VERIFICATION REPORT

IEC 61850 Edition 2 server conformance test of SEL-851

Schweitzer Engineering Laboratories, Inc

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Report title:	IEC 61850 Edition 2 server conformance test of SEL-851	DNV Netherlands B.V.
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Objective:

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

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Keywords:

IEC 61850, Conformance, Test

Reference to part of this verification report which may lead to misinterpretation is not permissible. The Rules and regulations for an Attestation of Conformity or a Certificate based on testing of communication interfaces performed by DNV, April 2021 is applicable to this verification report.

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	2023-08-29	First issue	P. Pourebrahim	R. Schimmel	G. Akse
1	2023-09-03	Updated after external review	P. Pourebrahim	R. Schimmel	G. Akse
2	2023-09-07	Updated after internal review	P. Pourebrahim	R. Schimmel	G. Akse

This revision replaces previous revision(s).

Table of contents

1 INTRODUCTION

1.1 Identifications

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

DUT	SEL-851 Feeder Protection Relay Firmware version: SEL-851-R100-V2 IEC 61850 library ID: 12417EA8 S/N: 3231985545
MANUFACTURER	Schweitzer Engineering Laboratories, Inc. 2350 NE Hopkins Court Pullman, WA 99163-5603 USA
PICS	Protocol Implementation Conformance Statement for the IEC 61850 interface in SEL-851, Version 1
MICS	Model Implementation Conformance Statement (MICS) for the IEC 61850 Edition 2 server interface in SEL-851, Version 1
TICS	TISSUES Implementation Conformance Statement for the IEC 61850 interface in SEL-851, Version 2.1
PIXIT	Protocol Implementation eXtra Information for Testing (PIXIT) for the IEC 61850 Edition 2 server interface in SEL-851, Version 1
ICD	0851 006.ICD
SCD	SEL851_ConformanceTest_FirmwareV2.scd SEL_851_1.CID, SEL_851_DOes.CID, SEL_851_SBOes.CID, SEL_851_1_GoCB_sCfn52.CID
TEST INITIATOR	Schweitzer Engineering Laboratories, Inc
TEST FACILITY	DNV Netherlands B.V. Protocol Competence & Test Center Utrechtseweg 310-B50, Arnhem, The Netherlands Accredited as independent Level A test lab by the UCAIug
TEST ENGINEER	Parya Pourebrahim parya.pourebrahim@dnv.com
TEST SESSION	08-2023 Arnhem, Netherlands
CLIENT SIMULATOR	UniGrid SA Simulator version 2.2 with test suite 20230820
ANALYSER	UniCA 61850 Analyzer 6.40.05
EQUIPMENT SIMULATOR	Omicron ISIO-200
TIME MASTER	DNVGL_SNTP.exe

1.2 Background

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 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 described procedures and test results are the basis for the DNV Attestation of Conformity and the UCAIug Level A certificate.

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 and the conclusion(s).

Annex A specifies the detailed test procedures and their outcome.

1.5 Glossary

DUT	Device Under Test
ICD	IED configuration description 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
SCD	System configuration description in SCL-format
SCL	System Configuration Language
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.*

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.*

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

IEC 61850-7-2, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI); Edition 2.0; 2010-08.*

IEC 61850-7-3, *Communication networks and systems for power utility automation – Part 7-3: Basic communication structure – Common data classes; Edition 2.0; 2010-12.*

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.*

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.*

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

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 Interface Revision 2.0.6, April 2022.

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.

http://iec61850.tissue-db.com/

Name space definition (nsd) code components related to IEC 61850 7-2, 7-3, 7-4 and 8-1 version 2007A3 and the SCL schema 2009 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
- CLIENT SIMULATOR
- ANALYSER
- EQUIPMENT SIMULATOR
- Ethernet switch
- Time master

