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Conformance test report of the IEC 61850 communication interface in <DUT>

Revision 1.1

On request of the UCA International Users Group

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Revision	Changed test procedures	New test procedures
Rev 0.1	-	-
Rev 0.2	SrvN1 DsetN1	Setting group procedures Substitution procedures File transfer procedures Time synch procedures
Rev 0.3	Resolved comments	Split and restructured GSE abstract test cases in GOOSE and GSSE test cases and test procedures
Rev 0.4	Added table A.4 with test procedures per conformance block in Annex A Use conformance blocks in test result summary Added TISSUE references for: Mdl7, Cnf3, DsetN1, Srv6, SrvN4, Sg3, Rpt10, RptN6, RptN8, CtlN6, Ft1	GoNs6
Rev 1.0 22dec2004	Removed Ass2 (part 10 FDIS) Updated Gop2, GoNs6, Ctl2 Copy right statement changed Updated table A.4	Rpt8 inserted (part 10 FDIS) Rpt13 Split the GOOSE management test cases: GoPm1 (former Gop5), GoNm1 (former GoNp1) Gop5, Gos3
Rev 1.1 11feb2005	Cnf2: also check predefined values Renamed Goose test procedures from GoNxy to GoxNy. Changed TBD to Future. Added table A4.1 with ACSI services per conformance block Updated table A4.2 with mandatory test procedures per conformance block	Split reporting (Rpt) test procedures in buffered (Br) and unbuffered (Rp) procedures. Ctl7 check conditions. Split former Sg3 in Sg3 and Sg4 Split former SgN1 in SgN1 and SgN2
Rev 1.1(*) 30Mar2005	Rp2: removed the not applicable buffer overflow and entryID optional fields	

Remark: the detailed change history is not part of this report but is archived by KEMA.

(*) editorial change only, revision number not updated

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1 INTRODUCTION

1.1 Identifications

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

DUT	<complete description of the device under test, type, hardware / software version>
MANUFACTURER	<name, location of the manufacturer of the DUT>
PICS	<complete reference description of the PICS>
MICS	<complete reference description of the MICS>
PIXIT	<complete reference description of the PIXIT>
ICD	<complete reference description of the ICD configuration file>
SCD	<complete reference description of the SCD configuration file>
TEST INITIATOR	<the initiator of the test, name, address, contact person>
TEST FACILITY	<test facility name> <accredited/recognized to issue Level A/B/C Certificates>
TEST ENGINEER	<name and e-mail address of test engineer>
TEST SESSION	<date and location(s) of the test session>
SIMULATOR	<name and type conformance test simulator version X.Y with reference test suite, version X.Y and Test parameters file>
ANALYSER	<name and type analyzer, version X.Y>
EQUIPMENT SIMULATOR	<name and type equipment simulator>
TIME MASTER	<name and type of time master>

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

1.2 Background

<OPTIONAL, short description on the environment where the *DUT* will be used>

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

"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?"

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 UCA IUG Quality Assurance Program. *TEST FACILITY* is accredited/recognized by the UCA IUG to perform formal UCA conformance tests and issue the Level A/B/C UCA certificate, by accreditation no …….

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 implementation in the *DUT*.

The test results are the basis of the conformance statement.

1.4 Contents of this document

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

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

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

Appendix A specifies the detailed test procedures and their outcome, appendix B contains detailed comments on test results, for instance when a defect is detected, including the actual message flow if appropriate.

1.5 Glossary

DUT	Device Under Test
ICD	IED configuration description in SCL-format
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
UCA IUG	UCA International Users Group

2 REFERENCES

2.1 Normative

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

IEC/TR 61850-1, *Communication networks and systems in substations – Part 1: Introduction and overview; First edition 2003-04*

IEC/TS 61850-2, *Communication networks and systems in substations – Part 2: Glossary; First edition 2003-08*

IEC 61850-3, *Communication networks and systems in substations – Part 3: General requirements; First edition 2003-01.*

IEC 61850-4, *Communication networks and systems in substations – Part 4: System and project management; First edition 2003-01*

IEC 61850-5, *Communication networks and systems in substations – Part 5: Communication requirements for functions and device models; First edition 2003-07*

IEC 61850-6, *Communication networks and systems in substations – Part 6: Substation Automation System configuration language; First edition 2004-03*

IEC 61850-7-1, *Communication networks and systems in substations – Part 7-1: Basic communication structure for substation and feeder equipment – Principles and models; First edition 2003-07*

IEC 61850-7-2, *Communication networks and systems in substations – Part 7-2: Basic communication structure for substation and feeder equipment – Abstract communication service interface (ACSI); First edition 2003-05*

IEC 61850-7-3, *Communication networks and systems in substations – Part 7-3: Basic communication structure for substation and feeder equipment – Common data classes and attributes; First edition 2003-05*

IEC 61850-7-4, *Communication networks and systems in substations – Part 7-4: Basic communication structure for substation and feeder equipment – Compatible logical node and data object addressing; First edition 2003-05*

IEC 61850-8-1, *Communication networks and systems in substations – 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; First edition 2004-05*

IEC 61850-9-1, *Communication networks and systems in substations - Part 9-1: Specific Communication Service Mapping (SCSM) - Sampled values over serial unidirectional multidrop point to point link; First edition 2003-05*

IEC 61850-9-2, *Communication networks and systems in substations - Part 9-2: Specific Communication Service Mapping (SCSM) - Sampled values over ISO/IEC 8802-3; First edition 2004-04*

IEC 61850-10, *Communication networks and systems in substations – Part 10: Conformance testing; First edition 2005-xx*

2.2 **Other**

IS 9646 – OSI – Conformance testing methodology and framework

UCA International User Group: Quality Assurance Program, <version>, <date>.

UCA International User Group: Accreditation and Recognition Program for IEC 61850 Device Testing, version 0.2, August, 2004

IEC 61850 Clarified Comments, Part 6, Version 1.0, September 17, 2004
IEC 61850 Clarified Comments, Part 7-2, Version 1.0, September 13, 2004
IEC 61850 Clarified Comments, Part 7-3, Version 1.0, May 20, 2004
IEC 61850 Clarified Comments, Part 7-4, Version 1.0, May 20, 2004
IEC 61850 Clarified Comments, Part 8-1, Version 1.0, September 17, 2004
IEC 61850 Clarified Comments, Part 9-2, Version 1.0, July 12, 2004

3 THE CONFORMANCE TEST

3.1 Components in the test environment

The test environment consists of the following components:

- DUT
- SIMULATOR
- ANALYSER
- EQUIPMENT SIMULATOR
- Ethernet switching HUB
- SCL engineering tools
- Time master

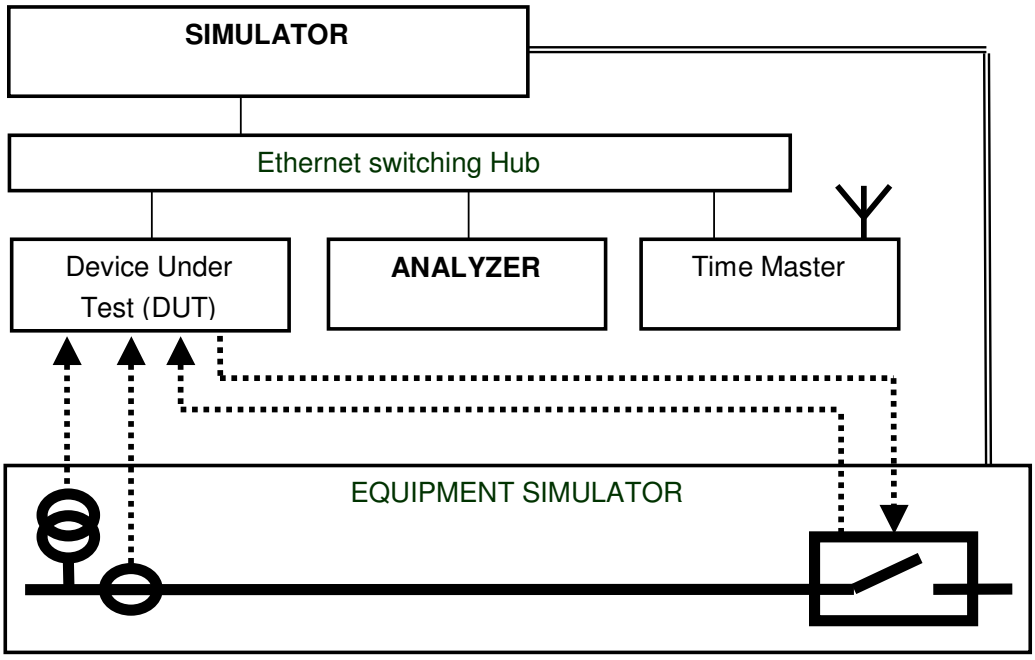

Figure 3.1 The test environment

3.2 Overview of the test suite

The server test cases are structured as follows:

- Documentation and version control (IEC 61850-4)
- Device performance (IEC 61850-5)
- 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, applicable SCSM)
    - Application association
    - Server & Logical Device & Logical Node & Data
    - Data set
    - Substitution
    - Setting group control
    - Reporting
    - Logging
    - Generic Substation events
    - Transmission of sampled values
    - Control
    - Time and time synchronization
    - File transfer
    - Combinations

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

4 TEST RESULTS

Table 4.1 in this Chapter gives a summary of the conformance test results. References shown in the table columns refer to references of individual test procedures in appendix A.

The **Failed** column indicates the test cases with test result failed. For details refer to the applicable test procedure in Appendix A.

The **Comment** column indicates the test cases with additional observations about the test case results. Some test procedures are partially tested and some could not be

tested at all due to limitations of the DUT or test environment. For details refer to the applicable test procedure in Appendix A.

The **Verdict** columns indicate the test result of all applicable test procedures in the test group. When one or more test procedures have test result Failed the test group receives verdict Failed.

Table 4.1 Summary of test results for *DUT*

Test Group	**Failed**	**Comment**	**Verdict**
Documentation			
Configuration			
Data model			
Conformance block			
1: Basic Exchange			
2: Data Set			
2+: Data Set Definition			
3: Substitution			
4: Setting Group Selection			
4+: Setting Group Definition			
5: Unbuffered Reporting			
6: Buffered Reporting			
7: Logging			
8a GSSE publish			
8b GSSE subscribe			
8c GSSE management			
9a GOOSE publish			
9b GOOSE subscribe			
9c GOOSE management			

Test Group	Failed	Comment	Verdict
10: Sampled values 9-1 pub/sub			
11: Sampled values 9-2 pub/sub			
12a Direct control			
12b SBO control			
12c Enhanced Direct Control			
12d Enhanced SBO control			
13 Time sync (client)			
14 File transfer			
Combinations / free testing			
TOTALS	**0**	**0**	

* N/A = Not Applicable

5 CONCLUSION AND RECOMMENDATIONS

Based on the test results described in this report, *TEST FACILITY* declares the tested IEC 61850 implementation in the *DUT* has **shown**/**not shown to be non-conforming** to IEC 61850, *PICS, MICS, PIXIT* and *ICD* for the *SCD* configuration.

5.1 Recommendations following from the test

The following recommendations apply for the *DUT*:

<Recommendations from *TEST FACILITY*>

ANNEX A – Detailed Test procedures and results

A1. Documentation and version control (IEC 61850-4)

Id	Test procedure	Verdict
Doc1	Check if the manufacturer PICS, MICS and PIXIT documentation and hardware/software versions of the DUT do match (part 4).	☐ Passed ☐ Failed ☐ Inconclusive

A2. Configuration file (IEC 61850-6)

Id	Test procedure	Verdict
Cnf1	Test if the ICD configuration file conforms to the SCL document type definition or schema (IEC 61850-6)	☐ Passed ☐ Failed ☐ Inconclusive
Cnf2	Check if the ICD configuration file corresponds with the actual data names, data types, pre-defined data values and services exposed by the DUT on the network. When more data or services are exposed, attach a list and set the test result to Passed. When less data or services are exposed the test result is Failed.	☐ Passed ☐ Failed ☐ Inconclusive
Cnf3	Change at least 5 end-user configurable parameters that are exposed by the DUT on the network in the SCD configuration file, configure the DUT using the SCD configuration file (using the supplied configuration tool) and check the updated configuration using online services corresponds with the updated SCD file. Restore the original SCD file and re-configure the DUT to its original state.	☐ Passed ☐ Failed ☐ Inconclusive

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

Id	Test procedure	Verdict
Mdl1	Verify presence of mandatory objects for each LN Passed when all objects/attributes are present, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl2	Verify presence of conditional presence true objects for each LN Passed when all objects/attributes are present, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl3	Verify non-presence of conditional presence false objects. Passed when these objects/attributes are not present, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl4	Verify data model mapping according to applicable SCSM concerning name length and object expansion Passed when mapping is according to applicable SCSM, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl5	Verify data model mapping according to applicable SCSM concerning organisation of functional components Passed when mapping is according to applicable SCSM, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl6	Verify data model mapping according to applicable SCSM concerning naming of control blocks and logs Passed when mapping is according to applicable SCSM, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive

Id	Test procedure	Verdict
Mdl7	Verify data type of all objects for each LN. Passed when data type of all objects/attributes do match with the IEC 61850-7-3, IEC 61850-7-4 and the applicable SCSM, when failed attach a list Data types should also match the Approved technical issues: - IEC 61850-7-2 Technical issue 7, 9 10, 11, 12, 14, 15 - IEC 61850-7-3 Technical issue 5 - IEC 61850-7-4 Technical issue 4, 7, 8 - IEC 61850-8-1 Technical issue 6	☐ Passed ☐ Failed ☐ Inconclusive
Mdl8	Verify data attribute values from the device are in specified range (this is a continuous effort during the whole conformance test) Passed when all values are in range, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive
Mdl9	Check if manufacturer specific data model extensions are implemented according to the extension rules in IEC 61850-7-4 Annex A. (only when extension are implemented) Passed when all extensions are implemented according to the rules, when failed attach a list	☐ Passed ☐ Failed ☐ Inconclusive

NOTE; the attached list should indicate the complete object reference, data type/common data class/data attribute type, M/O/Condition presence indication (from IEC 61850-7-3 and IEC 61850-7-4), attribute value and applicable error indication.

