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

Revision 2.3

On request of the UCA International Users Group

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Author Richard Schimmel
KEMA Nederland

author	:	Richard Schimmel	06-11-11	reviewed	:	Marijn flohil	06-16-11
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Utrechtseweg 310, 6812 AR Arnhem, the Netherlands.
Telephone +31 26 3 56 91 11. Telefax + 31 26 3 51 56 06.

Revision	Changed test procedures	New test procedures
Rev 2.0 02Apr2007	Released to Users Group	
Rev 2.1 26Sep2007	Updated according to Charlotte test sub committee meeting: Sg2, Sg3, SgN3, Rp7, Rp9, RpN4, Br7, Br11, Br13, Ctl7, CtlN2, CtlN3, CtlN4, CtlN9, CtlN10, CtlN11, Does2, Does5, SBOes3, SBOes5	RpN7, BrN7, Tm3, SgN5
Rev 2.2 08Oct2007	Updated according to Dean Ouellette comments: Glossary, SgN5, Gop8	
Rev 2.2a 08Jan2009	Updated test descriptions according to TPCL December 2008 for the following procedures: AssN4, BrN4, BrN6, Cnf6, Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, Dset6, DsetN2, DsetN15, Ft1, FtN1, Gop3, Gop6, RpN6, SBOes2, SBOns1, Sg4, SgN1b, SgN2, SgN3, SgN4, SgN5, Srv6, Sub3, SubN1	
Rev 2.2b 07Apr2009	Updated test descriptions according to TPCL March 3, 2009 for the following procedures: CtlN2, FtN1, Srv6	
Rev 2.3 17Aug2011	Updated many test cases according to telephone conferences April and May and June 2001.	Rp12, Br14, Gos4 Added PIXIT template Added server certificate template

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

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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>
TICS	<complete reference description of the TICS>
PIXIT	<complete reference description of the PIXIT>
ICD	<complete reference description of the ICD configuration file>
SCD	<complete reference description of the SCD or CID 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 UCA certificate.

1.3 Purpose of this document

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

The test results are the basis of the conformance statement.

1.4 Contents of this document

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

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

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

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

1.5 Glossary

DUT	Device Under Test
ICD	IED configuration description in SCL-format
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
TICS	Technical Issues Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
TISSUE	Technical issue
TPAA	Two-Party Application Association (Client-Server relationship)
UCAIUG	UCA International Users Group

2 REFERENCES

2.1 Normative

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

IEC/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 61850-10, *Communication networks and systems in substations – Part 10: Conformance testing; First edition 2005-05*

2.2 **Other**

IS 9646 – OSI – Conformance testing methodology and framework

UCA International User Group: Conformance Test Procedures for Server Devices with IEC 61850-8-1 Interface Revision 2.3, April, 2011

UCA International User Group: Test Procedures Change List (TPCL) for IEC 61850 server test procedures revision 2.3, Version XX, <date>

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

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

http://tissues.iec61850.com/

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

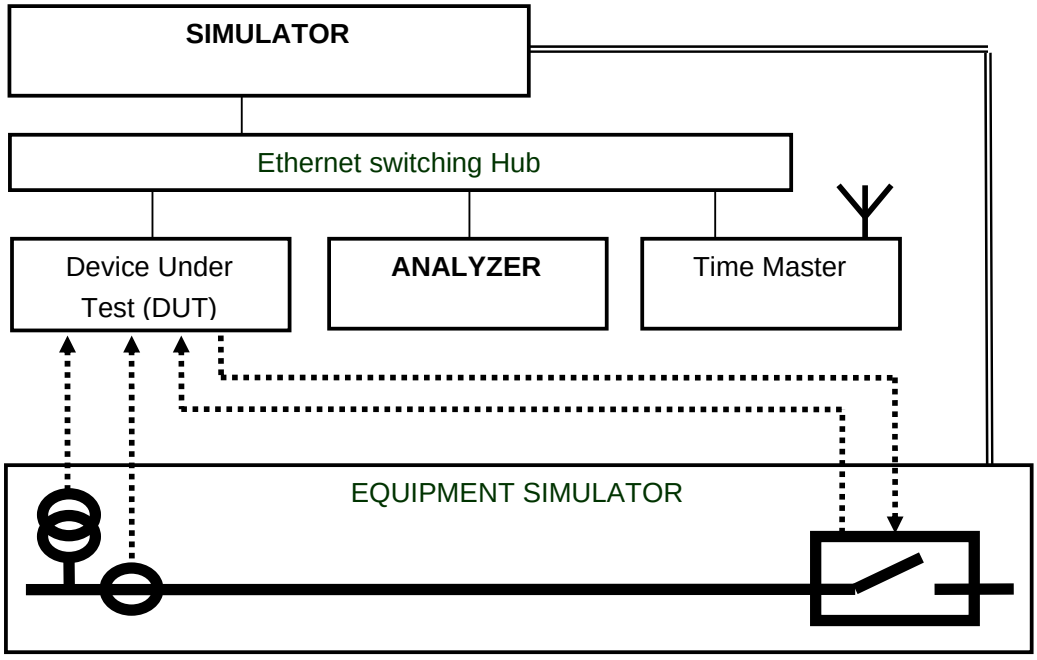

Figure 3.1 The test environment

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 and IEC 61850-8-1)
    - Application association
    - Server & Logical Device & Logical Node & Data
    - Data set
    - Substitution
    - Setting group control
    - Reporting
    - Logging
    - Generic Substation events
    - 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

Tables 4.1 and 4.2 in this Chapter give an overview of the conformance test results. References shown in the table columns refer to the individual test procedures in Annex A. The Mandatory column indicates the mandatory test cases and the Conditional column indicates the same for the conditional test cases. The Inconclusive column indicates those test cases that did not pass nor fail.