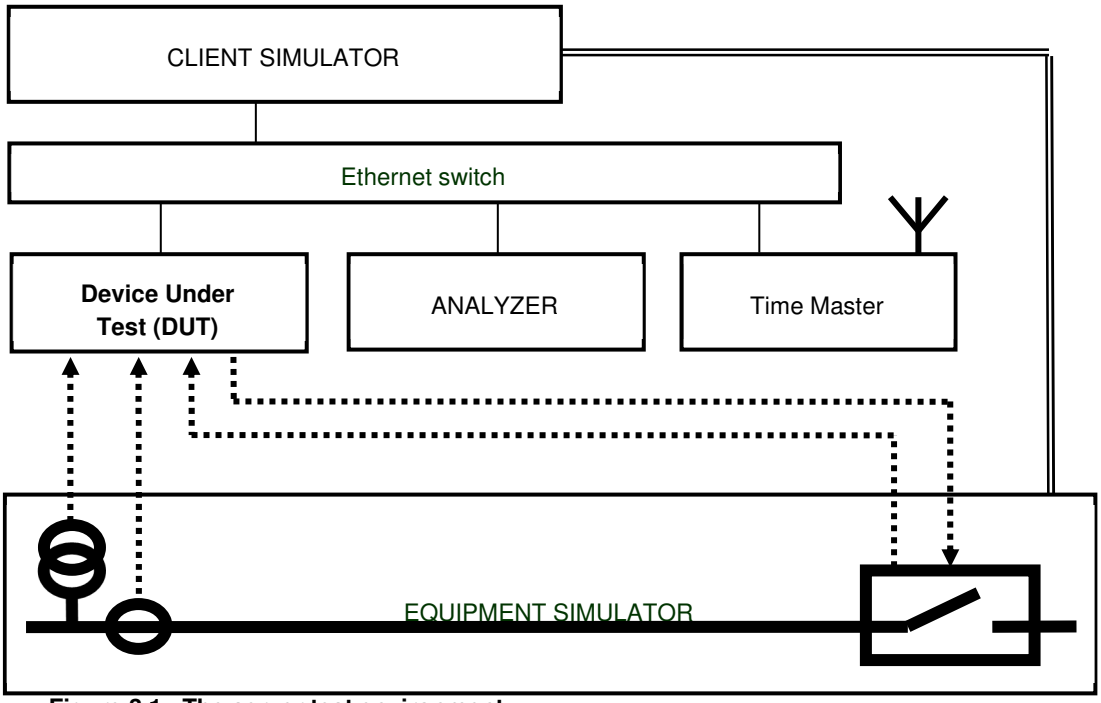

Figure 3.1 The server test environment

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 and IEC 61850-8-1)
    - Application association
    - Server & Logical Device & Logical Node & Data
    - Data set
    - Service tracking
    - Substitution
    - Setting group
    - Reporting
    - Logging
    - Generic object oriented substation events
    - 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.

4 TEST RESULTS

Table 4.1 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. The Mandatory column indicates the mandatory test cases and the Conditional column indicates the same for the conditional test cases.

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

Conformance Block	Mandatory	Conditional
1: Basic Exchange	sAss1, sAss2, sAss3, sAss4, sAssN2, sAssN3, sAssN4, sAssN5, sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrv8, sSrvN1abcdf, sSrvN4	sAssN6, sSrv9, sSrv10, sSrv12, sSrv13
2: Data Sets	sDs1, sDs10a, sDsN1ae	sDs15
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp16, sRpN1, sRpN2, sRpN3, sRpN4, sRpN8	sRp8, sRp10, sRp11, sRp12, sRp15
6: Buffered Reporting	sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr16, sBr20, sBr21, sBr22, sBr25, sBr26, sBr27, sBr28, sBr29, sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN8	sBr8, sBr10, sBr11, sBr12, sBr15
9a: GOOSE publish	sGop2a, sGop3, sGop4, sGop9, sGop10, sGop11, sGop12	sGop1, sGop5, sGopN2
9b: GOOSE subscribe	sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGos8, sGos9, sGos10, sGos11, sGos12, sGos23, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6	sGos4, sGos6b, sGos13
12a: Direct control	sCtl5, sCtl10, sDOns1, sDOns2	sCtl15, sCtl16
12c: Enhanced Direct Control	sCtl5, sCtl10, sDOes1, sDOes2	sCtl14, sCtl15, sCtl16s
12d: Enhanced SBO Control	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOes1, sSBOes2, sSBOes6, sSBOes8	sCtl4, sCtl6, sCtl15, sCtl16, sCtl26
13: Time sync	sTm1, sTm2, sTmN1	sTm3, sTm4, sTm5
14: File transfer	sFt1, sFt2ab, sFt4, sFt5, sFtN1ab	sFt3
15: Service tracking		sTrk1, sTrk2, sTrk8, sTrk9, sTrk11

5 CONCLUSIONS

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

5.1 Comments following from the test

The following comments apply for the *DUT*:

- sCnf61: URCB index=false and RptEna Max=7 is counted as 1 for: SCL - Services - ConfReportControl max

APPENDIX 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	☒ 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 non-standard Logical Nodes, Data Objects and enumerations	☒ 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
sDoc5	Check the ICD if the server capabilities in the IED “services” section(s) do correspond with the ACSI services specified in the PICS (compare TISSUE #901) 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 — S25 || S28 ReportSettings — S26 || S29 ConfLogControl — S30 LogSettings — S31 GOOSE — S35 Publisher GSESettings — S39 || S44 GSEDir — S36 || S37 SMVsc — S45 || S48 SMVSettings — S47 || S50 FileHandling — S57, S60, S61 ConfLNs — No condition in PICS Clientservices goose — S35 subscriber ClientServices supportsLdName — S35 subscriber ClientServices sv — S45 subscriber ClientServices TimeSyncProt — 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

A2 Configuration file (IEC 61850-6)