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

A4.1 Application association
A4.2 Server & Logical Device & Logical Node & Data
A4.3 Data set
A4.4 Substitution
A4.5 Setting group control
A4.6 Reporting
A4.7 Logging [FUTURE]
A4.8 Generic Substation events
A4.9 Transmission of sampled values [FUTURE]
A4.10 Control
A4.11 Time and time synchronization
A4.12 File transfer
A4.13 Combinations & Free testing

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 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	GetSGValues

Conformance Block	Mandatory	Optional
4+: Setting Group Definition	SelectEditSG GetSGValues SetSGValues ConfirmEditSGValues	
5: Unbuffered Reporting	Report GetURCBValues SetURCBValues	
6: Buffered Reporting	Report GetBRCBValues SetBRCBValues	
7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	SetLCBValues
8a: GSSE publish	SendGSSEMessage (publish)	GetGsCBValues SetGsCBValues
8b: GSSE subscribe	SendGSSEMessage (subscribe)	
8c: GSSE mngt	GetGsReference GetGSSEDataOffset	
9a: GOOSE publish	SendGOOSEMessage (publish)	GetGoCBValues SetGoCBValues
9b: GOOSE subscribe	SendGOOSEMessage (subscribe)	
9c: GOOSE mngt	GetGoReference GetGOOSEElementNumber	
10: Sampled values part 9-1 pub/sub	<no ACSI service associated>	
11: Sampled values part 9-2 pub/sub	SendUSVMessage or SendMSVMessage	GetxSVCBValues SetxSVCBValues
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	GetFile GetFileAttributeValues	SetFile DeleteFile

The following table specifies which test procedures are mandatory/conditional for each conformance block (defined in Quality Assurance Plan, QAP). Conditions refer to the SCL (IED - Services section), the PICS or PIXIT.

Table A.4.2: Test procedures per conformance block

Conformance Block	**Mandatory**	**Conditional**
1: Basic Exchange	Ass1– Ass3, AssN2–AssN5 Srv1 – Srv5, SrvN1abcd, SrvN4	Semantics: Srv9, Srv10 PICS-AlternateAccess: Srv8, SrvN1f PICS-SetDataValues: Srv6, Srv7, SrvN1e, SrvN2, SrvN3
2: Data Sets	Dset1, DsetN1ae, DsetN12	SCL-SetDataSetValues: Dset10, DsetN1b, DsetN16
2+: Data Set Definition (SCL-DynDataSet)	Dset2 – Dset9 DsetN1cd, DsetN2–DsetN15	
3: Substitution	Sub1, Sub2, SubN1	
4: Setting Group Selection (SCL-ConfSG)	Sg1, SgN1	PICS-GetSGValues: Sg4
4+: Setting Group Definition (SCL-SGEdit)	Sg2, Sg3, Sg4, Sg5 SgN2–SgN5	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7 RpN1-RpN4	PICS-Segmentation: Rp5 SCL-DynDatSet+DatSet: Rp6 PIXIT-URCB visible to all clients: RpN5 Unsupported options: RpN6
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9 BrN1 – BrN5	PICS-Segmentation: Br5 SCL-DynDatSet+DatSet: Br6 Unsupported options: BrN6
7: Logging	Will be defined in future release	
8a: GSSE publish	Will be defined in future release	
8b: GSSE subscribe	Will be defined in future release	
8c: GSSE mngt (SCL-GSEDir)	Will be defined in future release	
9a: GOOSE publish	Gop2 – Gop4, Gop7, Gop9	PICS-GetGoCBValues: Gop1 PIXIT-Test mode: Gop5

Conformance Block	Mandatory	Conditional
		PICS-SetGoCBValues: Gop6, Gop8, GopN1 Dataset to large: GopN2
9b: GOOSE subscribe	Gos1 – Gos3, GosN1 – GosN6	
9c: GOOSE mngt (SCL-GSEDir)	Gom1, GomN1	
10: Sampled values part 9-1 pub/sub	Will be defined in future release	
11: Sampled values part 9-2 pub/sub	Will be defined in future release	
12a Direct control	CltN3, CtlN8 DOns1, DOns3	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 SCL-TimerActivatedControl: Ctl4, DOns2, DOns4, DOns5 AddCauses: CtlN6
12b SBO control	Ctl3, CltN1, CltN2, CltN3, CltN4 SBOns1, SBOns2	PIXIT-Test mode: Ctl2SCL- PIXIT-Check: Ctl7 TimerActivatedControl: Ctl4, SBOns3, SBOns5 PIXIT-Operate-Many: SBOns4, SBOes5 AddCauses: CtlN6
12c Enhanced Direct Control	CltN3, CtlN8 DOes2, DOes5	PIXIT-Test mode: Ctl2SCL- PIXIT-Check: Ctl7 TimerActivatedControl: Ctl4, DOes1, DOes3, DOes4 AddCauses: CtlN6
12d Enhanced SBO control	Ctl3, CltN1, CltN2, CltN3, CltN4, CtlN9 SBOes1, SBOes2, SBOes3	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 SCL-TimerActivatedControl: Ctl4, SBOes4, SBOes5, SBOes7 PIXIT-Operate-Many: SBOes6, SBOes7 AddCauses: CtlN6
13 Time sync	Tm1, Tm2, TmN1	ClockFailure: TmN2

Conformance Block	Mandatory	Conditional
14 File transfer	Ft1, Ft2ab, FtN1ab	PICS-SetFile: Ft3 PICS-DeleteFile: Ft2c, FtN1c

Note that AssN1, Ctl5, Ctl6, CtlN5, CtlN7 are not applicable for part 8-1 and not referenced in this table, SrvN4 is already done by Srv6.

The following paragraphs describe for the abstract test cases and detailed test procedures. New test cases should be added at the end of the table. The revision history shows the history of new/changed test procedures.

A4.1 Application association

Abstract test cases

Ass1	Associate and release a TPAA association (IEC 61850-7-2 clause 7.4)
Ass2	Associate and client-abort TPAA association (IEC 61850-7-2 clause 7.4)
Ass3	Associate with maximum number of clients simultaneously (PIXIT)

AssN1	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 clause 7.4)
AssN2	Check that with incorrect association parameters at server or client the association fails (IEC 61850-7-2 clause 7.4, PIXIT)
AssN3	Set up maximum+1 associations, verify the last associate is refused
AssN4	Disconnect the communication interface, the DUT should detect link lost within a specified period
AssN5	Interrupt and restore the power supply, the DUT should accept an association request when ready

Detailed test procedures

Ass1	Associate and release a TPAA association	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2		
Expected result 2. DUT sends Associate Response+ 3. DUT sends Release Response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client request Associate 3. Client request Release 4. Repeat step 2 and 3 25 times		
Comment		

Ass2	Associate and client-abort TPAA association	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2		
Expected result 2. DUT sends Associate Response+ 3. DUT sends Abort Response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Client requests Abort 4. Repeat step 2 and 3 250 times		
Comment		

Ass3	Associate with maximum number of clients simultaneously	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4, IEC 61850-8-1 clause 10.2, PIXIT		
Expected result 2. DUT sends Associate Response+ for each client 3. DUT sends Abort Response+ for each client		
Test description 1. Configure the SIMULATOR 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 step 2 and 3 25 times		
Comment		

AssN1	Associate with incorrect authentication parameters	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2		
Expected result 2. DUT sends authentication failure Response-		
Test description 1. Configure the SIMULATOR and DUT with the correct association and incorrect authentication parameters 2. Client requests Associate 3. Repeat step 2 ten times		
Comment IEC 61850-8-1 does not support authentication		

AssN2	Associate with incorrect association parameters	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 7.4
IEC 61850-8-1 clause 10.2, PIXIT

Expected result

1. Client sends Associate Response+
2. Client 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 SIMULATOR and DUT with correct association and authentication parameters and request Associate
2. Client requests Release
3. Configure the SIMULATOR 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

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 + / +

AssN3	Associate with maximum+1 number of clients simultaneously	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4, IEC 61850-8-1 clause 10.2, PIXIT		
Expected result 2. DUT sends Associate Response+ for Client 1 to max and Response- for Client max+1 3. DUT sends Release Response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client 1 to max+1 requests Associate 3. Client 1 to max requests Release 4. Repeat step 2 and 3 25 times		
Comment		

AssN4	Detection of lost link	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4, IEC 61850-8-1 clause 10.2, PIXIT		
Expected result 2. DUT sends Associate Response+ 3. DUT sends GetDataValues Response+ 6. DUT sends GetDataValues Response-		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Client requests a correct GetDataValues 4. Disconnect the physical link some seconds longer than the KEEP ALIVE timeout specified in the PIXIT 5. Connect the physical link 6. Verify the DUT has lost the association by sending a correct GetDataValues request		
Comment		

AssN5	Power supply interrupt	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4, IEC 61850-8-1 clause 10.2, PIXIT		
Expected result 2. DUT sends Associate Response+ 4. The DUT sends Associate Response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Interrupt and restore the DUT power supply and wait till the DUT is initialised 4. Client requests Associate and DUT Response+		
Comment		

A4.2 Server & Logical Device & Logical Node & Data

Abstract test cases

Srv1	Request GetServerDirectory(LOGICAL-DEVICE) and check response (IEC 61850-7-2 clause 6.2.2)
Srv2	For each GetServerDirectory(LOGICAL-DEVICE) response issue a GetLogicalDeviceDirectory request and check response (IEC 61850-7-2 clause 8.2.1)
Srv3	For each GetLogicalDeviceDirectory response issue a GetLogicalNodeDirectory(DATA) request and check response (IEC 61850-7-2 clause 9.2.2)
Srv4	For each GetLogicalNodeDirectory(DATA) response issue a – GetDataDirectory request and check response (IEC 61850-7-2 clause 10.4.4) – GetDataDefinition request and check response (IEC 61850-7-2 clause 10.4.5) – GetDataValues request and check response (IEC 61850-7-2 clause 10.4.2)
Srv5	Issue one GetDataValues request with the maximum number of data values and check response
Srv6	For each write enabled DATA object issue a SetDataValues request and check response (IEC 61850-7-2 clause 10.4.2)
Srv7	Issue one SetDataValues request with the maximum number of data values and check response
Srv8	Request GetAllDataValues for each functional constraint and check response (IEC 61850-7-2 clause 9.2.3)
Srv9	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
Srv10	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)

SrvN1	Request following data services with wrong parameters (unknown object, name case mismatch, wrong logical device or wrong logical node) and verify response- service error – ServerDirectory(LOGICAL-DEVICE) (IEC 61850-7-2 clause 6.2.2) – GetLogicalDeviceDirectory (IEC 61850-7-2 clause 8.2.1) – GetLogicalNodeDirectory(DATA) (IEC 61850-7-2 clause 9.2.2) – GetAllDataValues (IEC 61850-7-2 clause 9.2.3) – GetDataValues (IEC 61850-7-2 clause 10.4.2) – SetDataValues (IEC 61850-7-2 clause 10.4.3) – GetDataDirectory (IEC 61850-7-2 clause 10.4.4)

	– GetDataDefinition (IEC 61850-7-2 clause 10.4.5)
SrvN2	Request SetDataValues of ENUMERATED data with out-of-range value and verify response-service error (IEC 61850-7-2 clause 10.4.2)
SrvN3	Request SetDataValues with mismatching data type (e.g. int-float) and verify response- service error (IEC 61850-7-2 clause 10.4.2)
SrvN4	Request SetDataValues for read-only data values and verify response- service error (IEC 61850-7-2 clause 10.4.2)

Detailed test procedures

Srv1	GetServerDirectory(LOGICAL-DEVICE)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 6.2.2 IEC 61850-8-1 clause 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 Srv2		
Comment		

Srv2	GetLogicalDeviceDirectory	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 8.2.1 IEC 61850-8-1 clause 11.1		
Expected result 1. DUT sends GetLogicalDeviceDirectory Response+ with a list of logical nodes		
Test description 1. For each responded logical device Client requests GetLogicalDeviceDirectory 2. Continue with Srv3		
Comment		

Srv3	GetLogicalNodeDirectory(DATA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1		
Expected result 1. DUT sends GetLogicalNodeDirectory(DATA) Response+ with a list of data		
Test description 1. For each responded logical node directory Client requests GetLogicalNodeDirectory(DATA) 2. Continue with Srv4		
Comment		

Srv4	GetDataDirectory, GetDataDefinition and GetDataValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.4, 10.4.5 and 10.4.2 IEC 61850-8-1 clause 13.2.3, 13.2.4 and 13.2.1		
Expected result 1. DUT sends GetDataDirectory Response+ 2. DUT sends GetDataDefinition Response+ 3. DUT sends GetDataValues Response+		
Test description For each responded data object Client requests a: 1. GetDataDirectory 2. GetDataDefinition 3. GetDataValues		
Comment		

Srv5	GetDataValues with multiple data and data hierarchy	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1		
Expected result 1. DUT sends GetDataValues Response+ with equal number of data values 2. DUT sends GetDataValues Response+ with requested data hierarchy		
Test description 1. Client requests one GetDataValues with multiple data objects 2. Client requests one GetDataValues of a data object for the supported data hierarchy level: – Logical node – Data – Data attribute – Data attribute type – Data attribute type attribute		
Comment Multiple? = 2? For all objects? in all logical nodes?		

Srv6	SetDataValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.3 IEC 61850-8-1 clause 13.2.2		
Expected result 1. DUT sends SetDataValues Response- for read-only data 2. DUT sends SetDataValues Response- for read-only data and Response+ for write enabled data (as specified in the standard, ICD or PIXIT) 4. and 6. the value does match		
Test description For each data object with functional constraint ST, MX, DC 1. Client sends a SetDataValue with the current value For each data object with functional constraint CF, SP, EX 2. Client sends a SetDataValue with the current value For the first write-enabled data object (if any) 3. Client sends a SetDataValue with a valid new value 4. Client sends a GetDataValue request and check the value does match 5. Client sends a SetDataValue with the original value 6. Client sends a GetDataValue request and check the value does match		
Comment		

Srv7	SetDataValues with multiple data objects	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.3 IEC 61850-8-1 clause 13.2.2		
Expected result 1. DUT sends SetDataValues Response+ and the data values do match 2. DUT sends GetDataValues Response+. Values match the values as set in step 1		
Test description 1. Client requests one SetDataValues with multiple data objects with new valid values 2. Client request one GetDataValues and check the data values do match		
Comment Multiple = 2, 10 , max??		

Srv8	GetAllDataValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.3 IEC 61850-8-1 clause 12.3.2		
Expected result 1. DUT sends GetAllDataValues Response+		
Test description 1. For each supported functional constraint the Client sends a GetAllDataValues request		
Comment		

Srv9	Semantic of measured value (MV)	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-3 clause 6.2, 6.3, 6.4, 6.5, 7.4.2, PIXIT

Expected result

1 to 4:

- The timestamp accuracy should match with the PICS time stamp accuracy
- The time stamp value should match the actual time (plausibility check)
- Default quality attribute value should be supplied when the functionality of the related quality attribute is not supported (PIXIT)
- When supported the scaling, range, units and dead band functionality should be supplied.