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

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Ass1, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	AssN6 Srv6, Srv7, Srv8, Srv9, Srv10, SrvN1e, SrvN1f, SrvN2, SrvN3
2: Data Sets	Dset1, Dset10a, DsetN1ae	Dset10b, DsetN1b, DsetN16
2+: Data Set Definition	Dset2, Dset3, Dset4, Dset5, Dset6, Dset7, Dset8, Dset9 DsetN1cd, DsetN2, DsetN3, DsetN4, DsetN5, DsetN6, DsetN7, DsetN8, DsetN9, DsetN10, DsetN11, DsetN12, DsetN13, DsetN14, DsetN15	
3: Substitution	Sub1, Sub2, Sub3, SubN1	
4: Setting Group Selection	Sg1, SgN1a	Sg3
4+: Setting Group Definition	Sg2, Sg4, SgN1b, SgN2, SgN3, SgN4, SgN5	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10, Rp12 RpN1, RpN2, RpN3, RpN4	Rp5, Rp6, Rp8, Rp9, Rp11, RpN5, RpN6, RpN7
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12, Br14 BrN1, BrN2, BrN3, BrN4, BrN5	Br5, Br6, Br10, Br11, Br13, BrN6, BrN7
6+: Enhanced buffered reporting	BrE1, BrE2, BrE3, BrE6, BrE7, BrE8, BrE9, BrE10, BrE11	BrE4, BrE5, BrE12
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7, Gop10a	Gop1, Gop5, Gop6, Gop8, Gop9, Gop10b, GopN1, GopN2
9b: GOOSE subscribe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	Gos1b, Gos4
12a: Direct control	CtlN3, CtlN8 DOns1, DOns3	Ctl2, Ctl4, Ctl7, CtlN10, CtlN11 DOns2, DOns4, DOns5
12b: SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, SBOns2	Ctl2, Ctl4, Ctl7, CtlN10, CtlN11 SBOns3, SBOns4, SBOns5
12c: Enhanced Direct Control	CtlN3, CtlN8 DOes2, DOes5	Ctl2, Ctl4, Ctl7, CtlN6, CtlN10, CtlN11, DOes1, DOes3, DOes4
12d: Enhanced SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, CtlN9 SBOes1, SBOes2, SBOes3	Ctl2, Ctl4, Ctl7, CtlN6, CtlN10, CtlN11, SBOes4, SBOes5, SBOes6, SBOes7
13: Time sync	Tm1, Tm2, TmN1	Tm3, TmN2
14: File transfer	Ft1, Ft2ab, Ft4, FtN1ab	Ft2c, Ft3, FtN1c

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

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

5 CONCLUSIONS 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 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1 as specified in the PICS, MICS, PIXIT, TICS and ICD and configured according to the SCD.

5.1 Recommendations following from the test

The following comments and recommendations apply for the *DUT*:

<Comments and Recommendations from *TEST FACILITY*>

ANNEX A – Detailed Test procedures and results

A1. Documentation (IEC 61850-4)

Id	Test procedure	Verdict
Doc1	Check if the manufacturer documentation and hardware / software versions of the DUT do match: a) PICS b) MICS c) PIXIT d) TICS e) Hardware/software versions match	☐ Passed ☐ Failed ☐ Inconclusive
Doc2	Verify the MICS describes the semantics of all non-standard Logical Nodes, Data Objects, Data Attributes and enumerations	☐ Passed ☐ Failed ☐ Inconclusive

A2. Configuration file (IEC 61850-6)

Id	Test procedure	Verdict
Cnf1	Test if the ICD configuration file conforms to the SCL schema (IEC 61850-6)	☐ Passed ☐ Failed ☐ Inconclusive
Cnf2	Check if the ICD configuration file corresponds with the actual data names, data types, data-sets, pre-defined data values 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. Check that the	☐ Passed ☐ Failed ☐ Inconclusive

	configuration is changed back.	
Cnf4	Check if the server capabilities in the ICD “services” section do match with the IED capabilities	☐ Passed ☐ Failed ☐ Inconclusive
Cnf5	In case the control model is fixed (not configurable) check if the ICD correctly initializes the ctlModel values for all controllable objects	☐ Passed ☐ Failed ☐ Inconclusive

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

Id	Test procedure	Verdict
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
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 Tissue #35, #37, #38, #39, #40, #42 - IEC 61850-7-3 Tissue #58 - IEC 61850-7-4 Tissue #72, #75, #76 - IEC 61850-8-1 Tissue #114, #120	☐ 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
Mdl10	Check if the order of the data attributes within the Data Object types match with IEC 61850-7-3 Passed when all attributes are in matching order	☐ Passed ☐ Failed ☐ Inconclusive
Mdl11	Check if the order of the data objects within the Logical Node types match with IEC 61850-7-4 Passed when all objects are in matching order	☐ Passed ☐ Failed ☐ Inconclusive

Note: the attached list(s) 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 Unbuffered Reporting
A4.7 Buffered Reporting
A4.8 Logging [FUTURE]
A4.9 Generic object oriented substation events (GOOSE)
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	
6+: Enhanced buffered reporting	When tissue #453 is implemented	
7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	SetLCBValues
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, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	AssN6 Semantics: Srv9, Srv10 PICS-AlternateAccess: Srv8, SrvN1f PICS-SetDataValues: Srv6, Srv7, SrvN1e, SrvN2, SrvN3
2: Data Sets	Dset1, Dset10a, DsetN1ae	SCL-SetDataSetValues: Dset10b, DsetN1b, DsetN16
2+: Data Set Definition (SCL-DynDataSet)	Dset2, Dset3, Dset4, Dset5, Dset6, Dset7, Dset8, Dset9 DsetN1cd, DsetN2, DsetN3, DsetN4, DsetN5, DsetN6, DsetN7, DsetN8, DsetN9, DsetN10, DsetN11, DsetN12, DsetN13, DsetN14, DsetN15	
3: Substitution	Sub1, Sub2, Sub3, SubN1	
4: Setting Group Selection (SCL-ConfSG)	Sg1, SgN1a	PICS-GetSGValues: Sg3
4+: Setting Group Definition (SCL-SGEdit)	Sg2, Sg4, SgN1b, SgN2, SgN3, SgN4, SgN5	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10,Rp12, RpN1, RpN2, RpN3, RpN4	PICS-Segmentation: Rp5 SCL-RCB.DatSet=dyn: Rp6 PIXIT-URCB visible to all clients: RpN5 PIXIT-Unsupported options: RpN6 PIXIT-data objects: Rp8 PIXIT-data attributes: Rp9 Controllable mode: Rp11 Assign: RpN7