IEC 61850-6 clause 7 states: " An IED which is claimed to implement a server or client 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 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 theis 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 the SCD 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 using 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"	☒ 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	☒ Passed ☐ Failed ☐ Inconclusive

2.2 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 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	If IED/Services/DynAssociation is declared, 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)	☒ Passed ☐ Failed ☐ Inconclusive
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, and OSI-AE-Invoke 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 (TISSUE #1208 forbids Ipv6 in Ed2) Verify OSI-AP-Invoke and OSI-AE-Invoke 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). Addresss/P[type=VLAN-ID] present Addresss/P[type=PRIORITY] present Addresss/P[type=APPID] = 0000-3FFF or 8000-BFFF Condition: when GSE element is present	☒ Passed ☐ Failed ☐ Inconclusive ☐ Not applicable
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: Addresss/P[type=VLAN-ID] present Addresss/P[type=PRIORITY] present Addresss/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

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 and IED@originalSclRevision attributes match corresponding attributes of SCL element (SCL@version and SCL@revision)	☒ 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). See 61850-6 page 173. Condition: when DOI/SDI/DAI ix attribute is present	☐ Passed ☐ Failed ☐ Inconclusive ☒ Not applicable
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 GSEControl can be added to any 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 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) Note: URCB index is false and RptEna Max is 7 and counted as 1	☒ 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
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. For serviceType=SMV the ClientServices.sv=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 (TISSUE #823); 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	☒ 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	Verify for each DA element which does not contain the attribute “type” that a maximum of one of dchg/qchg/dupd attributes is true	☒ Passed ☐ Failed ☐ Inconclusive

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 LD/LLN0.NamPlt.ldNs, a <Val> element exists with a valid namespace referring to Edition 2: IEC 61850-7-4:2007 or IEC 61850-7-4:2007A	☒ 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, TISSUE 1223) 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

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

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 2007A.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
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	Not applicable
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 of each configurable data type and FC (FC can be DC, CF or SP) using the supplied configuration tool and check the updated online parameter/setting values correspond with the configured values in the SCL. The tested parameters are specified in the detailed test procedure. Condition when a parameter/setting is configurable	See detail

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 ☐ Not applicable
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 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

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, SCL 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 (only unbuffered)	y	2	FALSE

- The report control block attributes owner and resvTms do match with the SCL IED Services element owner and resvTms
- The setting group control block attribute resvTms does match with the SCL IED Services element SGEdit resvTms
- The presence of the optional GOOSE control block attributes minTime, maxTime, fixedOffs have no SCL IED Services elements

Test description

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

Comment

DUT has URCB indexed=false and RptEnabled max>1

sMdl8	Enumerated Data attribute values	☒ Passed ☐ Failed ☐ Inconclusive

IEC 61850-6 Subclause 9.5.6
IEC 61850-7-3 Annex D
IEC 61850-7-4 Annex H
TISSUE #686

Expected result

1. All ENC enumeration types are correctly defined. Not supported enum values are removed for controllable data objects with common data class ENC.
2. All values are in range, when failed attach a list

Test description

1. Verify that the enumeration types are defined according IEC 61850-7-3 Annex D, IEC 61850-7-4 Annex H and TISSUE #686. Not supported enum values shall not be included in the ICD file for controllable data objects with common data class ENC
2. Verify that preconfigured enumerated data attribute values from the device and SCL are in specified range.

Comment

sMdl9	Data model extensions	☒ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-1 Subclause 13.4.5, 14
TISSUE #828, #1468

Expected result

- Private LN shall have lnNs referring to a non-standard name space
- Private DO (not defined in the LN) in a standardized LN shall have a dataNs referring to a non-standard name space
- Standardized LN may re-use DO's from another standard LN. The DO may have a dataNs = IEC 61850-7-4:2007[A] or IEC 61850-7-4:2003 or private or absent
- Private DO in a private LN may have a dataNs referring to a non-standard name space
- Standardized DO in a private LN may have a dataNs = IEC 61850-7-4:2007[A] or IEC 61850-7-4:2003
- Private CDC are not allowed, private extensions in existing CDC are not allowed
- Private data attributes are not allowed
- Private ENUM values in a standardized ENUM type shall have a negative ord value
- Private ENUM types are only allowed for private DO
- Extensions to control blocks are not allowed
- Only standardized data types are allowed

Test description

Scan SCL file for extensions: private LN, private DO, private DA and private ENUMs. Browse DUT for extensions: control blocks

Comment

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

Data objects as specified in name space definition 2007A2
IEC 61850-7-1 Subclause 14.6, TISSUE #742, #1498, #1511
IEC 61850-7-1 Clause 22.2

Expected result

- Standardized DO's ending with a number do have presCond="Omulti" in the 2007A.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 2007A.nsd)
- Standardized DO's ending without a number don't have the presCond="Omulti" in the 2007A nsd (example Mod)