Test description

1. Force EQUIPMENT SIMULATOR to change the measured value, Client request GetDataValue and checks the instantaneous / dead banded value does match the forced change
2. Force situations to set specific quality bits, Client request GetDataValues and checks the quality does match the forced situation
    - validity: good, invalid, questionable
    - detail: overflow, out of range, bad reference, oscillatory, failure, old data, inaccurate, inconsistent
    - source: process or substituted
    - test
    - operator blocked
3. Change the scale, range and units and repeat step 1
4. Change the dead band and repeat step 1 and verify differences in the instantaneous and dead banded value

Comment

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

Scaling, range, units and dead band are supported <to be adjusted>.

Srv10	Semantic of single and double point status (SPS, DPS)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-3 clause 6.2, 7.3.2 and 7.3.3 PIXIT		
Expected result 1. DUT sends GetDataValue Response+, values matches the forced changes 2. The timestamp accuracy should match with the PICS time stamp accuracy. Default quality attribute value should 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 double point status value, Client request GetDataValue and checks the value does match the forced change 2. Force situations to set specific quality bits, Client request GetDataValues and checks the quality does match the forced situation - validity: good, invalid, questionable - detail: bad reference, oscillatory, failure, old data, inaccurate, inconsistent - source: process or substituted - test - operator blocked 3. For 1 and 2 verify the time stamp value and time stamp accuracy (PICS)		
Comment PIXIT indicates the following quality bits are supported: <to be completed> The following quality bits could be forced for the specified data object: <to be completed>		

SrvN1	LD/LN/Data services with incorrect parameters	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 6.2.2, 8.2.1, 9.2-3, 10.4.2-5
IEC 61850-8-1 clause 9.3, 12.3.1-2, 13.2.1-4

Expected result

1 to 4:
DUT sends Response+ with empty list

5 to 8
DUT sends Response- with applicable service error

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):
    a) GetLogicalDeviceDirectory
    b) GetLogicalNodeDirectory
    c) GetDataDirectory / GetDataDefinition (same for part 8-1)
    d) GetDataValues
    e) SetDataValues
    f) GetAllDataValues

Comment

SrvN2	SetDataValues with out-of-range ENUMERATED value	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1-4		
Expected result 1. DUT sends Response- with applicable service error		
Test description 1. Client sends a SetDataValues request of an ENUMERATED data object with an out-of-range value		
Comment Behaviour not specified in standard (PIXIT?)		

SrvN3	SetDataValues with mismatching data type	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1-4		
Expected result 1 to 4: DUT sends Response- with applicable service error		
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 Behaviour not specified in standard (PIXIT?)		

SrvN4	SetDataValues of read-only data objects	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1-4		
Expected result 1. DUT sends Response- with applicable service error		
Test description 1. Client sends a SetDataValues request with an read-only data object		
Comment Compare Srv6		

A4.3 Data set

Abstract test cases

Dset1	Request GetLogicalNodeDirectory(DATA-SET) and check response (IEC 61850-7-2 clause 9.2.2) For each response issue a – GetDataSetValues request and check response (IEC 61850-7-2 clause 11.3.2) – GetDataSetDirectory request and check response (IEC 61850-7-2 clause 11.3.6)
Dset2	Request a persistent CreateDataSet with one, maximum members and check response (IEC 61850-7-2 clause 11.3.4) and verify that the persistent data set is visible for another client
Dset3	Request a non-persistent CreateDataSet with one, maximum members and check response (IEC 61850-7-2 clause 11.3.4) and verify that the persistent data set is not visible for another client
Dset4	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
Dset5	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
Dset6	Create a non-persistent dataset, release/abort the association, associate again and check the dataset has been deleted (IEC 61850-7-2 clause 11.1)
Dset7	Create a persistent dataset, release/abort the association, associate again and check the dataset is still present (IEC 61850-7-2 clause 11.1)
Dset8	Create and delete a persistent data set several times and verify every data set can be created normally
Dset9	Create and delete a non-persistent data set several times and verify every data set can be created normally
Dset10	Verify SetDataSetValues / GetDataSetValues with GetDataValues and SetDataValues

DsetN1	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 clause 11.3.2) SetDataSetValues (IEC 61850-7-2 clause 11.3.3) CreateDataSet (IEC 61850-7-2 clause 11.3.4) DeleteDataSet (IEC 61850-7-2 clause 11.3.5) GetDataSetDirectory (IEC 61850-7-2 clause 11.3.6)
DsetN2	Create a persistent dataset with the same name twice, and verify response- service error
DsetN3	Create a non-persistent dataset with the same name twice, and verify response- service error
DsetN4	Create more than maximum number of persistent data sets and verify response- service error
DsetN5	Create more than maximum number of non-persistent datasets and verify response- service error
DsetN6	Create a persistent dataset with more than maximum number of members and verify response- service error
DsetN7	Create a non-persistent dataset with more than maximum number of members and verify response- service error
DsetN8	Create a persistent dataset with unknown member verify response- service error

DsetN9	Create a non-persistent dataset with unknown member verify response- service error
DsetN10	Create a persistent dataset with no members, and verify response- service error
DsetN11	Create a non-persistent dataset with no members, and verify response- service error
DsetN12	Delete a (pre-defined) non-deletable dataset, and verify response- service error
DsetN13	Delete a persistent dataset twice, and verify response- service error
DsetN14	Delete a non-persistent dataset twice, and verify response- service error
DsetN15	Delete a dataset referenced by a (report) control class, and verify response- service error (IEC 61850-7-2 clause 11.1)
DsetN16	Request SetDataSetValues with a dataset with one or more read-only members, and verify response- service error

Detailed test procedures

Dset1	GetLogicalNodeDirectory, GetDataSetDirectory, GetDataSetValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.3.2, 11.3.6 IEC 61850-8-1 clause 14.3, PIXIT		
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		

Dset2	Persistent data set, one and max no. of members and accessibility	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.4 IEC 61850-8-1 clause 12.3.1, 14.3.3, PICS, PIXIT		
Expected result 1. DUT sends CreateDataSet Response+ 2. DUT responds GetLogicalNodeDirectory(DATA-SET) Response+. The response includes the data set name to Client2 3. See result 1 and 2		
Test description 1. Client1 requests a persistent CreateDataSet with one member 2. Client2 requests GetLogicalNodeDirectory(DATA-SET) 3. Repeat step 1 and 2 but now with the maximum number of members		
Comment		

Dset3	Non-persistent data set, one and max no. of members and accessibility	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.4 IEC 61850-8-1 clause 12.3.1, 14.3.3, PICS, PIXIT		
Expected result 1. DUT sends CreateDataSet Response+ 2. DUT sends GetLogicalNodeDirectory(DATA-SET) Response+, but does not list the created data set in the response 3. See result 1 and 2		
Test description 1. Repeat Dset2 but now for a non-persistent data set		
Comment		

Dset4	Create and delete persistent data set with same name, one extra member, and re-ordered members	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.4, 11.3.5, 11.3.6
IEC 61850-8-1 clause 12.3.1, 14.3.3, 14.3.4, 14.3.5

Expected result

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

Test description

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

Comment

Dset5	Create and delete non-persistent data set with same name , one extra member, and re-ordered members	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.4, 11.3.5, 11.3.6 IEC 61850-8-1 clause 12.3.1, 14.3.3, 14.3.4, 14.3.5		
Expected result 1. See Dset4		
Test description 1. Repeat Dset4 but now with a non-persistent data set		
Comment		

Dset6	Deletion of non-persistent dataset after Release	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.2, 11.3.4, 11.3.5 IEC 61850-8-1 clause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. DUT sends a Response+ 2. DUT sends a Response+ 3. DUT sends a Response-. The data set is not available, it is deleted 4. See result 1, 2 and 3		
Test description 1. Client requests a non-persistent CreateDataSet with at least one member 2. Client requests Release and then Associate 3. Client requests a GetDataSetValues for the just created data set 4. Repeat step 1, 2 and 3 but in 2 use Abort instead of Release		
Comment		

Dset7	Non-deletion of persistent dataset after Release	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.2,11.3.4, 11.3.5 IEC 61850-8-1 clause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. DUT sends a Response+ 2. DUT sends a Response+ 3. DUT sends a Response+. The data set is available, it is not deleted 4. See result 1, 2 and 3		
Test description 1. Repeat Dset6 but now for a persistent data set		
Comment		

Dset8	Create and delete persistent data set several times	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4, 11.3.5 IEC 61850-8-1 clause 14.3.3, 14.3.4		
Expected result 1. DUT responds with a CreateDataSet Response+ 2. DUT responds with a DeleteDataSet Response+ 3. Every data set can be created and deleted without problems		
Test description 1. Client requests a persistent CreateDataSet with a number of members (at least two) 2. Client requests a DeleteDataSet on the just created data set 3. Repeat step 1 and 2 250 times		
Comment		

Dset9	Create and delete non-persistent data set several times	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4, 11.3.6 IEC 61850-8-1 clause 12.3.1, 14.3.3, 14.3.5		
Expected result 1. See Dset8		
Test description 1. Repeat Dset8 but now for a non-persistent data set		
Comment		

Dset10	GetDataSetValues, SetDataSetValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 11.1, 11.3.2,11.3.4, 11.3.5 IEC 61850-8-1 clause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
Expected result 1. DUT sends a CreateDataSet Response+ 2. 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. Every service request results in a corresponding Response+ 3. See result 2		
Test description 1. Client requests a CreateDataSet with a number of members (at least two) that are writeable 2. For this just created data set: – 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 GetDataValues for each member of the dataset. 3. Repeat step 2 but now use SetDataValues instead of SetDataSetValues to alter the values		
Comment		

DsetN1	DataSet services with illegal parameters	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.3.6

IEC 61850-8-1 clause 14.3.1, 14.3.2, 14.3.3, 14.3.4, 14.3.5, **Technical issue 8**

Expected result

For 1 to 10:

DUT responds with a Response-

For 9: DUT responds with Respond+, with NumberMatched = 0 and NumberDeleted = 0

Test description

Test 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 DataSetReference 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 DataSetReference is replaced by another, existing Logical Node in another Logical Device in the DUT

Test b) Repeat step 1 to 6 for SetDataSetValues

Test c) Repeat step 1 to 6 for CreateDataSet

Test d) Repeat step 1 to 6 for DeleteDataSet

Test e) Repeat step 1 to 6 for GetDataSetDirectory

Comment

4. Only if DUT contains more than one Logical Device
6. Only if DUT contains more than one Logical Device

DsetN2	Create a persistent dataset twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result 1. DUT sends a Response+, 2. DUT sends a Response-		
Test description 1. Client requests a CreateDataSet for a persistent data set with at least one member 2. Client requests the same CreateDataSet again		
Comment		

DsetN3	Create a non-persistent dataset twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result See DsetN2		
Test description 1. Repeat DsetN2 but now for a non-persistent data set		
Comment		

DsetN4	Create more than max no. of data sets, persistent	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS, PIXIT		
Expected result 1. The DUT responds with a CreateDataSet Response+ for every created data set 2. The DUT responds with a CreateDataSet Response-		
Test description 1. Client requests as many persistent CreateDataSet's as supported by the DUT 2. Client requests one more CreateDataSet		
Comment		

DsetN5	Create more than max no. of data sets, non-persistent	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS, PIXIT		
Expected result 1. See DsetN4		
Test description 1. Repeat DsetN4 with non-persistent datasets		
Comment		

DsetN6	Create persistent data set with more than max. no of data members	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS, PIXIT		
Expected result 1. The DUT responds with a CreateDataSet Response-		
Test description 1. Client requests a persistent CreateDataSet with the maximum number + 1 of data members as supported by the DUT		
Comment		

DsetN7	Create non-persistent data set with more than max. no of data members	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS, PIXIT		
Expected result 1. See DsetN6		
Test description 1. Repeat DsetN6 with non-persistent datasets		
Comment		

DsetN8	Create persistent data set with unknown data reference	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result 1. The DUT responds with a CreateDataSet Response-		
Test description 1. Client requests a persistent CreateDataSet with at least two data references of which one is unknown		
Comment		

DsetN9	Create non-persistent data set with unknown data reference	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result 1. See DsetN8		
Test description 1. Repeat DsetN8 but now for a non-persistent data set		
Comment		

DsetN10	Create persistent data set without data references	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result 1. The DUT responds with a CreateDataSet Response-		
Test description 1. Client requests a persistent CreateDataSet without data references		
Comment		

DsetN11	Create non-persistent data set without data references	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4 IEC 61850-8-1 clause 14.3.3, PICS		
Expected result 1. See DsetN10		
Test description 1. Repeat DsetN10 but now for a non-persistent data set		
Comment		

DsetN12	Delete a pre-configured data set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.5 IEC 61850-8-1 clause 14.3.4, PICS, MICS, PIXIT		
Expected result 1. The DUT sends a DeleteDataSet Response with Number deleted = 0		
Test description 1. Client requests a DeleteDataSet to delete a pre-configured, non-deletable data set		
Comment		

DsetN13	Delete a persistent data set twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4, 11.3.5 IEC 61850-8-1 clause 14.3.3, 14.3.4, PICS		
Expected result 1. DUT sends a CreateDataSet Response+ 2. DUT sends a Response with Number deleted = 1 3. DUT sends a Response with Number deleted = 0		
Test description 1. Client requests a persistent CreateDataSet 4. Client requests a DeleteDataSet for the created data set in step 1 5. Client requests the same DeleteDataSet		
Comment		

DsetN14	Delete a non-persistent data set twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4, 11.3.5 IEC 61850-8-1 clause 14.3.3, 14.3.4, PICS		
Expected result See DsetN13		
Test description 1. Repeat DsetN13 but now for a non-persistent data set		
Comment		

DsetN15	Delete referenced data set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.1, 11.3.4, 11.3.5, 14.2 IEC 61850-8-1 clause 14.3.3, 14.3.4, 17.2, PICS		
Expected result 1. DUT sends a CreateDataSet Response+ 3. DUT sends a DeleteDataSet Response with Number deleted = 0		
Test description 1. Client requests a persistent CreateDataSet. 2. Client configures and enables a (buffered or unbuffered) RCB with this data set 3. Client requests a DeleteDataSet on the data set created in step 1		
Comment		

DsetN16	SetDataSetValues on read-only data attribute	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 11.3.2, 11.3.4 IEC 61850-8-1 clause 14.3.1, 14.3.3, PICS, PIXIT		
Expected result 1. DUT sends a CreateDataSet Response+ 2. DUT sends a SetDataSetValues Response-		
Test description 1. Client requests a persistent CreateDataSet where one or more of the members of the data set is a read-only data attribute 2. Client requests a SetDataSetValues		
Comment		

A4.4 Substitution

Abstract test cases

Sub1	Disable subEna and set subVal, subMag, subCMag, subQ and verify the substituted values are not transmitted when subEna is disabled and are transmitted when subEna enabled (IEC 61850-7-2 clause 12)
Sub2	Verify that in case the association fails, the substituted values shall remain unchanged

SubN1	Verify setting subVal, subMag, subCMag, subQ and subID response- service error when subEna is already enabled (clause 12)

Detailed test procedures

Sub1	Transmission of substituted values	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues Response+ 3. DUT sends SetDataValues Response+ 4. DUT sends GetDataValues Response+ with substituted values 5. DUT sends SetDataValues Response+ 6. DUT sends GetDataValues Response+ with process values		
Test description 1. Client requests GetDataValues of ST/MX data value 2. Client requests SetDataValues of the SV data value attributes 3. Client requests SetDataValues to enable substitution 4. Client requests GetDataValues of ST/MX data value 5. Client requests SetDataValues to disable substitution 6. Client requests GetDataValues of ST/MX data value		
Comment		

Sub2	Transmission of substituted values on failed association	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues Response+ 3. DUT sends SetDataValues Response+ 4. DUT aborts association 5. DUT sends Associate response+ 6. DUT sends GetDataValues Response+ with substituted values 7. DUT sends SetDataValues Response+		
Test description 1. Client requests GetDataValues of ST/MX data value 2. Client requests SetDataValues of the SV data value attributes 3. Client requests SetDataValues to enable substitution 4. Client requests Abort 5. Client requests Associate 6. Client requests GetDataValues of ST/MX data value 7. Client requests SetDataValues to disable substitution		
Comment		

Sub3	Transmission of substituted values after reboot	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues Response+ 3. DUT sends SetDataValues Response+ 4. DUT reboots 5. DUT sends Associate response+ 6. DUT sends GetDataValues Response+ with substituted values 7. DUT sends SetDataValues Response+		
Test description 1. Client requests GetDataValues of ST/MX data value 2. Client requests SetDataValues of the SV data value attributes 3. Client requests SetDataValues to enable substitution 4. Test engineer reboots DUT 5. Client requests Associate 6. Client requests GetDataValues of ST/MX data value 7. Client requests SetDataValues to disable substitution		
Comment In 7-2 the behavior after reboot is not specified.		