Conformance Block	**Mandatory**	**Conditional**
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12. Br14, BrN1, BrN2, BrN3, BrN4, BrN5	PICS-Segmentation: Br5 SCL-RCB.DatSet=dyn: Br6 PIXIT-Unsupported options: BrN6 PIXIT-data objects: Br10 PIXIT-data attributes: Br11 Controllable mode: Br13 Assign: BrN7
6+: Enhanced buffered reporting (when tissue #453 is implemented)	BrE1, BrE2, BrE3, BrE6, BrE7, BrE8, BrE9, BrE10, BrE11	ResvTms: BrE4, BrE5 SCL-RCB.DatSet=dyn: BrE12
7: Logging	To be defined	
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7, Gop10a	PICS-GetGoCBValues: Gop1 PIXIT-Test mode: Gop5 PICS-SetGoCBValues: Gop6, Gop8, Gop9, GopN1 Dataset to large: GopN2 PIXIT-data objects: Gop10b
9b: GOOSE subscribe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	No VLAN: Gos1b Support FCD: Gos4
9c: GOOSE mngt (SCL-GSEDir)	Gom1, GomN1	
12a Direct control	CtlN3, CtlN8 DOns1, DOns3	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 PICS-TimeActivatedOperate: Ctl4, DOns2, DOns4, DOns5 PIXIT-Mode: CtlN10 Local: CtlN11
12b SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4 SBOns2	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 PICS-TimeActivatedOperate: Ctl4, SBOns3, SBOns5 PIXIT-Operate-Many: SBOns4, SBOns5 PIXIT-Mode: CtlN10 Local: CtlN11

Conformance Block	**Mandatory**	**Conditional**
12c Enhanced Direct Control	CtlN3, CtlN8 DOes2, DOes5	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 PICS-TimeActivatedOperate: Ctl4, DOes1, DOes3, DOes4 AddCauses: CtlN6 PIXIT-Mode: CtlN10 Local: CtlN11
12d Enhanced SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, CtlN9 SBOes1, SBOes2, SBOes3	PIXIT-Test mode: Ctl2 PIXIT-Check: Ctl7 PICS-TimeActivatedOperate: Ctl4, SBOes4, SBOes5, SBOes7 PIXIT-Operate-Many: SBOes6 AddCauses: CtlN6 PIXIT-Mode: CtlN10 Local: CtlN11
13 Time sync	Tm1, Tm2, TmN1	PIXIT-ClockFailure: TmN2 PIXIT-Time zone: Tm3
14 File transfer	Ft1, Ft2ab, Ft4, FtN1ab	PICS-SetFile: Ft3 PICS-DeleteFile: Ft2c, FtN1c

Note that AssN1, Ctl5, Ctl6, CtlN5, CtlN7, SBOns1 are not applicable for IEC 61850 part 8-1 and not referenced in this table.

The following paragraphs describe the abstract test cases and corresponding 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
AssN6	Re-use of dropped association resource

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 3 250 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 Release 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 3 250 times		
Comment		

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 + / +

"-" = associate failed, DUT sends response-
"+" = associate succeeded, DUT sends response+

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 Association response+ for a count of at least the maximum server associate value in the PIXIT 3. DUT sends Release response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client sends Associate request until DUT sends response- 3. Client sends release for all accepted associations 4. Repeat step 2 and 3 250 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 no 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, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), 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 until the DUT is initialised 4. Client requests Associate and DUT response+		
Comment		

AssN6	Re-use of dropped association resource	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 7.4, IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 2. DUT sends at least one Associate response+ 3. DUT sends Abort response+ 5. DUT sends Associate response+ 6. DUT sends GetDataValues response+ 7. Note: DUT should internally abort all stack layers, a half-open TCP connection is not allowed 9. DUT sends Associate response+. 10. DUT sends GetDataValues response+		
Test description 1. Configure the SIMULATOR and DUT with the correct association and authentication parameters 2. Client 1 requests associations until they are refused 3. Client 1 aborts the last association 4. DUT issues keepalives on all associations 5. Client 2 requests association and sends keepalives 6. Client 2 requests a correct GetDataValues 7. Disconnect physical link between Client 2 and the switch, some seconds longer than the KEEPALIVE timeout specified in the PIXIT 8. Connect the physical link to Client2 9. Client 2 requests association 10. Client 2 requests a correct GetDataValues		
Comment		

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

Abstract test cases

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 – GetServerDirectory(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 Note: IEC 61850-8-1 maps both GetLogicalNodeDirectory(DATA) and GetLogicalDeviceDirectory to GetNameList service.		

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 Note1: IEC 61850-8-1 maps the functional constraint between the Logical Node and Data Object. As such Srv4 issues requests including the functional constraint: <LD>/<LN><FC><DO> Note2: IEC 61850-8-1 maps both GetDataDirectory and GetDataDefinition to GetVariableAccessAttributes		

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 Note: It is allowed that the GetDataValues on logical node level may fail for large logical nodes caused by server MMS PDU size limitations.		
Test description 1. Client requests one GetDataValues with multiple data objects 2. Client requests one GetDataValues of at least the following data objects for the supported data hierarchy level: – Functional constrained data: LLN0STMod – Functional constrained data attribute: LLN0STMod$stVal – Functional constrained data attribute type attribute		
Comment		

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

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 GetDataValues response+ with original values 2. DUT sends SetDataValues response+ 3. DUT sends GetDataValues response+ with the new values		
Test description 1. Client requests one GetDataValues with multiple data objects 2. Client requests one SetDataValues with multiple data objects with new valid values 3. Client request one GetDataValues		
Comment Tested with … objects		