Test description
Scan SCL file for DO names

Comment

sMdl16	**Change configurable parameters/settings in the SCL and check the online data model has been updated accordingly**	☒ Passed ☐ Failed ☐ Inconclusive

Tested parameters/settings:

Change SEL_851_1CFG/LGOS2.TotDwnTm.db [CF] from 1000 to 100000 (Unsigned32)
Change SEL_851_1CFG/LGOS3.TotDwnTm.db [CF] from 1000 to 100000 (Unsigned32)
Change SEL_851_1CFG/LGOS4.TotDwnTm.db [CF] from 1000 to 100000 (Unsigned32)
Change SEL_851_1CFG/LGOS5.TotDwnTm.db [CF] from 1000 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.TotW.db [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.PPV.phsAB.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.PPV.phsBC.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.PPV.phsCA.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.PhV.res.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.A.neut.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.A.res.dbAng [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMSQI1.SeqA.c1.db [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMSTA1.AvAmps.db [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMDST1.DmdA.phsA.db [CF] from 100 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/RMSMMXU2.PPV.phsAB.db [CF] from 50 to 100000 (Unsigned32)
Change SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMHAI1.ThdA.phsA.db [CF] from 3000 to 100000 (Unsigned32)
Change DNVSIM/PMVGGIO1.AnIn01.db [CF] from 1000 to 100000 (Unsigned32)

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
1: Basic Exchange	Associate, Abort, Release GetServerDirectory(LD) GetLogicalDeviceDirectory GetLogicalNodeDirectory (DATA) GetDataValues GetDataDirectory/GetDataDefinition	GetAllDataValues SetDataValues
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
9a: GOOSE publish	SendGOOSEMessage (publish)	GetGoCBValues SetGoCBValues
9b: GOOSE subscribe	SendGOOSEMessage (subscribe)	
9c: GOOSE management	GetGoReference GetGOOSEElementNumber	
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

13: Time sync	TimeSynchronization	
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**
1: Basic Exchange	sAss1, sAss2, sAss3, sAss4, sAssN2, sAssN3, sAssN4, sAssN5 sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrv8, sSrvN1abcdf, sSrvN4	SCL-DynAssociation max > 1: sAssN6 PIXIT Sr1 declares more bits than validity: sSrv9 PIXIT Sr2 declares more bits than validity: sSrv10 PICS-SetDataValues: sSrv6, sSrvN1e, sSrvN3 SCL-Enum with FC=CF/DC/SP and valKind=Set: sSrvN2 SCL-blkEna: sSrv11 SCL-Mode off/blocked/test: sSrv12 SCL-GrRef: sSrv13 SCL-blkEna: sSrv14
2: Data Sets	sDs1, sDs10a, sDsN1ae	PICS-SetDataSetValues: sDs10b, sDsN1b, sDsN13 SCL-configurable datasets: sDs15
2+: Data Set Definition	sDs2, sDs3, sDs4, sDs5, sDs6, sDs7, sDs8, sDs9, sDs13, sDs14, sDsN1cd sDsN2, sDsN3, sDsN4, sDsN5 sDsN6, sDsN7, sDsN8, sDsN8, sDsN9, sDsN10,	SCL-Report.DatSet=dyn: sDsN11, sDsN12 SCL-maxAttributes: sDs11, sDs12
3: Substitution	sSub1, sSub2, sSub3	
4: Setting Group Selection	sSg1, sSg3, sSgN1	SCL-NumOfSg>1 or PICS-SgEditing: sSg11
4+: Setting Group Definition	sSg2, sSg4, sSg6, sSg7, sSg8, sSg10, sSg12, sSgN2, sSgN3, sSgN4, sSgN5	SCL-ResvTms: sSg5 SCL-NumOfSg>1: sSg9
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp16, sRpN1, sRpN2, sRpN3, sRpN4, sRpN8	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 SCL-URCB visible to all clients: sRpN5
6: Buffered Reporting	sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr16, sBr20, sBr21, sBr22, sBr25. sBr26, sBr27, sBr28, sBr29 sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN8	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 SCL-ResvTms: sBr23, sBr24

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-Fixed offset: sGop2b PIXIT-Simulation: sGop5 PICS-SetGoCBValues: sGop6, sGopN1 PIXIT-Dataset too large: sGopN2
9b: GOOSE subscribe	sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGos8, sGos9, sGos10, sGos11, sGos12, sGos23, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6	SCL-LGOS: sGos4 PIXIT-Simulation: sGos6b PIXIT-Gs12 No Security: sGos13
9c: GOOSE management	sGom1, sGom2, sGomN1	
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-Select on DO: sCtl13 SCL-Operate time: sCtl14 PIXIT-Behaviour=off: sCtl15 SCL-Loc: sCtl16 SCL-LocSta: sCtl17 SCL-CmdBlk: sCtl18 PIXIT-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 PIXIT-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 PIXIT-Operate-Many: sSBOes7
13: Time sync	sTm1, sTm2, sTmN1	PIXIT-COMTRADE: sTm3 SCL-LTIM: sTm4 SCL-LTMS: sTm5 PIXIT-ClockFailure: sTmN2
14: File transfer	sFt1, sFt2ab, sFt4, sFt5, sFtN1ab	PICS-SetFile: sFt3 PICS-DeleteFile: sFt2c, sFtN1c

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

Note that sAssN1, sSrv7, sCtl12, sCtl22, sRpN6, sRpN7, sBrN6, sBrN7, sLog1, sGop8, sDOns3, sSBOns3, sDOes3 and sSBOes3 are not applicable for IEC 61850-8-1 and not referenced in this table.