SubN1	Substitute values when substation is already enabled	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 12 IEC 61850-8-1 clause 15		
Expected result 1. DUT sends GetDataValues response+ with process values 2. DUT sends SetDataValues Response+ 3. DUT sends SetDataValues Response+ 4. DUT sends SetDataValues Response- for all SV attributes 5. DUT sends SetDataValues Response+		
Test description 1. Client requests GetDataValues of ST/MX data value 2. Client requests SetDataValues of the SV data value attributes 3. Client requests SetDataValues to enable substitution 4. Client requests SetDataValues of all SV data value attributes 5. Client requests SetDataValues to disable substitution		
Comment		

A4.5 Setting group control

Abstract test cases

Sg1	Request GetLogicalNodeDirectory(SGCB) and check response+
Sg2	Verify the following setting group state machine path (IEC 61850-7-2 clause 13 figure 18); – SelectEditSGValues – Use SetSGValues [FC=SE] to change values – Use GetSGValues [FC=SE] to verify the new values – ConfirmEditSgValues
Sg3	Verify SelectActiveSG (IEC 61850-7-2 clause 13 figure 18); – SelectActiveSG of the first setting group – GetSGCBValues to verify active setting group – Repeat for all setting groups
Sg4	Verify GetSGValues [FC=SG] (IEC 61850-7-2 clause 13 figure 18); – SelectActiveSG of the first setting group – Use GetSGValues [FC=SG] to verify the values are of fist setting group – Repeat for all setting groups
Sg5	Verify that after loss of association the client can use SelectEditSG again to copy the values to the edit buffer (IEC 61850 7-2 clause 13.3.3.1)

SgN1	Request following setting group selection services with wrong parameters (out of range values, or non existent/null setting group) and verify response- service error – SelectActiveSG (IEC 61850-7-2 clause 13.3.2) – GetSGValues [FC=SG] (IEC 61850-7-2 clause 13.3.6) – GetSGCBValues (IEC 61850-7-2 clause 13.3.7)
SgN2	Request following setting group definition services with wrong parameters (out of range values, or non existent/null setting group) and verify response- service error – SelectEditSGValues (IEC 61850-7-2 clause 13.3.3) – SetSGValues (IEC 61850-7-2 clause 13.3.4) – ConfirmEditSgValues (IEC 61850-7-2 clause 13.3.5) – GetSGValues [FC=SE] (IEC 61850-7-2 clause 13.3.6)
SgN3	Request SetSGValues on an active setting group (FC=SG), verify response- service error
SgN4	Request SetSGValues (FC=SE) and then SelectEditSGValues another setting group, verify changes will be lost
SgN5	Request SelectEditSGValues of the first setting group, change one value and SelectEditSgValues of the second setting group without (ConfirmEditSgValues). Verify the response-

Detailed test procedures

Sg1	GetLogicalNodeDirectory(SGCB)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2 IEC 61850-8-1 clause 12.3.1		
Expected result 1. DUT sends GetLogicalNodeDirectory(SGCB) Response+ with a list of SGCB's 2. DUT sends GetSGCBValues Response+		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(SGCB) 2. For each SGCB Client requests GetSGCBValues()		
Comment		

Sg2	SelectEditSGValues, SetSGValues, ConfirmEditSGValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2		
Expected result 1. DUT sends SelectEditSGValues Response+ 7. DUT sends SetSGValues [FC=SE] Response+ 8. DUT sends GetSGValues [FC=SE] Response+ 9. DUT sends ConfirmEditSGValues Response+		
Test description 1. Client requests SelectEditSGValues 2. Client requests SetSGValues [FC=SE] to change all values in the group 3. Client requests GetSGValues [FC=SE] to verify the new values 4. Client requests ConfirmEditSGValues		
Comment		

Sg3	SelectActiveSG, GetSGCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.1, 16.2.5 PIXIT		
Expected result 1. DUT sends SelectActiveSG Response+ 2. DUT sends GetSGCBValues Response+		
Test description 1. Client requests SelectActiveSG of the first setting group 2. Client requests GetSGCBValues 3. repeat step 1 and 2 for other setting groups for this SGCB		
Comment		

Sg4	GetSGValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.1, 16.2.5 PIXIT		
Expected result 1. DUT sends SelectActiveSG Response+ 2. DUT sends GetSGValues [FC=SG] Response+		
Test description 1. Client requests SelectActiveSG of the first setting group 2. Client requests GetSGValues [FC=SG] to verify the values in the setting group 3. repeat step 1 and 2 for other setting groups for this SGCB		
Comment		

Sg5	SelectEditSG after lost association	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.3.3.1 IEC 61850-8-1 clause 16.2.2 PIXIT		
Expected result 1. DUT sends SelectEditSGValues Response+ 2. DUT sends SetSGValues [FC=SE] Response+ 3. DUT aborts the association 4. DUT send associate response+ 5. DUT sends SelectEditSGValues Response+ 6. DUT sends SetSGValues [FC=SE] Response+ 7. DUT sends ConfirmEditSGValues Response+		
Test description 1. Client requests SelectEditSGValues of the first setting group 2. Client requests SetSGValues [FC=SE] to change values 3. Clients aborts the association 4. Client requests associate 5. Client requests SelectEditSGValues of the first setting group 6. Client requests SetSGValues [FC=SE] to change values 7. Client requests ConfirmEditSGValues		
Comment		

SgN1	Setting group selection services with wrong parameters	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2., 13.3 IEC 61850-8-1 clause 16.2 PIXIT		
Expected result a) DUT sends SelectActiveSG Response- b) DUT sends GetSGValues Response- c) DUT sends GetSGCBValues Response-		
Test description a) Client requests SelectActiveSG with null / out-of-range setting group b) Client requests GetSGValues with FC=SG unknown object c) Client requests GetSGCBValues with unknown object		
Comment		

SgN2	Setting group definition services with wrong parameters	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2., 13.3 IEC 61850-8-1 clause 16.2 PIXIT		
Expected result a) DUT sends SelectEditSGValues Response- b) DUT sends SetSGValues Response- with applicable service error c) DUT sends ConfirmEditSGValues Response- d) DUT sends GetSGValues Response-		
Test description a) Client requests SelectEditSGValues with null / out-of-range setting group b) Client requests SetSGValues with unknown object / wrong datatype c) Client requests ConfirmEditSGValues with null / out-of-range setting group D) Client requests GetSGValues with FC=SE unknown object		
Comment		

SgN3	SetSGValues on active setting group	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.2 IEC 61850-8-1 clause 16.2.3		
Expected result 1. DUT sends SetSGValues Response-		
Test description 1. Client requests a valid SetSGValues [FC=SG]		
Comment		

SgN4	SetSGValues on selected setting group	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.3		
Expected result 1. DUT sends SetSGValues Response-		
Test description 1. Client requests a valid SetSGValues [FC=SE] without SelectEditSG		
Comment		

SgN5	SelectEditSGValues without confirmation	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.3, 13.3 IEC 61850-8-1 clause 16.2.1		
Expected result 1. DUT sends SelectEditSGValues Response+ 2. DUT sends GetSGValues [FC=SE] Response+ 3. DUT sends SetSGValues [FC=SE] Response+ 4. DUT sends GetSGValues [FC=SE] Response+ 5. DUT sends SelectEditSGValues Response+ 6. DUT sends GetSGValues [FC=SE] Response+, note that changes are lost		
Test description 1. Client requests SelectEditSGValues of the first setting group 2. Client requests GetSGValues [FC=SE] to read the original values 3. Client requests SetSGValues [FC=SE] to change all values in the group 4. Client requests GetSGValues [FC=SE] to verify the new values 5. Client requests SelectEditSGValues of the first setting group again 6. Client requests GetSGValues [FC=SE] to verify the original values		
Comment		

A4.6 Unbuffered Reporting

Abstract test cases

Rp1	Request GetLogicalNodeDirectory(URCB) and check response Request GetURCBValues of all responded URCB's
Rp2	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 clause 14.2.3.2.2.1), force/trigger a report and check the reports contain the enabled optional fields (7-1 clause 14.2.1)
Rp3	Verify the trigger conditions of a URCB - Configure and enable a URCB 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 (supported) trigger conditions: o on integrity o on update (dupd) o on update with integrity o on data change (dchg) o on data and quality change o on data and quality change with integrity period o on data and quality change with integrity period and BufTme (integrity reports should be transmitted immediately) – Verify the validity of the ReasonCode (IEC 61850-7-2 clause 14.2.3.2.2.9) – Verify that when more trigger conditions are met preferably only one report is generated (IEC 61850-7-2 clause 14.2.3.2.3.2) – Verify that reports are only sent when RptEna is set to True. (IEC 61850-7-2 clause 14.2.2.5), when reporting is disabled no reports should be transmitted
Rp4	General interrogation 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. (IEC 61850-7-2 clause 14.2.2.13)

Rp5	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 clause 14.2.3.3.2.2.5) – SeqNum (not changed) – SubSeqNum (0 for first report, incrementing, roll-over) – MoreSeqmentsFollow – TimeOfEntry (not changed as SeqNum is not altered) (IEC 61850-7-2 clause 14.2.3.2.2.9) 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 clause 14.2.3.2.3.5) 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 clause 14.2.3.2.3.4)
Rp6	Configuration revision (IEC 61850-7-2 clause 14.2.2.7) – 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: o deletion of a member of the data-set o re-ordering of members in the data-set ConfRev should never be 0 (zero). – Verify that after a restart of the server, the value of ConfRev remains unchanged (IEC 61850-7-2 clause 14.2.2.7) – Verify that configuration changes data sets due to processing of services are not allowed, changes to be taken into account for the ConfRev are those made by local means like system configuration (IEC 61850-7-2 clause 14.2.2.7. note 1)
Rp7	Buffer Time (IEC 61850-7-2 clause 14.2.2.9) – 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 clause 14.2.2.9) o 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 o 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 o may for analogue information substitute the current value in the pending report with the new one. – Configure Buffer Time to 1000 milliseconds and force a data value change of multiple dataset members within buffer time. Server should 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 clause 14.2.2.9) – Verify that the BufTm value can contain at least the value 3600000 (= one hour in milliseconds)

RpN1	Request GetURCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 clause 14.2.3.3.2)
RpN2	Configure reporting but omit setting one of the trigger options (dchg, qchg, dupd, integrity). When enabled only one report is transmitted (the GI). No reports should be send when generating events (IEC 61850-7-2 clause 14.2.3.2.2.9)

RpN3	Setting the integrity period to 0 with TrgOps = integrity will result in no integrity reports will be sent (IEC 61850-7-2 clause 14.2.2.12)
RpN4	Incorrect configuration of a URCB: configure when enabled, configure ConfRev and SqNum and configure with unknown data set
RpN5	Exclusive use of URCB and lost association Configure a URCB and set the Resv attribute and enable it. Verify another client can not set any attribute of that URCB (IEC 61850-7-2 clause 14.2.4.5)
RpN6	Configure unsupported URCB options (PIXIT); Configure unsupported trigger conditions, optional fields and related parameters

Detailed test procedures

Rp1	GetLogicalNodeDirectory(URCB) and GetURCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2 and 14.2.5.3 IEC 61850-8-1 clause 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 BRCB Client requests GetURCBValues()		
Comment		

Rp2	Reporting of optional fields for a URCB	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 14.2.2.8
IEC 61850-8-1 clause 17.1.1.1, 17.2.1, PIXIT

Expected result

1. DUT sends SetURCBValues Response+ for supported optional fields and Response- when one of the optional fields isn't supported
2. DUT sends SetURCBValues Response+
3. DUT sends a correct report according to trigger condition and IEC 61850-8-1 table 40 with all data set members for reason integrity and otherwise only the changed members. The configured and reported optional fields should match
   - the sequence number is incremented and starts with 0
   - the report time stamp is in UTC format and matches the trigger time
   - the reason for inclusion matches the trigger condition
   - the configured and reported data set name do match
   - the data-reference(s) match the data set member(s)
   - Configuration revision matches the configuration
   - When segmentation is set the report includes sub sequence number and more segments follow
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 (supported) optional fields:
   - sequence-number
   - report-time-stamp
   - reason-for-inclusion
   - data-set-name
   - data-reference
   - buffer-overflow
   - entryID
   - conf-rev
   - segmentation
2. Client enables the URCB (set RptEna to True)
3. Client waits for a report (trigger condition integrity) or EQUIPMENT SIMULATOR triggers a report (trigger condition data change)
5. Client disables the URCB (set RptEna to False)
6. Repeat step 1 to 5 for next combination of optional field

Rp2	Reporting of optional fields for a URCB	☐ Passed ☐ Failed ☐ Inconclusive
Comment PIXIT specifies the following optional fields are supported: <to be completed>		