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+ 2. DUT sends GetAllDataValues response+		
Test description 1. For each Logical Node and supported functional constraint the Client sends a GetAllDataValues request using MMS Alternate Access where the alternate access contains at least an allowed Data FC: ST, MX, CF, SP, DC, EX. 2. For each Logical node the Client sends a GetAllDataValues request using object reference <IED><LD>/<LN>$<FC> where FC can be: ST, MX, CF, SP, DC, EX.		
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 GetDataValues 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 GetDataValues 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 GetDataValues 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, Table 27, Table 23 Tissue #116		
Expected result a) DUT sends MMS service error with error class access object-non existent (table 27) b) DUT sends MMS service error with error class access object-non existent (table 27) c) DUT sends MMS service error with error class access object-non existent (table 27) d) DUT sends response with Access result “object-non-existent” (table 23) e) DUT sends response with Access result “object-non-existent” (table 23) f) DUT sends response with Access result “object-non-existent” (table 23)		
Test description Client requests the following data services with wrong parameters (unknown object, logical device and/or logical node, known object but with a name case mismatch when applicable): a) GetLogicalDeviceDirectory b) GetLogicalNodeDirectory (for part 8-1 same as a)) 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 10.4.3 IEC 61850-8-1 clause 13.2.1-4		
Expected result 1. DUT sends response with data access error “object-value-invalid” (see note below table 23)		
Test description 1. Client sends a SetDataValues request of an ENUMERATED data object with an out-of-range value		
Comment		

SrvN3	SetDataValues with mismatching data type	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.3 IEC 61850-8-1 clause 13.2.1-4, Table 23		
Expected result 1 to 4: DUT sends response with data access error “type-inconsistent”		
Test description 1. Client sends a SetDataValues request with an integer data object with a float value 2. Client sends a SetDataValues request with a float data object with an integer value 3. Client sends a SetDataValues request with a boolean data object with a float value 4. Client sends a SetDataValues request with a bitstring data object with a float value		
Comment		

SrvN4	SetDataValues of read-only data objects	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 10.4.3 IEC 61850-8-1 clause 13.2.1-4, Table 23		
Expected result 1. DUT sends response with data access error “object-access-denied”		
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 member and with maximum possible 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 member, and verify response- service error
DsetN11	Create a non-persistent dataset with no member, 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		
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 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 member, 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. The data set is not available, it is deleted. DUT sends MMS service error with error class access object-non-existent (table 23) 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, 11.3.5 IEC 61850-8-1 clause 12.3.1, 14.3.3, 14.3.4		
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 a) The DUT returns the corresponding values for GetDataSetValues and GetDataValues b) Before the SetDataSetValues: – The values returned by GetDataSetValues and GetDataValues correspond After the SetDataSetValues: – The values returned by GetDataSetValues and GetDataValues correspond and contain the new values as set with SetDataSetValues and SetDataValues. Every service request results in a corresponding response+		
Test description a) Select or create a data set with read-only elements – Client requests a GetDataSetValues – Client requests a GetDataValues for each member of the dataset. b) Select or create a data set with writable elements – Client requests a GetDataSetValues – Client requests a GetDataValues for each member of the dataset. – Client requests a SetDataSetValues with different values than received by GetDataValues – Client requests a GetDataSetValues – Client requests a SetDataValues for each member of the dataset. – Client request GetDataSetValues		
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,
Tissue #165, #377

Expected result

a) DUT sends ServiceError with errorClass access “object-non-existent” (Tissue #165)
b) DUT sends ServiceError with errorClass access “object-non-existent” (Tissue #165)
c) DUT sends ServiceError with errorClass definition “invalid-address” (table 31)
d) DUT sends DeleteDataSet with numberMatched 0, numberDeleted 0 (Tissue #377)
e) DUT sends ServiceError with errorClass definition “object-undefined” (table 35)

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		
Expected result 1. DUT sends a response+, 2. DUT sends MMS service error with error class definition object-exists (table 31)		
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		
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 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 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 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		
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, not referenced in a report control block		
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 4. 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 4. Client disables the RCB and requests a DeleteDataSet on the data set created in step 1 5. Repeat step 1 to 4 for non-persistent dataset and unbuffered RCB		
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 with data set created in step1		
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
Sub3	Verify transmission of substituted values after reboot

SubN1	Verify setting subVal, subMag, subCMag, subQ and subID 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 PIXIT		
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 when substituted values are Non-Volatile and with process values when Volatile (PIXIT) 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 behaviour after reboot is not specified. PIXIT may describe cases where a local automatic function disables substitution		

SubN1	Substitute values when substitution 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 GetDataValues response+ with substituted values 5. DUT sends SetDataValues response+ 6. DUT sends GetDataValues response+ with new substituted values 7. DUT sends SetDataValues response+ 8. DUT sends GetDataValues response+ with process values		
Test description 1. Client requests GetDataValues of a ST and/or MX data object 2. Client requests SetDataValues of the SV data value attributes 3. Client requests SetDataValues to enable substitution 4. Client requests GetDataValues of a ST and/or MX data object 5. Client requests SetDataValues of the SV with new data value attributes 6. Client requests GetDataValues of the ST and/or MX data object 7. Client requests SetDataValues to disable substitution 8. Client requests GetDataValues of the ST and/or MX data object		
Comment		

A4.5 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); – SelectEditSG – 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 – Use GetSGValues [FC=SG] to verify the values are of first setting group – Repeat for all setting groups
Sg4	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)

SgN1a	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)
SgN1b	Request following setting group definition services with wrong parameters (out of range values, or non existent/null setting group) and verify response- service error – SelectEditSG (IEC 61850-7-2 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)
SgN2	Request SetSGValues (FC=SG), verify response- service error
SgN3	Request SetSGValues (FC=SE) when EditSG = 0, verify response- service error
SgN4	Request SelectEditSG of the first setting group, change one value and SelectEditSG of the second setting group without (ConfirmEditSGValues). Verify the changes will be lost
SgN5	Verify that the values of the active setting group can be edited and confirmed