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

A4.1 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

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

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 Tested with 7 clients.		

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/IEC9506
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 step 1 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, 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 Data Objects with CDC CMV then nesting level must be >= 6

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

Expected result
2. DUT sends Association response+ for at least the maximum server associates as defined in the PIXIT 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

Tested with 7 clients.

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		

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 the SIMULATOR and DUT with the correct association and authentication parameters 2. Client 1 requests associations until they are refused 3. Client 1 aborts the last association 4. DUT issues keepalives on all associations 5. Client 2 requests association and send KEEP ALIVE messages 6. Client 2 requests a correct GetDataValues 7. Disconnect physical link between Client 2 and the switch, some seconds longer than the KEEPALIVE timeout 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		

A4.2 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 on-blocked the process data quality is valid (IEC 61850-7-4 Annex A, TISSUE #712)
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 oerpator using blkEna (deprecated)

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		
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		
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. a) DUT sends GetDataDirectory response+ b) DUT sends GetDataDefinition response+ c) DUT sends GetDataValues response+		
Test description 1. For each responded data object Client requests a: a) GetDataDirectory b) GetDataDefinition c) 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		

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)	☒ 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 instantaneous / dead banded value does match the forced change; for WYE, DEL, SEQ all SDO.t are identical
3. 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)
4. DUT sends GetDataValues Response+. Verify the range enum value changes from low-low, low, normal, high, high-high according to the rangeC limits
5. DUT sends GetDataValues Response+. Verify that the .f and .i value match the scaleFactor, offset and units.multiplier

Test description

1. Force EQUIPMENT SIMULATOR to change the measured value.
2. Client request GetDataValues
3. Force situation to set the following supported quality values for this measured value:
   - validity: good, invalid, questionable
   - detail: overflow, out of range, bad reference, failure, old data, inaccurate, inconsistent
   - source: process
4. When range is available change the measured value from min to max, Client request GetDataValues after each change
5. When both AnalogueValue.i and .f are available change the measured value, Client request GetDataValues after each change

Comment

PIXIT indicates that the following quality bits are supported: Good, Invalid, Failure
The following quality bits could be forced for the specified data object: Good, Invalid, Failure
The following object(s) was/were used for this test case:
- SEL_851_1_maximumLengthLogicalDeviceNameWithSixtyFourCharacteMET/METMMXU1.MX.A.phsA
range is not supported.
AnalogueValue.f is available

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

1. DUT sends GetDataValues Response+, status value matches the forced change.
2. 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:
   - validity: good, invalid, questionable
   - detail: oscillatory, failure, old data, inconsistent
   - 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: Good, Invalid, Failure
The following quality bits could be forced for the specified data object: Good, Invalid, Failure
The following object(s) was/were used for this test case: SEL_851_1CFG/LGOS1.ST.St

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
TISSUE #712, #1331

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 (TISSUE #712)
10. Mode and Behaviour values are updated, all quality bits are cleared in process data

Mod and 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 TISSUE #779, #672, #1128		
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: "@<LDinst>" or "<IEDname><LDinst>" and in the online datamodel: "<IEDname><LDinst>" or <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		

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 Part e) is not applicable		

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		

A4.3 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

Test case	Test case description
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+ 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		

sDs10	**GetDataSetValues, 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 a) The DUT returns the corresponding values for GetDataSetValues and GetDataValues b) Before the SetDataSetValues: The values returned by GetDataSetValues and GetDataValues correspond After the SetDataSetValues: The values returned by GetDataSetValues and GetDataValues correspond and contain the new values as set with SetDataSetValues and SetDataValues. Every service request results in a corresponding response+		
Test description a) Select or create a data set with read-only elements Client requests a GetDataSetValues Client requests a GetDataValues for each member of the dataset. b) Select or create a data set with writable elements Client requests a GetDataSetValues Client requests a GetDataValues for each member of the dataset. Client requests a SetDataSetValues with different values than received by GetDataValues Client requests a GetDataSetValues Client requests a SetDataValues for each member of the dataset with different values than received by GetDataSetValues Client request GetDataSetValues		

Comment
Only step a) is applicable and tested

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

Only parts a) and e) are applicable and tested because SetDataSetValues, CreateDataset and DeleteDataset services are not supported.