Rp3	Trigger conditions for a URCB	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 14.2.2.11
IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 17.2.1, PIXIT

Expected result

1. DUT sends SetURCBValues Response+ for supported trigger conditions and Response- when one of the trigger conditions isn't supported
2. DUT sends SetURCBValues Response+
3. DUT sends a report according to trigger condition
   - integrity reports should be transmitted immediately at timeout
   - data change reports are transmitted immediately when BufTme=0
   - data change reports are transmitted after BufTme of first data change when BufTme>0
4. The configured and reported optional fields should match
6. DUT does not sends reports

Test description

1. Configure an available RCB using SetxRCBValues with all supported optional fields and one of the following (supported) trigger conditions:
   - on integrity
   - [on update (dupd)]
   - [on update with integrity]
   - on data and quality change
   - on data and quality change with integrity period
   - on data and quality change with integrity period and BufTm
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 within/outside BufTm
4. Verify the reports are only transmitted according to trigger condition
5. Client disables the RCB, set RptEna to False
6. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set within/outside BufTm
7. Repeat step 1 to 6 for next trigger condition combination

Comment

PIXIT specifies the following trigger conditions are supported:

- integrity
- data/quality change

Rp4	General interrogation URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.13 IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 17.2.1		
Expected result 3. DUT sends SetURCBValues() Response+ and then sends GI report 4. DUT sends GetURCBValues() Response+ with GI attribute not set		
Test description 1. Client configures an available URCB 2. Client enables the URCB 3. Client requests SetURCBValues() to set the GI report 4. Client requests GetURCBValues() 5. Client disables the URCB		
Comment		

Rpt5	Segmentation of reports URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.5 IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 17.2.1, PIXIT		
Expected result 3. The segmented report messages have same SqNum, Incremented SubSeqNum starting with 0 and more segments follow is set and same EntryTime		
Test description 1. Create or use a pre-configured data set which reported values do not fit in one MMS PDU 2. Client configures an available URCB with the data set, with at least the optional fields sequence-number, report timestamp and segmentation 3. Client enables the RCB and verify the segmentation of integrity reports 4. Client disables the RCB		
Comment		

Rp6	Configuration revision URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.7 IEC 61850-8-1 clause 17.2.1		
Expected result 2. DUT sends GetURCBValues() Response+ with ConfRev >0 6. The value of ConfRev is incremented		
Test description 1. Client configures a RCB to use a dynamic data-set 2. Client request GetxRCBValues() 3. Client configures the same RCB with an empty datSet 4. Client deletes the dynamic dataset and create a new data set with same name and re-ordered members or a deleted member 5. Client configures a RCB to use a dynamic data-set 6. Client request GetxRCBValues()		
Comment Test procedure mandatory when datSet of RCB is dynamic see ICD.		

Rpt7	Buffer time URCB	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 14.2.2.9
IEC 61850-8-1 clause 17.2.1, PIXIT

Expected result

3. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer
4. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer OR DUT substitutes the current value in the pending report with the new one
5. Each data change result in a report
6. DUT accepts BufTm value 3.600.000 (optional)

Test description

NOTE: this test case will take approx. 1 hour

1. Client configures an available URCB using SetURCBValues with a valid BufTm and all supported optional fields with the trigger conditions: on data and quality change and BufTme
2. Client enables the URCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces several data changes of one status data set members in the data set within BufTm
4. EQUIPMENT SIMULATOR forces several data changes of one analogue data set members in the data set within BufTm
5. Client disables the URCB, sets BufTm to zero and repeats step 2, 3 and 4
6. Client disables the URCB, sets BufTm to 3.600.000 and repeats step 2, 3 and 4 (optional)
7. Client disables the URCB

Comment

RpN1	Incorrect GetURCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.5.3 IEC 61850-8-1 clause 17.1.1.2		
Expected result 1. See SrvN1		
Test description 1. Repeat SrvN1 for a GetURCBvalues		
Comment		

RpN2	No trigger condition URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.2		
Expected result 1. DUT does not send reports when reporting is enabled and events are generated		
Test description 1. Repeat Rp3 with no trigger condition		
Comment		

RpN3	Integrity period zero URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.2		
Expected result 1. DUT does not send reports when reporting is enabled		
Test description 1. Repeat RptP5 with trigger condition “integrity” and IntgPd = 0		
Comment		

RpN4	Incorrect configuration of URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.1.1.2		
Expected result 2. DUT sends SetURCBValues() Response- 4. DUT sends SetURCBValues() Response- 5. DUT sends SetURCBValues() Response- 6. DUT sends SetURCBValues() Response-		
Test description 1. Client configures and enables an available URCB 7. Client requests SetURCBValues() with one of the following attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd, PurgeBuf, EntryID 4. Client disables the URCB 5. Client requests SetURCBValues() with one of the following attributes ConfRev, SqNum, TimeOfEntry 6. Client requests SetURCBValues() with unknown DatSet		
Comment		

RpN5	Exclusive use of URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.2, **Technical issue 6**		
Expected result 2. DUT sends SetURCBValues() Response- 4. DUT sends SetURCBValues() Response+ 8. DUT sends SetURCBValues() Response+		
Test description 1. Client1 reserves an available URCB 2. Client2 configures the same URCB by requesting SetURCBValues() with one of the following attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd 3. Client1 resets the reservation of the URCB 4. Client2 reserves and configures of the URCB 5. Client2 resets the reservation of the URCB 6. Client1 reserves the URCB 7. Client1 aborts and re-establishes the association 8. Client1 configures the URCB 9. Client1 resets the reservation of the URCB		
Comment		

RpN6	Configure unsupported URCB options	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.2		
Expected result 1 to 3: DUT sends SetURCBValues() Response-		
Test description 1. Client requests SetURCBValues() with one of the unsupported optional fields 2. Client requests SetURCBValues() with one of the unsupported trigger conditions 3. Client requests SetURCBValues() with one of the URCB parameters		
Comment PIXIT specifies that the following optional fields are not supported: <to be completed> PIXIT specifies that the following trigger conditions are not supported: <to be completed> PIXIT specifies that the following RCB parameters are not supported: <to be completed>		

A4.7 Buffered Reporting

Abstract test cases

Br1	Request GetLogicalNodeDirectory(BRCB) and check response Request GetBRCBValues of all responded BRCB's
Br2	Verify the reporting of optional fields of a BRCB Configure/enable a URCB 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 clause 14.2.3.2.2.1), force/trigger a report and check the reports contain the enabled optional fields (7-1 clause 14.2.1)
Br3	Verify the trigger conditions 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 (supported) trigger conditions: o on integrity o on update (dupd) o on update with integrity o on data change (dchg) o on data and quality change o on data and quality change with integrity period o on data and quality change with integrity period and BufTme (integrity reports should be transmitted immediately) – Verify the validity of the ReasonCode (IEC 61850-7-2 clause 14.2.3.2.2.9) – Verify that when more trigger conditions are met preferably only one report is generated (IEC 61850-7-2 clause 14.2.3.2.3.2) – Verify that reports are only sent when RptEna is set to True. (IEC 61850-7-2 clause 14.2.2.5), when reporting is disabled no reports should be transmitted
Br4	General interrogation 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. (IEC 61850-7-2 clause 14.2.2.13)

Br5	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 clause 14.2.3.2.2.5) – SeqNum (not changed) – SubSeqNum (0 for first report, incrementing, roll-over) – MoreSeqmentsFollow – TimeOfEntry (not changed as SeqNum is not altered) (IEC 61850-7-2 clause 14.2.3.2.2.9) 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 clause 14.2.3.2.3.5) 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 clause 14.2.3.2.3.4)
Br6	Configuration revision (IEC 61850-7-2 clause 14.2.2.7) – 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: o deletion of a member of the data-set o re-ordering of members in the data-set ConfRev should never be 0 (zero). – Verify that after a restart of the server, the value of ConfRev remains unchanged (IEC 61850-7-2 clause 14.2.2.7) – Verify that configuration changes data sets due to processing of services are not allowed, changes to be taken into account for the ConfRev are those made by local means like system configuration (IEC 61850-7-2 clause 14.2.2.7. note 1)
Br7	Buffer Time (IEC 61850-7-2 clause 14.2.2.9) – 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 clause 14.2.2.9) o 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 o 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 o may for analogue information substitute the current value in the pending report with the new one. – Configure Buffer Time to 1000 milliseconds and force a data value change of multiple dataset members within buffer time. Server should 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 clause 14.2.2.9) – Verify that the BufTm value can contain at least the value 3600000 (= one hour in milliseconds)

Br8	Buffered reporting (BRCB) state machine (IEC 61850-7-2 clause 14.2.2.5 figure 20) – 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 clause 14.2.1, IEC 61850-7-2 clause 14.2.2.5) – Do the same but now set PurgeBuf to True before enabling the reporting. No stored buffered reports should be send (IEC 61850-7-2 clause 14.2.2.14) – Verify that all buffered events are sent before an integrity or general-interrogation report can be sent. (IEC 61850-7-2 clause 14.2.3.2.3.3, IEC 61850-7-2 clause 14.2.3.2.3.4) – Verify that after changing DatSet, the report buffer is purged. (IEC 61850-7-2 clause 14.2.2.5) – Force buffer overflow, the OptFlds buffer-overflow should be set in the first report that is sent with events that occurred after the overflow. (IEC 61850-7-2 clause 14 2.3.2.2.8)
Br9	Buffered reporting (BRCB); buffering events (IEC 61850-7-2 clause 14.2.3.2.3.6) - Verify that after the association is available again and after the client has set the EntryID, and enabled the BRCB, the BRCB shall start sending the reports of events that have been buffered. The BRCB shall use the sequence and subsequence numbers so that no gaps occur.

BrN1	Request GetBRCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 clause 14.2.3.3.2)
BrN2	Configure reporting but omit setting one of the trigger options (dchg, qchg, dupd, integrity). When enabled only one report is transmitted (the GI). No reports should be send when generating events (IEC 61850-7-2 clause 14.2.3.2.2.9)
BrN3	Setting the integrity period to 0 with TrgOps = integrity will result in no integrity reports will be sent (IEC 61850-7-2 clause 14.2.2.12)
BrN4	Incorrect configuration of a BRCB: configure when enabled, configure ConfRev and SqNum and configure with unknown data set
BrN5	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 clause 14.2.1)
BrN6	Configure unsupported BRCB options (PIXIT); Configure unsupported trigger conditions, optional fields and related parameters

Detailed test procedures

Br1	GetLogicalNodeDirectory(BRCB) and GetBRCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2 and 14.2.3.3 IEC 61850-8-1 clause 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		

Br2	Reporting of optional fields for a BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.8 IEC 61850-8-1 clause 17.1.1.1, 17.2.1, PIXIT		
Expected result 1. DUT sends SetBRCBValues Response+ for supported optional fields and Response- when one of the optional fields isn't supported 2. DUT sends SetBRCBValues Response+ 3. DUT sends a correct report according to trigger condition and IEC 61850-8-1 table 40 with all data set members for reason integrity and otherwise only the changed members. The configured and reported optional fields should match – the sequence number is incremented and starts with 0 – the report time stamp is in UTC format and matches the trigger time – the reason for inclusion matches the trigger condition – the configured and reported data set name do match – the data-reference(s) match the data set member(s) – buffer overflow is false – EntryID as specified in the PIXIT – Configuration revision matches the configuration – When segmentation is set the report includes sub sequence number and more segments follow 4. DUT sends SetBRCBValues Response+ and sends no reports anymore		

Br2	Reporting of optional fields for a BRCB	☐ Passed ☐ Failed ☐ Inconclusive

Test description

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

Comment

PIXIT specifies the following optional fields are supported: <to be completed>

Br3	Trigger conditions for a BRCB	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 14.2.2.8
IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 17.2.1, PIXIT

Expected result

1. DUT sends SetBRCBValues Response+ for supported trigger conditions and Response- when one of the trigger conditions isn't supported
2. DUT sends SetBRCBValues Response+
3. DUT sends a report according to trigger condition
   - integrity reports should be transmitted immediately at timeout
   - data change reports are transmitted immediately when BufTme=0
   - data change reports are transmitted after BufTme of first data change when BufTme>0
4. The configured and reported optional fields should match
6. DUT does not sends reports

Test description

1. Configure an available BRCB using SetBRCBValues with all supported optional fields and one of the following (supported) trigger conditions:
   - on integrity
   - [on update (dupd)]
   - [on update with integrity]
   - on data and quality change
   - on data and quality change with integrity period
   - on data and quality change with integrity period and BufTme
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 within/outside BufTm
4. Verify the reports are only transmitted according to trigger condition
5. Client disables the BRCB, set RptEna to False
6. EQUIPMENT SIMULATOR forces several data changes of one or more data set members in the data set within/outside BufTm
7. Repeat step 1 to 6 for next trigger condition combination

Comment

PIXIT specifies the following trigger conditions are supported:

- integrity
- data/quality change

Br4	General interrogation URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.8, 14.2.2.13 IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 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		
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		
Comment		

Br5	Segmentation of reports BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.8, 14.2.3.2.2.5, 14.2.3.2.2.9, 14.2.3.2.3.5, 14.2.3.2.3.4 IEC 61850-8-1 clause 8.1.3.8, 17.1.1.1, 17.2.1, PIXIT		
Expected result 3. The segmented report messages have same SqNum, Incremented SubSeqNum starting with 0 and more segments follow is set and same EntryTime		
Test description 1. Create or use a pre-configured data set which reported values do not fit in one MMS PDU 2. Client configures an available RCB with the data set, with at least the optional fields sequence-number, report timestamp and segmentation 3. Client enables the RCB and verify the segmentation of integrity reports 4. Client disables the RCB		
Comment		

Br6	Configuration revision	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.2.7 IEC 61850-8-1 clause 17.2.1		
Expected result 2. DUT sends GetBRCBValues() Response+ with ConfRev >0 6. The value of ConfRev is incremented		
Test description 1. Client configures a RCB to use a dynamic data-set 8. Client request GetxRCBValues() 9. Client configures the same RCB with an empty datSet 10. Client deletes the dynamic dataset and create a new data set with same name and re-ordered members or a deleted member 11. Client configures a RCB to use a dynamic data-set 12. Client request GetxRCBValues()		
Comment Test procedure mandatory when datSet of RCB is dynamic see ICD.		

