLog4, sLog5, sLog6, sLog7, sLog8, sLog9, sLog11, sLog12, sLog13, sLogN1, sLogN2	sLog10
9a: GOOSE publish	sGop2a, sGop3, sGop4, sGop9, sGop10, sGop11, sGop12	sGop1, sGop2b, sGop5, sGop6, sGopN1, sGopN2
9b: GOOSE subscribe	sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGos8, sGos9, sGos10, sGos11, sGos12, sGos14, sGos15, sGos20, sGos21, sGos22, sGos23, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6, sGosN7	sGos4, sGos6b, sGos13
9c: GOOSE mngt	sGom1, sGom2, sGomN1	
11a: Sampled Values publish	sSvp1, sSvp2, sSvp3, sSvp4, sSvp5, sSvp6, sSvp7, sSvp8, sSvp12, sSvp14	sSvp9, sSvp10, sSvp11, sSvp13, sSvp15, sSvp16, sSvp17, sSvp20, sSvp21, sSvp22, sSvp23
11b: Sampled Values subscribe	sSvs1, sSvs2, sSvs3, sSvs4, sSvs5, sSvs6, sSvs7, sSvs8, sSvs9, sSvs10, sSvs11, sSvs14, sSvs15, sSvsN1, sSvsN3, sSvsN4, sSvsN5, sSvsN6	sSvs12, sSvs13, sSvsN2
12a Direct control	sCtl5, sCtl10, sDOns1, sDOns2	sCtl2, sCtl3, sCtl7, sCtl13, sCtl15, sCtl16, sCtl17, sCtl18, sCtl21, sCtl23, sCtl24, sCtl28, sDOns4, sDOns5
12b SBO control	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOns1, sSBOns2, sSBOns6	sCtl2, sCtl3, sCtl4, sCtl6, sCtl7, sCtl15, sCtl16, sCtl17, sCtl18, sCtl20, sCtl21, sCtl23, sCtl24, sCtl27, sCtl28, sSBOns4, SBOns5, sSBOns7
12c Enhanced Direct Control	sCtl5, sCtl10, sDOes1, sDOes2	sCtl2, sCtl3, sCtl7, sCtl13, sCtl14, sCtl15, sCtl16, sCtl17, sCtl18, sCtl21, sCtl23, sCtl24, sCtl26, sCtl28, sDOes4, sDOes5
12d Enhanced SBO control	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOes1, sSBOes2, sSBOes6, sSBOes8	sCtl2, sCtl3, sCtl4, sCtl6, sCtl7, sCtl15, sCtl16, sCtl17, sCtl18, sCtl20, sCtl21, sCtl23, sCtl24, sCtl26, sCtl28, sSBOes4, sSBOes5, sSBOes7
13a Time sync SNTP	sTm1, sTm2, sTm7, sTmN1	sTm3, sTm4, sTm5, sTmN2
13b Time sync PTP	sTmP1, sTmP2, sTmPN1	sTmP5
14 File transfer	sFt1, sFt2ab, sFt4, sFt5, sFtN1ab	sFt2c, sFt3, sFtN1c
15 Service tracking		sTrk1, sTrk2, sTrk3, sTrk4, sTrk5, sTrk6, sTrk7, sTrk8, sTrk9, sTrk10, sTrk11,

Conformance Block	Mandatory	Conditional
		sTrk12, sTrk13, sTrk14, sTrk15, sTrk16, sTrk17

[All configuration file and data model tests have been successfully performed for the product variants using the same communication hardware and software version:

- << ID and NAME of variant 1>>
- << ID and NAME of variant N>>]

Test case	Limitations

Instructions not to be included in the actual certificate

For applicable conditional/mandatory tests that have a test tool limitation and the test result did not fail the result has to be set to “inconclusive” and the limitation specified. If none leave it blank.