A4.4 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 1: 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 2: The object reference is ACSI (not MMS) see tissue 784: Object reference as defined in part 7-2 clause 11.3.2.

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 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 another BRCB trigger option and optional fields, enables the reporting and requests GI 3. Client 2 releases the association		
Comment Tested with URCB		

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 configures a 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 another URCB trigger option and optional fields, enables the reporting and requests GI 3. Client 2 releases the association		
Comment Tested with URCB		

sTrk8	Tracking of single point control	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1 TISSUE #784		
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 configures a URCB (if available) or a BRCB (if available) or a 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		

sTrk9	Tracking of double point control	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1 TISSUE #784		
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 configures a URCB (if available) or a BRCB (if available) or a 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 and SBOes configuaration		

sTrk11	Tracking of enumerated control	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.6.2 IEC 61850-8-1 TISSUE #784		
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 configures a URCB (if available) or a BRCB (if available) or a 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		

A4.7 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)
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)

Test case	Test case description
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	Events are no longer supporessed when db=0 (tissue #1565)

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)

Note: sRpN6 and sRpN7 are 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		
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 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, TISSUE #780, 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. Configure 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

Dupd report could not be triggered because there is no attribute in the datamodel that supports data update so it has been tested n service tracking part

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 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 configures the URCB RptID with an empty string
1. 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, the same report time stamp and EntryID, 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 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		

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 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 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 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 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 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 configures an available URCB using SetURCBValues with all optional fields, with a valid BufTm and with the trigger options: data-change and general-interrogation 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		

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 reptID		
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 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 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. 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: - MMXU.PhV - MMXU.A.phsA - MMXU.A.phsB.cVal - MMXU.A.phsC.cVal.mag - MMXU.A.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, TISSUE#1322		
Expected result 1. DUT sends SetURCBValues response+ and sends GI report 2. DUT sends SetURCBValues response+		
Test description 1. Client reserves, configures all supported "dyn" attributes, enables and triggers the GI in a single SetURCBValues request 2. Client disables the URCB		
Comment		

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. 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. 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 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

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 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

A4.8 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)
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	Events no longer suppressed when db=0 (tissue #1565)
	Specific to BRCB (leave a gap for future sRp test cases)
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 ResvTms = 0 a client can reserve the BRCB by writing a value and configure the BRCB On lost association, the reserved BRCB is released after the ResvTms number of seconds (ResvTms set to zero) On lost association, within ResvTms time none of other clients can reserve the BRCB except the one who did it originally (the client restores association)
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 only 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)

Note: sBrN6 and sBrN7 are 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+		
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 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, TISSUE #780, 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. 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
Data update and is tested with service tracking.

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 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 2. 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 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		

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 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 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 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 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 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 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		

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
1. DUT sends SetBRCBValues response+
2. DUT sends SetBRCBValues response+
7. DUT sends GI report with the same DatSet name and RptID value from step 5

Test description

1. 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. 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:
   - MMXU.PhV
   - MMXU.A.phsA
   - MMXU.A.phsB.cVal
   - MMXU.A.phsC.cVal.mag
   - MMXU.A.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, TISSUE #1322		
Expected result 1. DUT sends SetBRCBValues response+ and sends GI report 2. DUT sends SetBRCBValues response+		
Test description 1. Client reserves (when ResvTms is available), configures all supported “dyn” attributes, resyncs, purges, enables and triggers the GI in a single SetBRCBValues request 2. 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 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 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 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 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 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 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 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		

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 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 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 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 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 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

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 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 sets EntryID to last received EntryID
9. Client enables the BRCB
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	Only last GI report is transmitted	☒ Passed ☐ Failed ☐ Inconclusive

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

Expected result

4. DUT transmits at least one integrity report and 3 GI reports
6. DUT responds the EntryID of the last entry added to the buffer
7. DUT sends SetBRCBValues response+
8. DUT transmits the old and 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 configures a BRCB with all optional fields with the trigger options general-interrogation and integrity with a 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 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 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. 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 4. DUT does not send integrity reports		
Test description 1. Configure an available BRCB using SetBRCBValues with trigger option Integrity and integrity period 0 2. Wait one minute 3. Client sets the BRCB RptEna to True (without synchronizing the BRCB by setting the BRCB EntryID) 4. Wait one minute 5. 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 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 configures and enables an available BRCB 2. Client2 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 (if available) the ResvTms reached the value 0 and then enable TCP communication. E.g. connect the physical link 4. Client2 requests a SetBRCBValues of a “dyn” attribute		
Comment		

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 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		

A4.10a 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	Deprecated - 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	Deprecated - 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: sGop8 is 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
TISSUE #817

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

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
– 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
– 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) Force no data change. Wait for several variable offset GOOSE messages
b) Force no data change. Wait for several fixed offset GOOSE messages