Br7	Buffer time	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 14.2.2.9
IEC 61850-8-1 clause 17.2.1, PIXIT

Expected result

3. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer
4. On second data change in BufTm DUT sends the report of the first data change, and restarts the timer OR DUT substitutes the current value in the pending report with the new one
5. Each data change result in a report
6. DUT accepts BufTm value 3.600.000 (optional)

Test description

NOTE: this test case will take approx. 1 hour

1. Client configures an available RCB using SetxRCBValues with a valid BufTm and all supported optional fields with the trigger conditions: on data and quality change and BufTm
2. Client enables the RCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces several data changes of one status data set members in the data set within BufTm
4. EQUIPMENT SIMULATOR forces several data changes of one analogue data set members in the data set within BufTm
5. Client disables the RCB, sets BufTm to zero and repeats step 2, 3 and 4
6. Client disables the RCB, sets BufTm to 3.600.000 and repeats step 2, 3 and 4 (optional)
7. Client disables the RCB

Comment

Br8	Buffered reporting	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1, 14.2.2.14, 14.2.2.5, 14.2.3..2.2.8 IEC 61850-8-1 clause 17.2.1, PIXIT		
Expected result 1 to 6: Events are buffered after the association is released / aborted and reporting is disabled 7. Not received reports while not associated are received now in the correct order 8. Not received reports while not associated are received now in the correct order 9. No stored buffered reports should be send 10. No stored buffered reports should be send 11. The Optional field buffer-overflow should be set in the first report that is sent with events that occurred after the overflow		
Test description 1. Client configures an available BRCB with all supported optional fields with the trigger conditions: on data and quality change and BufTm 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes of different status data set members in the data set within BufTm 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 8. Repeat step 2-7, but Abort the association at step 4 9. Repeat step 2-7, but set PurgeBuf before between step 6 and 7 10. Repeat step 2-7, but change the data set name between step 6 and 7 11. Repeat step 2-7, but generate more data changes then the PIXIT buffer size at step 5.		
Comment		

Br9	Buffered events	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.6 IEC 61850-8-1 clause 17.2.1, PIXIT		
Expected result 8. the BRCB shall start sending the reports of events that have been buffered starting with specified EntryID. The BRCB shall use the sequence and subsequence numbers so that no gaps occur.		
Test description 1. Client configures an available BRCB with all supported optional fields with the trigger conditions: on data and quality change and BufTm 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes of different status data set members in the data set within BufTm 4. Client requests Release 4. EQUIPMENT SIMULATOR forces several more data changes 5. Client re-establishes the association and requests GetBRCBValues() 6. Client set a valid EntryID in the BRCB 7. Client enables the BRCB		
Comment		

BrN1	Incorrect GetBRCBvalues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.3.2 IEC 61850-8-1 clause 17.2		
Expected result 1. See SrvN1		
Test description 1. Repeat SrvN1 for a GetBRCBvalues		
Comment		

BrN2	No trigger condition	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.2		
Expected result 1. DUT does not send reports when reporting is enabled and events are generated		
Test description 1. Repeat Rpt5 with no trigger condition		
Comment		

BrN3	Integrity period zero	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.2		
Expected result 1. DUT does not send reports when reporting is enabled		
Test description 1. Repeat RptP5 with trigger condition “integrity” and IntgPd = 0		
Comment		

BrN4	Incorrect configuration of BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.9 IEC 61850-8-1 clause 17.1.1.1		
Expected result 2. DUT sends SetBRCBValues() Response- 4. DUT sends SetBRCBValues() Response- 5. DUT sends SetBRCBValues() Response-		
Test description 1. Client configures and enable an available BRCB 2. Client requests SetBRCBValues() with one of the following attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd, PurgeBuf, EntryID 3. Disable the BRCB 4. Client requests SetBRCBValues() with one of the following attributes ConfRev, SqNum, TimeOfEntry 5. Client requests SetBRCBValues() with unknown DatSet		
Comment		

BrN5	Exclusive use of BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.2		
Expected result 2. DUT sends SetBRCBValues() Response- 4. DUT sends SetBRCBValues() Response+ 5. DUT sends SetBRCBValues() Response+ 6. DUT sends SetBRCBValues() Response+ 9. DUT sends SetBRCBValues() Response-		
Test description 1. Client1 configures and enables an available BRCB 2. Client2 configures the BRCB by requesting SetBRCBValues() with one of the following attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd, PurgeBuf, EntryID 3. Client1 disables the BRCB 4. Client2 configures the BRCB 5. Client1 configures the BRCB 6. Client2 enables the BRCB 7. Client2 aborts and re-establishes the association 8. Client1 configures and enables the BRCB 9. Client2 purges the BRCB 10. Client1 disables the BRCB		
Comment		

BrN6	Configure unsupported BRCB options	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.1		
Expected result 1 to 3: DUT sends SetBRCBValues() Response-		
Test description 1. Client requests SetBRCBValues() with one of the unsupported optional fields 2. Client requests SetBRCBValues() with one of the unsupported trigger conditions 3. Client requests SetBRCBValues() with one of the unsupported BRCB parameters		
Comment PIXIT specifies that the following optional fields are not supported: <to be completed> PIXIT specifies that the following trigger conditions are not supported: <to be completed> PIXIT specifies that the following RCB parameters are not supported: <to be completed>		

A4.8 Logging [Future]

This work will be completed in future releases of this document.

A4.9 Generic Object Oriented Substation Events (GOOSE)

Compared to IEC 61850-10 the GSE test cases are split in GOOSE and GSSE test procedures and each split in publish – subscribe – management.

Abstract test cases DUT publish

Gop1	Request GetLogicalNodeDirectory(GoCB) and request GetGoCBValues (IEC 61850-7-2 clause 15.2.2.5, clause 9.2.2)
Gop2	GOOSE messages are published with a long cycle time, check the GOOSE data with configured data; (IEC 61850-7-2 clause 15.2.3) – 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 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 – test is not present or if present with value FALSE – confRev >0 and is same as the GoCB and SCL (IEC 61850-7-2 clause 15.2.1.6) – needsCommisioning 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 – VID, priority and APPID as in SCL, CFI=0, TPID=0x8100 (IEC 61850-8-1 Annex C)
Gop3	Verify that a newly activated device sends the initial GOOSE message with sqNum and stNum initial value one (1) (IEC 61850-7-2 clause15.1, 15.2.3.6+7)
Gop4	Force a data change of a data value in the GOOSE dataset, DUT should publish GOOSE messages as specified/configured, stNum is incremented, sqNum = 0
Gop5	Enable test mode and verify that the test flag is set (IEC 61850-7-2 clause 15.2.3.8)
Gop6	Disable GoCB, verify that changing parameters with SetGoCBValues are active (IEC 61850-7-2 clause 15.2.1.3, 15.2.2.5+6) and no Goose message are transmitted anymore
Gop7	Verify that the Configuration revision and a restart of the device shall not reset the value (IEC 61850-7-2 clause 15.2.1.6)
Gop8	Verify that ConfRev represents a count of the number of times the configuration of the data set referenced by DatSet has been changed (IEC 61850-7-2 clause 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
Gop9	Verify that GoCB attribute NdsCom is set when DatSet is not yet configured (is NULL) (IEC 61850-7-2 clause 15.2.1.7)

GopN1	When GoEna=TRUE, no attributes of the GoCB control block can be set except for GoEna. (IEC 61850-7-2 clause 15.2.1.3)
GopN2	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 clause 15.2.1.7)

Abstract test cases DUT subscribe

Gos1	Send single GOOSE message 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
Gos2	Send single GOOSE message with the Test or ndsCom parameter set. Verify that on a status change the values are not used for operational purposes (IEC 61850-7-2 clause 15.2.3.8)
Gos3	Proper detection and action roll-over of sqNum with no status change (sqNum=max -> sqNum = 1) and with status change (sqNum=max -> sqNum = 0)

GosN1	Check behaviour of DUT as specified in PIXIT on Missing GOOSE message
GosN2	Check behaviour of DUT as specified in PIXIT on Double GOOSE message
GosN3	Check behaviour of DUT as specified in PIXIT on Delayed GOOSE message, with and without exceeding timeAllowedToLive
GosN4	Check behaviour of DUT as specified in PIXIT on Out of order GOOSE message
GosN5	Check behaviour of DUT as specified in PIXIT on No GOOSE messages
GosN6	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 – APPID different from SCL and 0 (IEC 61850-8-1 Annex C)

Abstract test cases DUT management

Gom1	Verify GOOSE services: request service with legal parameters and check respond (IEC 61850-7-2 clause 15.2.2) – GetGoReference (IEC 61850-7-2 clause 15.2.2.3) – GetGOOSEElementNumber (IEC 61850-7-2 clause 15.2.2.4)

GomN1	Services: request GOOSE service with illegal parameters and verify response- service error (IEC 61850-7-2 clause 15.2.2), Verify that NULL for MemberReference in GetGOOSEElementNumber indicates that no member of the referenced data set is defined. (IEC 61850-7-2 clause 15.2.2.4.2.2)

Detailed test procedures

Gop1	GetLogicalNodeDirectory(GoCB) and GetGoCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.3.2.2 IEC 61850-8-1 clause		
Expected result 1. DUT sends GetLogicalNodeDirectory(GoCB) Response+ with a list of GoCB's. The objectreference shall be "LDName/LLN0.GsCBName" 2. DUT sends GetGoCBValues Response+		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(GoCB) 2. For each GsCB Client requests GetGsCBValues()		
Comment		

Gop2	GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3.6+7 IEC 61850-8-1 clause		
Expected result 1. DUT sends valid GOOSE messages with valid references, time stamp, incrementing sequence number, status number is the same		
Test description 1. Force no data change. Wait for several GOOSE messages		
Comment		

Gop3	Initial GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.3.2.2 IEC 61850-8-1 clause		
Expected result 1. DUT sends initial GOOSE message with sqNum and stNum value one (1)		
Test description 1. Restart the DUT, enable GoCB when necessary, and wait for initial GOOSE		
Comment		

Gop4	GOOSE on data change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.3.2.2 IEC 61850-8-1 clause		
Expected result 2. DUT sends GOOSE messages according to the configured retransmission strategy as, stNum is incremented, sqNum = 0 of 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		

Gop5	Test mode	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3.8 IEC 61850-8-1 clause 18.1.2.5		
Expected result 1. DUT sends a GOOSE messages with test mode set 2. DUT sends a GOOSE messages with test mode not set		
Test description 1. Test engineer enable test mode 2. Test engineer disables test mode		
Comment		

Gop6	SetGoCBValues	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.3, 15.2.2.5, 15.2.2.6 IEC 61850-8-1 clause		
Expected result 1. DUT sends a SetGoCBValues response+ and stops transmitting GOOSE messages 2. DUT sends a SetGoCBValues response+ 3. DUT sends a GetGoCBValues response+ with the correct values 4. DUT sends a SetGoCBValues response+ 5. DUT sends a GetGoCBValues response+ with NdsCom = TRUE 6. DUT sends a SetGoCBValues response+ and initializes/starts transmitting GOOSE messages (first message has stNum=1 and sqNum=1)		
Test description 1. Client requests a SetGoCBValues with GoEna set to FALSE 2. Client requests a SetGoCBValues with new GoCBName, GoCBref, AppID, DatSet 3. Client requests a GetGoCBValues 4. Client requests a SetGoCBValues with DatSet is NULL 5. Client requests a GetGoCBValues 6. Client requests a SetGoCBValues with GoEna set to TRUE		
Comment		

Gop7	Configuration revision after restart	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.6 IEC 61850-8-1 clause		
Expected result 1. DUT restarts 2. DUT sends a GetGoCBValues response+ with the same ConfRev (not null) value as before the restart 3. DUT sends GOOSE message with the same ConfRev value as before the restart		
Test description 1. Test engineer restart the DUT 2. Client request GetGoCBValues() 3. Enable GoCB when necessary and wait for GOOSE message		
Comment		

Gop8	Configuration revision updating	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.6 IEC 61850-8-1 clause		
Expected result 1. - 2. - 3. DUT sends a GetGoCBValues response+ with incremented ConfRev value 4. DUT sends GOOSE message with incremented ConfRev value		
Test description 1. Test engineer deletes the first member of the GoCB data set 2. Test engineer updates/activates the configuration in the DUT 3. Client requests a GetGoCBValues() 4. Client waits for GOOSE message 5. Test engineer re-orders the first and last member of the GoCB data set; repeat step 2-4 6. Test engineer changes the value of the GoCB data set; repeat step 2-4		
Comment		

Gop9	Needs commissioning	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause		
Expected result 2. DUT sends a GetGoCBValues response+ with NdsCom=TRUE, (DUT sends no GOOSE messages?)		
Test description 1. Test engineer changes the value of the GoCB data set to NULL and updates/activates the configuration in the DUT 2. Client requests a GetGoCBValues()		
Comment		

GopN1	Verify that GoCB components are read-only	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.2.3, 15.2.2.4 IEC 61850-8-1 clause 18.1, Table 50, PIXIT		
Expected result 1. DUT sends a SetGoCBValues response- 2. DUT sends a SetGoCBValues response- 3. DUT sends a SetGoCBValues response- 4. According to PIXIT (DUT sends a SetGoCBValues response-)		
Test description 1. Client requests a SetGoCBValues with valid GoID 2. Client requests a SetGoCBValues with valid DatSet 3. Client requests a SetGoCBValues with valid DstAddress 4. Client requests a SetGoCBValues to enable/disable GoEna		
Comment Table 50 in 8-1 specifies that only GoEna can be written, other components are read-only		

GopN2	Verify to large Goose message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
Expected result 1. DUT does not accepts configuration or DUT sends a GOOSE message with NdsCom=TRUE (PIXIT)		
Test description 1. Test engineer configures the DUT with a dataset and GoCB which values will not fit in a single GOOSE message		
Comment		

DUT subscribe

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 or RCB that publish/reports the (changed) value(s) in the data set

As such the analyzer trace file contains the proof that (in)correct subscribed GOOSE messages have been processed or not.