Detailed test procedures

Sg1	GetLogicalNodeDirectory(SGCB)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 9.2.2, 13.3.7 IEC 61850-8-1 clause 12.3.1, 16.2.6		
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	SelectEditSG, 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 SelectEditSG response+ 2. DUT sends SetSGValues [FC=SE] response+ 3. DUT sends GetSGValues [FC=SE] response+ 4. DUT sends ConfirmEditSGValues response+, the value of CnfEdit shall return to FALSE once the storage is completed.		
Test description 1. Client requests SelectEditSG 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 Note: Sg3 must be executed after Sg2 to verify changed values are active		

Sg3	SelectActiveSG and 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 has set the activated setting group value 3. DUT sends GetSGValues response+		
Test description 1. Client requests SelectActiveSG of the first setting group 2. Client requests GetSGCBValues 3. Client requests GetSGValues [FC=SG] to verify the values in the first setting group 4. repeat step 1 and 2 for other setting groups for this SGCB		
Comment		

Sg4	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 SelectEditSG response+ 2. DUT sends SetSGValues [FC=SE] response+ 3. DUT aborts the association 4. DUT send associate response+ 5. DUT sends SelectEditSG response+ and the values in the edit buffer are refreshed. 6. DUT sends SetSGValues [FC=SE] response+ 7. DUT sends ConfirmEditSGValues response+		
Test description 1. Client requests SelectEditSG 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 SelectEditSG of the first setting group 6. Client requests SetSGValues [FC=SE] to change values 7. Client requests ConfirmEditSGValues		
Comment		

SgN1a	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		

SgN1b	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 SelectEditSG 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 SelectEditSG with out-of-range setting group b) Client requests SetSGValues with unknown object / wrong data type c) Client requests ConfirmEditSGValues with unknown object D) Client requests GetSGValues with FC=SE unknown object		
Comment		

SgN2	SetSGValues [FC=SG]	☐ 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=SG]		
Comment		

SgN3	SetSGValues when EditSG=0	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.3		
Expected result 2. DUT sends SetSGValues response-		
Test description 1. Client requests SelectEditSG with edit setting group 0 2. Client requests a valid SetSGValues [FC=SE]		
Comment		

SgN4	SelectEditSG without confirmation	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.2, 16.2.3, 16.2.5		
Expected result 1. DUT sends SelectEditSG 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 SelectEditSG response+ 6. DUT sends GetSGValues [FC=SE] response+, note that changes are lost		
Test description 1. Client requests SelectEditSG 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 SelectEditSG of the first setting group again 6. Client requests GetSGValues [FC=SE] to verify the original values		
Comment		

SgN5	Edit the active setting group	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 13.2, 13.3 IEC 61850-8-1 clause 16.2.1, 16.2.5		
Expected result 1. DUT sends SelectActiveSG response+ 2. DUT sends SelectEditSG response+ 3. DUT sends SetSGValues response+ 4. DUT sends ConfirmEditSGValues response+ and the values in the active buffer are refreshed		
Test description 1. Client requests SelectActiveSG of the first setting group 2. Client requests SelectEditSG of the first setting group 3. Client requests SetSGValues [FC=SE] 4. Client requests ConfirmEditSGValues		
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 – 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 14.2.3.2.2.5) – 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)
Rp8	Verify the DUT can send reports with data objects
Rp9	Verify the DUT can send reports with data attributes
Rp10	Verify the DUT send any buffered events before the integrity and GI report
Rp11	Verify that when the LLN0 Behaviour value changes from On to Off or Blocked no reports should be transmitted anymore for this logical device (IEC 61850-7-4 page 80)

RpN1	Request GetURCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 clause 14.2.5.3)
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
RpN7	Verify another client can not configure a pre-assigned URCB

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 URCB 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 URCB 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 and conf-rev
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)
4. Client disables the URCB (set RptEna to False)
5. Repeat step 1 to 4 for next combination of optional field

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 BufTm=0
   - data change reports are transmitted after BufTm of first data change when BufTm>0
4. The configured and reported optional fields should match
6. DUT does not sends reports

Test description

1. Configure an available RCB using SetURCBValues 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
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		

Rp5	Segmentation of reports URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.2.5 and 14.2.3.2.2.9 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 report timestamp		
Test description 1. Create or use a pre-configured data set which reported values do not fit in one MMS PDU (reduce the MMS PDU size when necessary) 2. Client configures an available URCB with the data set, with at least the optional fields sequence-number and report timestamp 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 4. The value of ConfRev is incremented		
Test description 1. Client configures an URCB with a data-set 2. Client request GetURCBValues() 3. Client configures the same URCB with another data-set 4. Client request GetURCBValues()		
Comment Test procedure is mandatory when datSet of RCB is dynamic see ICD.		

Rp7	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, at BufTm expiration DUT sends the report of the second data change
4. On second data change in BufTm DUT sends the report of the first data change, restarts the timer and at BufTm expiration DUT sends the report of the second data change OR DUT substitutes the current value in the pending report with the new one and sends it at BufTm expiration. Verify the behaviour matches PIXIT
5. DUT sends one report with both status events after BufTm expires
6. DUT sends one report with both analogue events after BufTm expires
7. Each data change result in a report
8. DUT accepts BufTm value 3.600.000

Test description

1. Client configures an available URCB using SetURCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data change and quality change
2. Client enables the URCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces two data changes of the same status data set element in the data set before expiration of BufTm
4. EQUIPMENT SIMULATOR forces two data changes of the same analogue data set element in the data set before expiration of BufTm
5. EQUIPMENT SIMULATOR forces one data change of two different status data set elements in the data set before expiration of BufTm
6. EQUIPMENT SIMULATOR forces one data change of two different analogue data set elements in the data set before expiration of BufTm
7. Client disables the URCB, sets BufTm to zero; repeat step 2, 3 and 4
8. Client disables the URCB, sets BufTm to 3.600.000
9. Client disables the URCB