Comment

Part b) is not applicable because fixed offset is not supported

sGop3	Initial GOOSE message	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.3.2.2 IEC 61850-8-1 Subclause 18.1 IEC 61850-10 Subclause 3.12 PIXIT: Gp7, As9 TISSUE #1238		
Expected result 2. DUT sends initial GOOSE message with stNum=1 and sqNum=0 or 1		
Test description 1. Enable GoCB when necessary 2. Restart the DUT and wait for initial GOOSE. Test equipment may be reconfigured and the GoCB enabled after restart		
Comment		

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		

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(allowed when none of the SCL Services GSESettings=Fix) or -it ignores parts of the new configuration(allowed when none of the SCL Services GSESettings=Fix) or -or it accepts the configuration (allowed when one of the SCL Services GSESettings=Fix) 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 GoCB without dataset is not accepted by the configuration.		

sGop10	GOOSE with data attributes (FCDA) and data objects (FCD)	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2 IEC 61850-8-1 Subclause 18.1 PIXIT-Gp8		
Expected result 1) DUT sends a GOOSE messages with data attributes 2) DUT sends a 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 message with data attributes (FCDA) If the DUT supports GOOSE datasets with at least one FCD (PIXIT): 2) Verify the DUT able to send GOOSE message with data objects (FCD)		
Comment Tested with FCDA and FCD.		

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		

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 DUT does not accept the configuration		

A4.10b GOOSE Subscribe

Abstract test cases

Test case	Test case description
sGos1	Send GOOSE messages with/without the VLAN tag 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 message with non-1 boolean “true” value
sGos9	Subscribe GOOSE message with “fixed length” GOOSE
sGos10	Subscribe GOOSE message with ldName
sGos11	Subscribe GOOSE message with private DO
sGos12	Process first GOOSE message after state change
sGos13	Subscribe GOOSE message with security bits and trailer
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

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)

As such the analyzer trace files contain the proof when the subscribed GOOSE messages are processed.

sGos1	**Subscribe GOOSE message**	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1: PIXIT: Gs8		
Expected result 1,2,3 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 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 with MAC-Address outside the recommended range, for example 03-BB-CC-DD-EE-FF		
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 behaves as specified in the PIXIT		
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		

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 TISSUE 1223		
Expected result 1. LGOS.St.stVal=TRUE, LGOS.LastStNum.stVal (when available), LGOS.ConfRevNum.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 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)	☒ 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 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
TISSUE #1151

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) DUT accepts GOOSE messages from Publisher 3, LGOS3.St=TRUE and oesn not change in following steps
   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 and continues to accept GOOSE messages from Publisher 3
   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

Below, Publisher 1 and Publisher 3 send same GOOSE differing only in Simulation bits. Publisher 3 sends different GOOSE messages. Publisher 1/2 are supervised by LGOS, publisher 3 is supervised by LGOS3.

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 GOOSE message

b) LPHD.Sim=TRUE
   5. Force the DUT to accept simulated GOOSE messages
   6. Publisher1 and Publisher 3 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

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, GoCBRef and GoID

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 0 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.stVal” structure or an integer value and a Boolean value. The pong dataset does not need to contain every ping attribute. When INS or ENS subscribe is supported 1. Publisher sends “fixed length” GOOSE with initial integer value 2. Publisher sends “fixed length” GOOSE with other integer value When INS or ENS subscribe is not supported 3. Publisher sends “fixed length” GOOSE with initial boolean value 4. Publisher sends “fixed length” GOOSE with other boolean value		
Comment		

sGos10	**Subscribe GOOSE message with ldName**	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 18.2.3 IEC 61850-8-1 Subclause 18.1 TISSUE #1419		
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 PIXIT: Gs12		
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 Security bits not zero, Reserved 2 bits not zero and several tailing non-zero bytes. 2. Publisher sends GOOSE messages with boolean “true” value with the same Reserved bits and tailing bytes		
Comment		

sGos23	Verify Processing of GOOSE data values with quality.test	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-4 Annex A PIXIT: Sr5, Gs13		
Expected result 2. And 5. DUT processes the data value flagged with quality test true as described in PIXIT (for instance: keep last non test value, substitute to configured value, ….) Other steps. DUT updates the value and sends a GOOSE message with 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) 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=test/blocked (when supported) 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		
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 2. DUT accepts GOOSE messages 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		
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 , 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		

A4.11 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 • direct with normal security (IEC 61850-7-2 Subclause 20.2.1) • SBO-control with normal security (IEC 61850-7-2 Subclause 20.2.2) • direct with enhanced security (IEC 61850-7-2 Subclause 20.3.2) • SBO-control with enhanced security (IEC 61850-7-2 Subclause 20.3.3) • 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
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 or on/blocked control requests are rejected with AddCause "Blocked-by-Mode" (IEC 61850-7-4 Annex A)
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"
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

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		
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		
Comment Part d) has been performed because the control model SBOns is not supported.		

sCtl5	Operate with test flag and test mode	☒ 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. Control commands are accepted and executed
3. Control commands are accepted and executed
4. Commands are not accepted with AddCause = blocked-by-mode
5. Control commands are accepted and executed
6. Control commands are accepted however output is not activated (blocked)
7. Commands are not accepted with AddCause = blocked-by-mode
8. 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 4 and 5
   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 and client sends correct Mod control command without test flag set (when supported)

b) Repeat steps 1 to 8 for SBOns
c) Repeat steps 1 to 8 for Does
d) Repeat steps 1 to 8 for SBOes

Comment

Parts a), c) and d) have been performed because the control model SBOns is not supported.