Gos1	Subscribe GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1		
Expected result 2. DUT updates the value and sends a GOOSE message or Report with changed status value		
Test description 1. Test engineer configures the DUT as specified 2. Client sends GOOSE message with new data value		
Comment		

Gos2	Subscribe GOOSE with Test or ndsCom set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
Expected result 2. Compare PIXIT 3. DUT ignores the data value change		
Test description 1. Test engineer configures the DUT as specified 2. Client sends GOOSE message with new data value with Test set 3. Client sends GOOSE message with new data value with ndsCom set		
Comment		

Gos3	SqNum roll-over with/without status change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
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. Client sends GOOSE message with sqNum = max–1, max and 1 without status change 2. Client sends GOOSE message with sqNum = max–1, max 3. Client forces a status change stNum and sends a GOOSE message with incremented stNum and sqNum=0		
Comment		

GosN1	Missing GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
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		

GosN2	Double GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1		
Expected result 3. DUT accepts first GOOSE message, resulting in a report or published GOOSE message 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		

GosN3	Delayed GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1		
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		

GosN4	Out-of-order GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
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		

GosN5	No GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1.7 IEC 61850-8-1 clause 18.1, PIXIT		
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 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 no GOOSE messages for 30 seconds 4. Publisher continues to send GOOSE messages (same stNum) 5. Publisher sends no GOOSE messages for 30 seconds 6. Publisher continues to send GOOSE messages (incremented stNum, sqNum=0)		
Comment		

GosN6	Invalid GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.1, 15.2.3.1 IEC 61850-8-1 clause 18.1, Annex C, PIXIT		
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: 1. GoCB reference = unknown, NULL 2. timeAllowedtoLive = 0 3. datSet reference = mismatch with GoCB, NULL 4. goID reference = mismatch with GoCB, NULL 5. timestamp of status change = plus one hour, minus one hour, 0 6. confRev = mismatching with GoCB 7. numDatSetEntries = +1, -1, 0 8. number of allData entries = new front element, missing first element, 0-1 element 9. values of allData entries = out-of-order 10. APPID = different from SCL and 0		
Comment		

DUT management

Gom1	GetGoReference, GetGOOSEElementNumber	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.2.3+4 IEC 61850-8-1 clause		
Expected result 3. DUT sends a GetGoReference response+ with the member reference 4. DUT sends a GetGOOSEElementNumber response+ with the same member offset as the GetGoReference() request		
Test description 3. Client requests a GetGoReference() for first member offset 4. Client requests a GetGOOSEElementNumber for responded member reference 5. Repeat 1 and 2 for next member offset in the GoCB		
Comment		

GomN1	Wrong parameters	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.2.3, 15.2.2.4 IEC 61850-8-1 clause 18.1		
Expected result 1. DUT sends a GetGoReference response- 2. DUT sends a GetGoReference response+ with a NULL reference and 2 correct references 3. DUT sends a GetGoReference response+ with 2 correct references and a NULL reference 4. DUT sends a GetGOOSEElementNumber response- 5. DUT sends a GetGOOSEElementNumber response+ with 2 correct MemberOffset and a NULL offset		
Test description 1. Client requests a GetGoReference with unknown GoCBReference and MemberOffset 1 2. Client requests a GetGoReference with MemberOffset 0, 1 and 2 3. Client requests a GetGoReference with MemberOffset n-1, n, n+1 (n is the number of elements in the dataset) 4. Client requests a GetGOOSEElementNumber with 2 known and 1 unknown GoCBReference 5. Client requests a GetGOOSEElementNumber with unknown MemberReference		
Comment		

A4.10 Generic Substation State Events (GSSE) [Future]

Abstract test cases

DUT GSSE publish

Gsp1	Request GetLogicalNodeDirectory(GsCB) and check response+
Gsp2	GSSE messages are published with a long cycle time, check the GSSE data with configured data; sqNum is incremented, stNum isn't changed. (IEC 61850-7-2 clause 15.3.3.4+5)
Gsp3	Verify that a newly activated device sends the initial GOOSE message with sqNum and stNum initial value one (1) (IEC 61850-7-2 clause 15.1, 15.2.3.5 & 6, IEC 61850-7-2 clause 15.3.4.3 & 4)
Gsp4	Force data change of a data value in the GSSE dataset, DUT should publish GOOSE messages as specified/configured, stNum is incremented, sqNum = 0
Gsp5	Verify GSSE services: request service with legal parameters and check respond (IEC 61850-7-2 clause 15.3.3) GetGsReference (IEC 61850-7-2 clause 15.3.3.3) GetGSSEElementNumber (IEC 61850-7-2 clause 15.3.3.4) GetGsCBValues (IEC 61850-7-2 clause 15.3.3.5) SetGsCBValues (IEC 61850-7-2 clause 15.3.3.6)
Gsp6	Disable GSSE, verify that changing parameters with SetGsCBValues are active (IEC 61850-7-2 clause 15.3.3.6) and no GSSE messages are transmitted

GspN1	Services: request GSSE service with illegal parameters and verify response- service error (IEC 61850-7-2 clause 15.2.2)
GspN2	Verify that NULL for DataLabel in GSSE GetReference indicates that no member is defined for the respective Data Offset. (IEC 61850-7-2 clause 15.3.3.3.3.2)
GspN3	GSSE: Verify that if Gsse's are enabled (GsEnable = True), no attributes of the GsCB control block can be set except for GsEnable. (IEC 61850-7-2 clause 15.3.3.6.3)

DUT subscribe

Gss1	Send single GSSE message 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
Gss2	Send single GSSE message with the Test parameter set. Check behaviour as specified in PIXIT

GssN1	Check behaviour of DUT as specified in PIXIT on – Missing GSSE message – Double GSSE message – Delayed GSSE message – Out of order GSSE message

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

- a data point that can be controlled by remote client, e.g. a SPC

- a DNA or user bitstring that contains the status/control value of this data point
- a GsCB or RCB that publish/report the changed value(s) in the data set

As such the analyzer trace file contains the proof that (in)correct subscribed GSSE messages have been processed or not.

The detailed test procedures will be completed in future releases of this document.

A4.11 Transmission of sampled values [Future]

Note the applicable SCSM for this part is IEC 61850-9-1 or IEC 61850-9-2.
This work will be completed in future releases of this document.

A4.12 Control

A4.12.1 Control general

Abstract test cases

CtI1	Force and check each path in control state machine for several control objects with control modes 1. direct with normal security (IEC 61850-7-2 clause 17.2.1) 2. SBO-control with normal security (operate once/many) (IEC 61850-7-2 clause 17.2.2) 3. direct with enhanced security (IEC 61850-7-2 clause 17.3.2) 4. SBO-control with enhanced security (operate once/many) (IEC 61850-7-2 clause 17.3.3) Compare detailed state machine test cases for each control mode
CtI2	Verify that with test mode set no operations to the process are performed.
CtI3	Select all SBO control objects and cancel them in opposite order
CtI4	Time Operate a second enhanced security control object before the activation time of the first control object
CtI5	Change control model using online services >> not applicable for part 8-1
CtI6	Enable/disable command termination using online services >> not applicable for part 8-1
CtI7	Verify that with specified check conditions the supported checks are performed and the command is executed accordingly (IEC 61850-7-2 clause 17.5.2.5)

CtIN1	Operate (without select) for a SBO control object and verify the response- and AddCause (IEC 61850-7.2 clause 17.2.2)
CtIN2	Select twice, second select should fail and verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtIN3	Operate value is the same as the actual value (On-On, or Off-Off) and verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtIN4	Select the same control object from 2 different clients, verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtIN5	Select / Operate a unknown control object and verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtIN6	Verify situations to set specific other applicable AddCause values (IEC 61850-7-2 clause 17.5.2.6)
CtIN7	Select an direct operate control object >> not applicable for part 8-1
CtIN8	Operate a direct control object twice from 2 clients
CtIN9	Operate with different value then the SelectWithValue of a SBOes control object

Detailed test procedures

Ctl1	Control model state machine	☐ Passed ☐ Failed ☐ Inconclusive

PICS, MICS

Expected result

Test description

Perform the following steps for at least one control object of the following supported controllable common data classes: SPC, DPC, INC, BSC, ISC and APC

1. For SBO with enhanced security compare the SBOes test cases
2. For SBO with normal security compare the SBOns test cases
3. For direct with enhanced security compare the Des test cases
4. For direct with normal security compare the Dns test cases

Comment

The following control objects have been used for the test

	SBOes	**SBOns**	**Des**	**Dns**
SPC				
DPC				
INC				
BSC				
ISC				
APC				

Ctl2	Test mode	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.5.2.4 IEC 61850-8-1 clause 20, Annex E		
Expected result DUT sends all messages without executing the control action (for enhanced security with command termination)		
Test description 1. Repeat SBOes3, and request SelectWithValue and Operate with the Test flag set 2. Repeat SBOns2, and request Operate with the Test flag set 3. Repeat DOes5, and request Operate with the Test flag set 4. Repeat DOns3, and request Operate with the Test flag set		
Comment		

Ctl3	Select/cancel all SBO control objects	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 20, Annex E		
Expected result DUT sends Response+ for non-interlocked objects and Response- for interlocked objects		
Test description 1. Client request SelectWithValue for all SBOes control objects 2. Client requests Select for all SBOns control objects 3. Client request Cancels all control object in reversed order		
Comment		

Ctl4	Activate multiple time activated operate commands	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2		
Expected result DUT responds according to state machine		
Test description 1. Client requests Time Activated Operate of multiple SBO and Direct control objects supporting Time Activation with the exact same operate time		
Comment		

Ctl7	Check conditions	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.5.2.5		
Expected result The supported check conditions are checked and command is executed when check is Ok.		
Test description 1. Repeat SBOes3, and request SelectWithValue and Operate with both Check conditions set 2. Repeat SBOns2, and request Operate with both Check conditions set 3. Repeat DOes5, and request Operate with both Check conditions set 4. Repeat DOns3, and request Operate with both Check conditions set		
Comment		

CtlN1	Direct operate an SBO control object	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result DUT responds with Operate Response- and the control object returns to the “unselected” state		
Test description 1. Client sends correct Operate once request of an unselected SBOes object 2. Client sends correct Operate once request of an unselected SBOns object		
Comment		

CtlN2	Select an SBO control object twice	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT respond with SelectWithValue Response- and the control object keeps its selected state 3. DUT responds with Select Response+ 4. DUT respond with Select Response- and the control object keeps its selected state		
Test description 1. Client sends correct SelectWithValue request of an unselected SBOes object 2. Client sends correct SelectWithValue request of the selected SBOes object 3. Client sends correct Select request of an unselected SBOns object 4. Client sends correct Select request of the selected SBOns object		
Comment		

CtlN3	Select or Operate value is same as actual value	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response- and the control object keeps its unselected state 2. DUT respond with Operate Response- and the control object keeps its unselected state 3. DUT respond with Operate Response- and the control object keeps its unselected state		
Test description 1. Client sends SelectWithValue request with actual value of an unselected SBOes object 2. Client sends Operate request with actual of an DOes object 3. Client sends Operate request with actual of an DOns object		
Comment		

CtlN4	Select an SBO control object twice from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT respond with SelectWithValue Response- and the control object keeps its selected state 3. DUT responds with Select Response+ 4. DUT respond with Select Response- and the control object keeps its selected state		
Test description 1. Client1 sends correct SelectWithValue request of an unselected SBOes object 2. Client2 sends correct SelectWithValue request of the selected SBOes object 3. Client1 sends correct Select request of an unselected SBOns object 4. Client2 sends correct Select request of the selected SBOns object		
Comment		

CtlN5	Select / Operate an unknown control object	☐ Passed ☐ Failed ☐ Inconclusive
Comment Already tested at SBOes1, SBOns1, DOes1 and DOns1.		

CtlN6	Force other AddCause values	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 17.3.3
IEC 61850-8-1 clause 20.6, 20.7 and 20.8, table 78

Expected result
DUT responds with specific AddCause value

Test description
1. Repeat one or more of previous test procedures, but now use EQUIPMENT SIMULATOR to force a specific AddCause situation
   - not supported
   - block by switching hierarchy
   - select-failed
   - invalid position
   - position reached
   - parameter-change in execution
   - step-limit
   - blocked by mode
   - blocked by process
   - blocked by interlocking
   - blocked by synchrocheck
   - command already in execution
   - blocked by health
   - 1-of-n control
   - abortion by cancel
   - time limit over
   - Abortion by trip
   - Object-not-selected

Comment
PIXIT specifies the support of the following AddCause values: <to be completed>
The following AddCause values have been tested: <to be completed>

CtlN8	Operate an direct control object twice from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with Operate Response+ 2. DUT respond with Operate Response- and the control object keeps its selected state 3. DUT responds with Operate Response+ 4. DUT respond with Operate Response- and the control object keeps its selected state		
Test description 1. Client1 sends correct Operate request of an unselected DOes object 2. Client2 sends correct Operate request of the selected DOes object 3. Client1 sends correct Operate request of an unselected DOns object 4. Client2 sends correct Operate request of the selected DOns object		
Comment		

CtlN9	Operate with different value then the SelectWithValue of a SBOes control object	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT respond with Operate Response- and the control object keeps its selected state		
Test description 1. Client sends correct SelectWithValue request of an unselected SBOes object 2. Client sends Operate request of the selected object setting one of the following attributes to another value then the SelectWithValue: ctlVal (setMag), origin, ctlNum, test, Check 3. or Client sends Time Activated Operate request of the selected object setting one of the following attributes to another value then the SelectWithValue: ctlVal (setMag), operTm, origin, ctlNum, test and Check 4. Wait till control object returns to the “unselected state”		
Comment		

A4.12.2 Control SBOes

SBOes1	Path 1 (returning to Unselected state): Select device using SelVal with improper access rights. Access should be denied (IEC 61850-7-2 clause 17.2.2)
SBOes2	Path 2+3a/b/c/d (returning to Unselected state): Select device correctly using SelVal Verify each of these paths will return the device to the Unselected state: – Client requests Cancel (3a) – Client waits for timeout (3b) – Client requests TimOper resulting in Test not ok (3c) – Client requests Operate resulting in Test not ok (3d)
SBOes3	Path 2+4+8a/b/c (returning to Unselected state): Select device correctly using SelVal Verify each of these paths will return the device to the Unselected state: – Perform a correct Operate Once request (8a) – Perform a correct Operate Once request and force the output of the device such that the output keeps its old state (8b) – Perform a correct Operate Once request and force the output of the device such that the output keeps reaches the 'between' state (8c)
SBOes4	Path 2+5+6 (returning to Unselected state): Select device correctly using SelVal Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Force situation that the WaitForActionTime results in a timer expired ‘Test not ok’
SBOes5	Path 2+5+7+8a/b/c (returning to Unselected state): Select device correctly using SelVal Send a correct TimeActivatedOperate request Verify the WaitForActionTime results in a timer expired ‘Test ok’ After the timer has expired, verify each of these paths will return the device to the Unselected state: – Perform a correct Operate Once request (8a) – Perform a correct Operate Once request and force the output of the device such that the output keeps its old state (8b) – Perform a correct Operate Once request and force the output of the device such that the output keeps reaches the 'between' state (8c)
SBOes6	Path 2+4+9a/b/c (returning to the Ready state): Select device correctly using SelVal Send a correct Operate request Verify each of these paths will return the device to the Ready state: – Perform a correct Operate Many request (9a) – Perform a correct Operate Many request and force the output of the device such that the output keeps its old state (9b) – Perform a correct Operate Many request and force the output of the device such that the output keeps reaches the 'between' state (9c)
SBOes7	Path 2+5+7+9a/b/c (returning to the Ready state): Select device correctly [SelVal] Send a correct TimeActivatedOperate request After the timer has expired, test each of these paths which will return the device to the Ready State: – Perform a correct Operate Many request (9a) – Perform a correct Operate Many request and force the output of the device such that the output keeps its old state (9b) – Perform a correct Operate Many request and force the output of the device such that the output keeps reaches the 'between' state (9c)