Comment

Rp8	Report data objects (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.2		
Expected result 2. Verify the DUT does report the whole data object		
Test description 1. Configure DUT to report on data change of one or more data objects 2. Change the data portion of one data object		
Comment		

Rp9	Report data attributes (FCDA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.2 PIXIT		
Expected result 2. DUT reports the “data” attribute. Verify that the “timestamp” and “quality” attribute are not sent 3. All attributes are reported 4. All attributes are reported		
Test description 1. Configure DUT to report a change on one or more data attributes including the “data” attribute and “quality” attribute of the same data object. If the PIXIT indicates timestamps are supported as data set attributes, then configure the “timestamp” attribute for this object 2. Force a change of the data attribute value 3. Request a general interrogation 4. Wait for integrity report		
Comment		

Rp10	Send buffered events before integrity report	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-8-1 clause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data change event and then the integrity report		
Test description 1. Client configures an available URCB using SetURCBValues with a valid BufTm, a valid IntgPd whose value is smaller than the BufTm value and all supported optional fields with the trigger conditions: data change and integrity 2. Client enables the URCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a data change in the data set 4. Client disables the URCB		
Comment		

Rp11	Behaviour Off or Blocked stops reporting	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-7-4 page 80 IEC 61850-8-1 clause 17.2		
Expected result 2. DUT sends reports 3. DUT should not report the process value change within the logical device 4. DUT sends reports 5. DUT should not report the process value change within the logical device 6. DUT sends reports		
Test description 1. Client configures an available URCB with trigger condition “dchg” 2. Client enables the URCB, and force a process value data change 3. Client send Operate with LLN0 Mode = Off, and force a process value data change 4. Client send Operate with LLN0 Mode = On, and force a process value data change 5. Client send Operate with LLN0 Mode = Blocked, and force a process value data change 6. Client send Operate with LLN0 Mode = On, and force a process value data change 7. Client disables the URCB		
Comment		

Rp12	Send buffered events before GI	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-8-1 clause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data change event and then the general interrogation report		
Test description 1. Client configures an available URCB using SetURCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data change and general-interrogation 2. Client enables the URCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a change in the data set and then the Client requests SetURCBValues (GI=TRUE) before expiration of BufTm 4. 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 3. DUT does not send reports when reporting is enabled		
Test description 1. Configure an available URCB using SetURCBValues with trigger condition Integrity and integrity period 0 2. Client enables the URCB, set RptEna to True 3. Wait one minute 4. Client disables the URCB, set RptEna to False		
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, Table 23		
Expected result 2. DUT sends SetURCBValues() response with data access error “temporarily-unavailable” 4. DUT sends SetURCBValues() response with data access error “object-access-denied” 5. DUT sends SetURCBValues() response with data access error “object-value-invalid”		
Test description 1. Client configures and enables an available URCB 2. Client requests SetURCBValues() with one of the following “dyn” attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd 3. Client disables the URCB 4. Client requests SetURCBValues() with one of the following attributes ConfRev, SqNum and DatSet (when “fix” or “conf”) 5. Client requests SetURCBValues() with unknown DatSet (when DatSet is “dyn”)		
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 Tissue #114		
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 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- with error “object-value-invalid"		
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 unsupported 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>		

RpN7	Pre-assigned URCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.2		
Expected result 1. DUT sends SetURCBValues() response-		
Test description 1. Client configures an URCB that is pre-assigned to another client		
Comment		

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 BRCB with all optional fields combinations: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer-overflow, and/or entryID (IEC 61850-7-2 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 – 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)
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 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.
Br10	Verify the DUT can send reports with data objects
Br11	Verify the DUT can send reports with data attributes
Br12	Verify that all buffered events shall be sent before integrity and GI reports can be sent (IEC 61850-7-2 clause 14.2.3.2.3.3)
Br13	Verify that when the LLN0 behaviour value changes from On to Off or Blocked no reports should be transmitted anymore for this logical device (IEC 61850-7-4 page 80)

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). 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
BrN7	Verify another client can not configure a pre-assigned BRCB

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, Tissue #297 and #301

Expected result

1. DUT sends SetBRCBValues response+
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 (Tissue #297 and #301)
   - the report time stamp is in binary time 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 BRCB 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

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 and conf-rev
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)
4. Client disables the BRCB (set RptEna to False)
5. Repeat step 1 to 4 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 BufTm=0
   - data change reports are transmitted after BufTm of first data change when BufTm>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
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 BRCB	☐ 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 **and EntryID**		
Test description 1. Create or use a pre-configured data set which reported values do not fit in one MMS PDU (reduce the MMS PDU size when necessary) 2. Client configures an available BRCB with the data set, with at least the optional fields sequence-number and report timestamp 3. Client enables the BRCB and verify the segmentation of (integrity) reports 4. Client disables the BRCB		
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 4. The value of ConfRev is incremented		
Test description 1. Client configures a BRCB to use a data-set 2. Client request GetBRCBValues() 3. Client configures the same BRCB with another data-set 4. Client request GetBRCBValues()		
Comment Test procedure is 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, at BufTm expiration DUT sends the report of the second data change 4. On second data change in BufTm DUT sends the report of the first data change, restarts the timer and at BufTm expiration DUT sends the report of the second data change OR DUT substitutes the current value in the pending report with the new one and sends it at BufTm expiration. Verify the behaviour matches PIXIT 5. DUT sends one report with both status events after BufTm expires 6. DUT sends one report with both analogue events after BufTm expires 7. Each data change result in a report 8. DUT accepts BufTm value 3.600.000		
Test description 1. Client configures an available BRCB using SetBRCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data change and quality change 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces two data changes of the same status data set element in the data set before expiration of BufTm 4. EQUIPMENT SIMULATOR forces two data changes of the same analogue data set element in the data set before expiration of BufTm 5. EQUIPMENT SIMULATOR forces one data change of two different status data set elements in the data set before expiration of BufTm 6. EQUIPMENT SIMULATOR forces one data change of two different analogue data set elements in the data set before expiration of BufTm 7. Client disables the BRCB, sets BufTm to zero; repeat step 2, 3 and 4 8. Client disables the BRCB, sets BufTm to 3.600.000 9. Client disables the BRCB		
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 Tissues #297 and #301		
Expected result 8. the BRCB shall start sending the reports of events that have been buffered starting with the next event after the event specified in EntryID (see the note in Clause 14.2.2.15). 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 condition: data 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 set a valid EntryID in the BRCB 8. Client enables the BRCB		
Comment		