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

Part d) has been performed because the control models SBOns is not supported.

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

Comment
Part d) has been performed because the control model SBOns is not supported.

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
Parts a), c) and d) have been performed because the control mode SBOns is not supported.

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
PIXIT: Ct6

Expected result

b) SBOns:
1. DUT responds with Select response+
2. DUT responds with Select response-
3. DUT responds with Cancel response-
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

Part d) has been performed because the control model SBOns is not supported.

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

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 20.3.3 IEC 61850-7-4 page 122, Table A.2, TISSUE #712 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 Parts a), c) and d) have been performed because the control model SBOns is not supported.		

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, PIXT: Ct20, Ct21		
Expected result a) DUT sends Operate response- with optional AddCause “Blocked-by-switching-hierarchy” b) SBOns 1. DUT sends Select response- or Operate response- with optional AddCause “Blocked-by-switching-hierarchy” 3. DUT sends Select response+ 5. DUT sends Operate response- with optional AddCause “Blocked-by-switching-hierarchy” c) DUT sends Operate response- with AddCause “Blocked-by-switching-hierarchy”. d) SBOes 1. DUT sends SelectWithValue or Operate response- with AddCause “Blocked-by-switching-hierarchy” 3. DUT sends SelectWithValue response+ 5. DUT sends Operate response- with AddCause “Blocked-by-switching-hierarchy”		
Test description Test engineer sets the local/remote switch on the DUT to “Local” (LLN0.Loc=True or CSWI.Loc=True) a) Client sends DOns – Operate request b) SBOns 1. Client sends Select request, on respond+ Client sends Operate 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 within the select timeout c) Client sends DOes – Operate request d) SBOes 1. Client sends SelectWithValue request, on respond+ Client sends Operate 2. Test engineer sets the local/remote switch on the DUT to “Remote” 3. Client sends SelectWithValue request 4. Test engineer sets the local/remote switch on the DUT to “Local” 5. Client sends Operate request within the select timeout		
Comment Parts a), c) and d) have been performed because the control model SBOns is not supported.		

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 Part d) has been performed because the control model SBOns is not supported.		

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 Part d) has been performed because the control model SBOns is not supported.		

A4.11a 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

sDOns3 is not applicable for part 8-1 (compare TISSUE #783, part 8-1 does not support Authentication).

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		

A4.11c 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

sDOes3 is not applicable for part 8-1 (compare TISSUE #783, part 8-1 does not support Authentication).

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		
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 3. Or force EQUIPMENT SIMULATOR to keep the old state 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		

A4.11d 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

sSBOes3 is not applicable for part 8-1 (compare TISSUE #783, part 8-1 does not support Authentication).

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

sSBOes6	Incorrect SelectWithValue	☒ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6 and 20.8.4, 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 incorrect originator category		
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 4. Repeat step 1-3 for the other attributes in step 2		
Comment		

A4.12 Time synchronization

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 master supervision in logical node LTMS

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 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 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 master
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 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 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		

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 4. 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 master, the TmSrc value matches one of the TmSrcSetX values (when available) and the corresponding LTMS.TmChStX=TRUE (when available)
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 master and configure DUT with (at least) this time source
2. Client requests GetDataValues of the LTMS data objects
3. Disconnect the time master
4. Client requests GetDataValues of the LTMS data objects
5. Reconnect the time master
6. Client requests GetDataValues of the LTMS data objects

Comment

sTmN1	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. DUT updates the event 3. DUT sends GetDataValues response+ or Report/GOOSE with time quality “ClockNotSynchronized”		
Test description 1. Test engineer disconnects all time masters and waits specified period 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		

A4.13 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 respond contains moreFollows=T client request GetServerDirectory(FILE) with the continueAfter file specification 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 a DUT sends GetFile response+ for at least one file with received length >0 b DUT sends GetFileAttributeValues response+		
Test description For each responded file: a Client requests GetFile with correct File Name parameter b Client requests GetFileAttributeValues with correct File Name parameter		
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 Only specific settings files are allowed with SetFile. These settings file have specific names and contents.		

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)		
Test description 1. Client1 requests GetFile 2. Client2 requests GetFile of the same file while the first 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 Parts a) and b) have been performed.		

ABOUT DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimizing the performance of a wind farm, analyzing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.