SBOes1	Incorrect SelectWithValue	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6 and 20.8.4		
Expected result DUT responds with AdditionalCauseDiagnostic (AddCause) followed by a Write Response+ with AccessResult indicating failure as defined in IEC 61850-8-1 table 76		
Test description 1. Client sends SelectWithValue request with incorrect access rights 2. Client sends SelectWithValue request with unknown control object		
Comment		

SBOes2	SelectWithValue followed by cancel, timeout or operate resulting in test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with Cancel Response+ 2. DUT sends nothing 3. DUT responds with AdditionalCauseDiagnostic (AddCause) followed by a Write Response+ with AccessResult indicating failure as defined in IEC 61850-8-1 table 76 4. DUT responds with AdditionalCauseDiagnostic (AddCause) followed by a Write Response+ with AccessResult indicating failure as defined in IEC 61850-8-1 table 76 In all cases the control object returns to the “unselected” state		
Test description Client sends correct SelectWithValue request followed by: 1. Client sends correct Cancel request 2. Or Client waits for timeout 3. Or force EQUIPMENT SIMULATOR that the Client Time Activated operate request results in “test not ok” 4. Or force EQUIPMENT SIMULATOR that the Client Operate request results in “test not ok”		
Comment		

SBOes3	SelectWithValue, operate once followed by new, old and in between state change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT responds with Operate Response+ 3. DUT reports command termination+ 4. After timeout DUT reports command termination- with LastApplError 5. After timeout DUT reports command termination- with LastApplError In all cases the control object returns to the “unselected” state		
Test description 1. Client sends correct SelectWithValue request 2. Client sends correct Operate once request followed by 3. Force EQUIPMENT SIMULATOR to go to the new state 4. Or force EQUIPMENT SIMULATOR to keep the old state 5. Or force EQUIPMENT SIMULATOR to go to the in between state		
Comment I		

SBOes4	SelectWithValue, time actived operate once followed by failed wait for action time or cancel	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT responds with Time Activated Operate Response+ 3. After wait time DUT reports command termination- with LastApplError 4. DUT responds with Cancel Response+ In all cases the control object returns to the “unselected” state		
Test description 1. Client sends correct SelectWithValue request 2. Client sends correct Time Activated Operate once request 3. During wait time force EQUIPMENT SIMULATOR to create an interlock resulting in wait for action time – test not ok 4. Or Client sends correct Cancel request		
Comment		

SBOes5	SelectWithValue, time activate operate once followed by new, old and in between state change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
Expected result 1. DUT responds with SelectWithValue Response+ 2. DUT responds with Time Activated Operate Response+ 3. After wait time DUT reports timer expired test ok (**??**) 4. DUT reports command termination+ 5. After wait for change timeout DUT reports command termination- with LastApplError with AddCause – “invalid position” 6. After wait for change timeout DUT reports command termination- with LastApplError with AddCause – “invalid position” In all cases the control object returns to the “unselected” state		
Test description 1. Client sends correct SelectWithValue request 2. Client sends correct Time Activate Operate request 3. After wait time DUT reports/responds timer expired test ok, followed by 4. Force EQUIPMENT SIMULATOR to go to the new state 5. Or force EQUIPMENT SIMULATOR to keep the old state 6. Or force EQUIPMENT SIMULATOR to go to the in between state		
Comment		

SBOes6	SelectWithValue, operate <u>many</u> followed by new, old and in between state change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
<u>Expected result</u> In all cases the control object returns to the “ready” state		
<u>Test description</u> Repeat SBOes3, but set the control object sboClass to “operate-many”		
<u>Comment</u>		

SBOes7	SelectWithValue, time activate operate <u>many</u> followed by new, old and in between state change	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.6, 20.7 and 20.8		
<u>Expected result</u> In all cases the control object returns to the “ready” state		
<u>Test description</u> Repeat SBOes5, but set the control object sboClass to “operate-many”		
<u>Comment</u>		

A4.12.3 Control SBOns (Future)

SBOns1	Path 1 SelectReq[test not ok] resp-: Select the device using Select with improper access rights. Verify the device returns to the Unselected state.
SBOns2	Path SelectReq[test ok] resp+: Select device correctly using Select Verify each of these paths will return the device to the Unselected state: – Client requests Cancel – Client waits for timeout – Client requests TimOper resulting in Test not ok – Client requests Oper resulting in Test not ok – Client requests correct Operate Once
SBOns3	Path SelectReq[test ok] resp+ and TimOperReq[test ok] resp+: Select device correctly using Select Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Verify each of these paths will return the device to the Unselected state: – Force situation that the WaitForActionTime results in a timer expired ‘Test not ok’ – Verify the WaitForActionTime results in a timer expired ‘Test ok, operate once’
SBOns4	Path SelectReq[test ok] resp+ and OperReq[test ok, OPERATE MANY] resp+: Select device correctly using Select Verify that sending a correct Operate Many request will return the device to the Ready state
SBOns5	Path SelectReq[test ok] resp+ and TimOperReq[test ok] resp+ and TimerExpired[test ok, OPERATE MANY] resp+: Select device correctly using Select Send a correct TimeActivatedOperate Many request After the timer has expired, verify the device returns to the Ready State

Detailed test procedures will be added in future releases.

A4.12.4 Control DOes (Future)

DOes1	Path TimOperReq[test not ok] resp-: Send a TimeActivated Operate request, thereby making sure the device will generate a 'test not Ok'.
DOes2	Path OperReq[test not ok] resp-: Send an Operate request, thereby making sure the device will generate a 'test not Ok'.
DOes3	Path TimOperReq[test ok] resp+: Send a correct TimeActivated Operate request Verify each of these paths will return the device to the Ready state: – Client waits for timeout (test not ok) – Client requests correct Cancel
DOes4	Path TimOperReq[test ok] resp+ and Timer expired [test ok] resp+: Send a correct TimeActivated Operate request Verify the WaitForActionTime results in a timer expired 'Test ok' After the timer has expired, verify each of these paths will return the device to the Ready state: – The output of the device moves to its new state, resulting in a state new, CmdTerm req+ – Force the output of the device such that the output keeps its old state, resulting in a state old, CmdTerm req- – Force the output of the device such that the output keeps reaches the 'between' state, resulting in a state between, CmdTerm req-
DOes5	Path OperReq[test ok] resp+: Send a correct Operate request After the timer has expired, verify each of these paths will return the device to the Ready state: – The output of the device moves to its new state, resulting in a state new, CmdTerm req+ – Force the output of the device such that the output keeps its old state, resulting in a state old, CmdTerm req- – Force the output of the device such that the output keeps reaches the 'between' state, resulting in a state between, CmdTerm req-

Detailed test procedures will be added in future releases.

A4.12.5 Control DOns

DOns1	Path OperReq[test ok] resp+ Perform a correct Operate request
DOns2	Path OperReq[test ok] resp+ Client requests TimOper resulting in Test not ok
DOns3	Path OperReq[test not ok] resp- Client requests Oper resulting in Test not ok
DOns4	Path TimOperReq[test ok] + TimerExpired[test ok] resp+ Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Verify the WaitForActionTime results in a timer expired ‘Test ok’
DOns5	Path TimOperReq[test ok] + TimerExpired[test not ok] resp- Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Force situation that the WaitForActionTime results in a timer expired ‘Test not ok’

DOns1	Operate, test ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 and 20.8		
Expected result 1. DUT responds with Operate Response+ 2. - 3. - 4. – 5. DUT sends GetDataValues response+ with the process value		
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 5. Client requests GetDataValues of the corresponding process value		
Comment		

DOns2	TimeActivatedOperate test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 and 20.8		
Expected result 1. DUT responds with TimeActivatedOperate Response-, test not ok		
Test description 1. Client requests TimeActivatedOperate forcing a test not ok		
Comment Test not ok may be forced by forcing an interlock or the command value is the same as the process value		

DOns3	Operate, test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 and 20.8		
Expected result 1. DUT responds with Operate Response-, test not ok		
Test description 1. Client requests Operate forcing a test not ok		
Comment		

DOns4	TimeActivedOperate, test ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 and 20.8, Annex E		
Expected result 1. DUT responds with TimeActivatedOperate Response+ 2. After wait time DUT/the process executes the control command 3. DUT responds with GetDataValues Response+ with the change process value		
Test description 1. Client sends correct TimeActivatedOperate request 2. Client waits the wait time 3. Client requests GetDataValues of the corresponding process value		
Comment		

DOns5	TimeActivedOperate, test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 and 20.8, Annex E		
Expected result 1. DUT responds with first (write) TimeActivatedOperate Response+ 2. After wait time DUT reports responds second (informationReport) TimeActivatedOperate Response- with LastApplError		
Test description 1. Client sends correct TimeActivatedOperate request 2. During wait time force EQUIPMENT SIMULATOR to create an interlock resulting in wait for action time – test not ok		
Comment		

A4.13 Time and time synchronization

Abstract test cases

Tm1	Verify the DUT supports the SCSM time synchronisation
Tm2	Check report/logging timestamp accuracy matches the documented timestamp quality of the server

TmN1	Verify that when time synchronisation communication lost is detected after a specified period
TmN2	On synchronisation error, deviation beyond time stamp tolerance should be detected

Detailed test procedures

Tm1	SCSM time synchronisation (SNTP or GPS)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. DUT accepts the new time 2. DUT updates the event 3. DUT sends GetDataValues response+ with new time		
Test description 1. Test engineer changes the time in the TIME MASTER 2. Force an event using the EQUIPMENT SIMULATOR 3. Client requests GetDataValues of the event		
Comment		

Tm2	Time stamp accuracy	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. The time stamp quality matches with the documented accuracy		
Test description 1. Repeat Tm1, and check the time stamp quality		
Comment		

TmN1	Lost time synchronisation	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. DUT detects the lost time synch 2. DUT updates the event 3. DUT sends GetDataValues response+ with time synch lost quality		
Test description 1. Test engineer disconnects the TIME MASTER and waits specified period 2. Force an event using the EQUIPMENT SIMULATOR 3. Client requests GetDataValues of the event		
Comment		

TmN2	ClockFailure	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. DUT keeps the old time 2. DUT updates the event 3. DUT sends GetDataValues response+ with old time and time quality “ClockFailure”		
Test description 1. Test engineer controls the TIME MASTER to force a ClockFailure as specified in the PIXIT 2. Force an event using the EQUIPMENT SIMULATOR 3. Client requests GetDataValues of the event		
Comment		

A4.14 File transfer

Abstract test cases

Ft1	Request a GetServerDirectory(FILE) with correct parameters and verify the response (IEC 61850-7-2 clause 6.2.2)
Ft2	For each responded file: – request a GetFile with correct parameters and verify the response (IEC 61850-7-2 clause 20.2.1) – request a GetFileAttributeValues with correct parameters and verify the response (IEC 61850-7-2 clause 20.2.4) – request a DeleteFile with correct parameters and verify the response (IEC 61850-7-2 clause 20.2.3)
Ft3	Verify the SetFile service with a small and large file and the maximum number of maximum sized file

FtN1	Request following file transfer services with an unknown file name and verify the appropriate response-service error – GetFile (IEC 61850-7-2 clause 20.2.1) – GetFileAttributeValues (IEC 61850-7-2 clause 20.2.4) – DeleteFile (IEC 61850-7-2 clause 20.2.3)

Detailed test procedures

Ft1	GetServerDirectory(FILE)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 6.2.2 IEC 61850-8-1 clause 23, **Technical issue 10** PIXIT		
Expected result 1. DUT sends GetServerDirectory(FILE) Response+ with a list of files and/or directories according to the PIXIT		
Test description 2. Client requests GetServerDirectory(FILE) and for each responded directory Client requests GetServerDirectory(FILE)		
Comment		

Ft2	GetFile, GetFileAttributeValues, DeleteFile	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 20.2.1, 20.2.4, 20.2.3 IEC 61850-8-1 clause 23.2.1, 23.2.3, 23.2.4 PIXIT		
Expected result a) DUT sends GetFile Response+ and sends the contents of the file b) DUT sends GetFileAttributeValues response+ c) DUT sends DeleteFile response+		
Test description For each responded file: a) Client requests GetFile with correct parameters b) Client requests GetFileAttributeValues with correct parameters c) Client requests DeleteFile with correct parameters		
Comment		

Ft3	SetFile	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 20.2.2 IEC 61850-8-1 clause 23.2.2 PIXIT		
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 step 1 and 2 with a large (maximum) size file 4. repeat step 3 10 times with unique file names		
Comment		

FtN1	GetFile, GetFileAttributeValues, DeleteFile with unknown file name	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 20.2.1, 20.2.4, 20.2.3 IEC 61850-8-1 clause 23.2 PIXIT		
Expected result a) DUT sends GetFile Response- b) DUT sends GetFileAttributeValues response- c) DUT sends DeleteFile response-		
Test description a) Client requests GetFile with unknown file b) Client requests GetFileAttributeValues with unknown file c) Client requests DeleteFile with unknown file		
Comment		

A4.15 Combinations & free form testing

Abstract test cases

Comb1	Test if reporting and control services keep on responding as specified while requesting other services 1. Combine server actions: Reporting, Logging, Goose subscribing/publishing, Time Sync with client request services ▪ enable reporting ▪ enable logging ▪ enable Goose publishing ▪ send Goose messages ▪ enable time synch ▪ enable other supported services that consumes processing time at server 2. Start requests of all supported request and control services. As soon as one request is responded issue a new request. Continue this for 10 minutes ▪ request logical server, logical node and data GetDataValues-services ▪ request GetDataSetValues-services ▪ request GetxRCBValues-services ▪ request QueryLog-services ▪ request GetFile-services ▪ select and operate control objects

Detailed test procedures

For free form testing a test lab can add extra test cases/procedures and propose these to the UCA IUG. The UCA IUG decides if and how to include the test case.

A5 Device performance [Future]

The UCA IUG decides what and how to measure the performance of a device. Consider:

- Number of repetitions for each test
- Background network load
- Background GOOSE messages (not subscribed)
- Number of subscribed GOOSE messages
- Time synchronization accuracy
- Average/maximum time from input to published GSE
- Average/maximum time from subscribed GSE to output
- Average/maximum time from subscribed GSE to published GSE

This work will be completed in future releases of this document.

ANNEX B - Detailed description of test results

This appendix contains detailed comments on test results, for instance when a defect is detected or to explain an inconclusive test result, including the actual message flow if appropriate.

<Test procedure identifier X>
<Additional extra information, e.g. a trace dump>

<Test procedure identifier Y>
<Additional extra information, e.g. a trace dump>