Br10	Report data objects (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.2		
Expected result 2. Verify the DUT does report the whole data object		
Test description 1. Configure DUT to report on data change of one or more data objects 2. Change the data portion of one data object		
Comment		

Br11	Report data attributes (FCDA)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.2		
Expected result 2. DUT reports the “data” attribute. Verify that the “timestamp” and “quality” attribute are not sent 3. All attributes are reported 4. All attributes are reported		
Test description 1. Configure DUT to report a change on one or more data attributes including the “data” attribute and “quality” attribute of the same data object. If the PIXIT indicates timestamps are supported as data set attributes, then configure the “timestamp” attribute for this object 2. Force a change of the data attribute value 3. Request a general interrogation 4. Wait for integrity report		
Comment		

Br12	Send buffered events before integrity report	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-8-1 clause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data change event and then the integrity report		
Test description 1. Client configures an available BRCB using SetBRCBValues with a valid BufTm, a valid IntgPd whose value is smaller than the BufTm value and all supported optional fields with the trigger conditions: data change and integrity 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a data change in the data set 4. Client disables the BRCB		
Comment		

Br13	Behaviour Off or Blocked stops reporting	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-7-4 page 80 IEC 61850-8-1 clause 17.2		
Expected result 2. DUT sends reports 3. DUT should not report the process value change within the logical device 4. DUT sends reports 5. DUT should not report the process value change within the logical device 6. DUT sends reports		
Test description 1. Client configures an available BRCB with trigger condition “dchg” 2. Client enables the BRCB, and force a process value data change 3. Client send Operate with LLN0 Mode = Off, and force a process value data change 4. Client send Operate with LLN0 Mode = On, and force a process value data change 5. Client send Operate with LLN0 Mode = Blocked, and force a process value data change 6. Client send Operate with LLN0 Mode = On, and force a process value data change 7. Client disables the BRCB		
Comment		

Br14	Send buffered events before GI	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.3.2.3.3 IEC 61850-8-1 clause 17.2		
Expected result 3. DUT does send 2 reports: first a report with the buffered data change event and then the general interrogation report		
Test description 1. Client configures an available BRCB using SetBRCBValues with a valid BufTm and all supported optional fields with the trigger conditions: data change and general-interrogation 2. Client enables the BRCB, set RptEna to True 3. EQUIPMENT SIMULATOR forces a change in the data set and then the Client requests SetBRCBValues (GI=TRUE) before expiration of BufTm 4. Client disables 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 Br3 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 4. DUT does not send integrity reports		
Test description 1. Configure an available BRCB using SetBRCBValues with trigger condition Integrity and integrity period 0 2. Wait one minute 3. Client sets the BRCB RptEna to True (without synchronizing the BRCB by setting the BRCB EntryID) 4. Wait one minute 5. Client disables the BRCB		
Comment		

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 with data access error “temporarily-unavailable” 4. DUT sends SetBRCBValues() response with data access error “object-access-denied” 5. DUT sends SetBRCBValues() response with data access error “object-value-invalid”		
Test description 1. Client configures and enable an available BRCB 2. Client requests SetBRCBValues() with one of the following “dyn” 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 (when “fix” or “conf”) 5. Client requests SetBRCBValues() with unknown DatSet (when DatSet is “dyn”)		
Comment		

BrN5	Exclusive use of BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1, 14.2.2.5 IEC 61850-8-1 clause 17.1.1.2		
Expected result 2. DUT sends SetBRCBValues() response-		
Test description 1. Client1 configures and enables an available BRCB 2. Client2 configures the same BRCB by requesting SetBRCBValues() with one of the following attributes RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd, PurgeBuf, EntryID 3. 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- with data access error “object-value-invalid"		
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>		

BrN7	Pre-assigned BRCB	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 14.2.1 IEC 61850-8-1 clause 17.1.1.2		
Expected result 1. DUT sends SetBRCBValues() response-		
Test description 1. Client configures an BRCB that is pre-assigned to another client		
Comment		

A4.7+ Enhanced Buffered Reporting

Abstract test cases for tissue: 49, 190, 191, 275, 278, 297, 300, 322, 329, 335, 349 as specified in annex “Reporting Version7.zip” of tissue #453

BrE1	Verify that integrity reports are buffered
BrE2	Verify that the first report after RptEna is set to true always has SqNum=0
BrE3	Verify that BufOvl flag is set at the first report after the BRCB is enabled and reset at the following reports
BrE4	Verify successful ResvTms behaviour • On ResvTms = -1 the BRCB can be used by the configured client • On ResvTms = 0 a client can reserve the BRCB by writing a value and configure the BRCB • On lost association the reserved BRCB is released after the ResvTms number of seconds
BrE5	Verify that a SetBRCBValues request, for setting ResvTms, shall: • Generate a negative response if the BRCB’s ResvTms value is -1. • Generate a negative response if the BRCB’s ResvTms value is non-zero and if the SetBRCBValues request is being issued by another client for whom the BRCB is not reserved. • Generate a negative response if the ResvTms value to be set is negative.
BrE6	Verify that TimeOfEntry and EntryID pair are consistent after restoring a lost association by setting the EntryID to zero to transmit the whole buffer again
BrE7	Verify that a change of one of the following BRCB parameters purges the buffer: RptID, BufTm, TrgOps, IntgPd, DatSet. A change of OptFlds should not purge the buffer
BrE8	Verify that after setting an invalid or non-existing EntryID the DUT sends all reports in the buffer
BrE9	Verify that without the GI trigger condition the DUT does not send GI reports
BrE10	Verify that when the BRCB state is RptEna=FALSE a GetBRCBValues shall return the EntryID value that represents the last (newest) entry that has been entered into the buffer. And when the BRCB RptEna=TRUE: The value of EntryID, returned in a GetBRCBValues response, shall be the EntryID of the last EntryID formatted and queued for transmission.
BrE11	Verify that only the last buffered GI report is transmitted after restoring a lost association
BrE12	Verify the DUT increments ConfRev when the BRCB datset is changed using SetBRCBValues()

BrE1 BrE2 BrE3	Buffer integrity reports First report has Sequence number 0 BufOvl flag is set only at first report	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		

BrE1 BrE2 BrE3	Buffer integrity reports First report has Sequence number 0 BufOvl flag is set only at first report	☐ Passed ☐ Failed ☐ Inconclusive
Expected result 1 to 6: Integrity reports are buffered after the association is released and reporting is disabled 3. and 7. First report after BRCB is enabled has sequence number 0 8. First report after BRCB is enabled has sequence number 0 and BufOvl=True, following reports have BufOvl=False		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and integrity with a valid integrity period 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes 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 3 to 7 and but force a buffer overflow at step 5		
Comment		

BrE4	Successful BRCB reservation	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 1. DUT accepts configuration and send reports as configured 2. DUT accepts configuration and send reports as configured 4. DUT responds ResvTms = 0		

BrE4	Successful BRCB reservation	☐ Passed ☐ Failed ☐ Inconclusive
Test description 1. The pre-assigned client (compare ClientLN in SCL) configures and enables a pre-configured BRCB with ResvTms = -1 2. Client configures and enables a BRCB with ResvTms = 0 (no ClientLN in SCL) after it has set the ResvTms to a positive value 3. Client requests Release and wait 2 seconds longer then the ResvTms period 4. Client re-establishes the association and requests GetBRCBValues()		
Comment		

BrE5	Failed BRCB reservation	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 1. DUT sends SetBRCBValues respond- 2. DUT sends SetBRCBValues respond- to Client2 3. DUT sends SetBRCBValues respond-		
Test description 1. A non pre-assigned client configures a BRCB which is assigned to another client (ResvTms = -1) 2. Client1 reserves a BRCB with ResvTms = 0 by setting the ResvTms to a positive value. Client2 configures the same BRCB 3. Client set ResvTms=-1 on a BRCB with ResvTms = 0		
Comment		

BrE6	TimeOfEntry and EntryID	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 8. The matching EntryID's in the reports send at step 3 and 8 have the same TimeOfEntry		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and integrity with a valid integrity period 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes 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 sets the EntryID=0 8. Client enables the BRCB		
Comment		

BrE7	Purge buffer	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 8..12. The buffer is purged, buffered reports are not transmitted 13. The buffer is NOT purged, buffered reports are transmitted		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and Integrity with a valid Integrity period 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes 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 changes the RptID 8. Client enables the BRCB 9. Repeat step 3 to 8 and at step 7 client changes the BufTm 10. Repeat step 3 to 8 and at step 7 client changes the TrgOps 11. Repeat step 3 to 8 and at step 7 client changes the IntgPd 12. Repeat step 3 to 8 and at step 7 client changes the DatSet 13. Repeat step 3 to 8 and at step 7 client changes the OptFlds		
Comment		

BrE8	Invalid EntryID	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 8. DUT responds with the EntryID value of the last Entry entered in the buffer 9. All reports in the buffer are transmitted (the BRCB transits from disabled to enabled state)		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and integrity with a valid integrity period 2. Client enables the BRCB (set RptEna to True) 3. EQUIPMENT SIMULATOR forces several data changes 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 sets an invalid or unknown EntryID value 8. Client requests GetBRCBValues() 9. Client enables the BRCB		
Comment		

BrE9	GI without GI trigger condition	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 3. DUT does not send the GI report 4. DUT responds GI=false		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and Integrity with a valid Integrity period, without GI 2. Client enables the BRCB (set RptEna to True) 3. Client sets GI=true 4. Client requests GetBRCBValues()		
Comment		

BrE10	GetBRCBValues and EntryID	☐ Passed ☐ Failed ☐ Inconclusive

TISSUE 453

Expected result

7. DUT responds the EntryID of the last entry that has been entered into the buffer (this value is different from the EntryID received in the last report)
8. DUT transmits the reports in the buffer (not transmitted before)
9. DUT responds the EntryID of last entry that has been formatted and queued for transmission
11. DUT responds the EntryID of the last entry that has been entered into the buffer
13. DUT responds the EntryID of the last entry that has been entered into the buffer
14. DUT transmits all reports in the buffer (including the reports transmitted before)
15. DUT responds the EntryID of last entry that has been formatted and queued for transmission

Test description

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

Comment

BrE11	GI reports not transmitted	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 3. DUT transmits the integrity reports and the GI reports 8. DUT transmits the old and new integrity reports and only the last GI report		
Test description 1. Client configures a BRCB with all supported optional fields with the trigger condition data change and integrity with a valid integrity period 2. Client enables the BRCB (set RptEna to True) 3. Client requests GI report 3 times 4. Client requests Release and waits several integrity periods 5. Client re-establishes the association 6. Client sets EntryID to 0 7. Client request GetBRCBValues 8. Client enables the BRCB		
Comment		

BrE12	DUT increments ConfRev when datset changes	☐ Passed ☐ Failed ☐ Inconclusive
TISSUE 453		
Expected result 4. DUT has incremented the ConfRev value in the BRCB 5. DUT transmits reports with the new ConfRev		
Test description 1. Client request a GetBRCBValues() of a valid BRCB 2. Client disables the BRCB 3. Client changes the data set by deleting a dataset member or reordering dataset members. 4. Client request a GetBRCBValues() 5. Client enables the BRCB with optional field ConfRev		
Comment		

A4.8 Logging [Future]

Abstract test cases

Test case	Test case description
Log1	Request GetLogicalNodeDirectory(LOG) and check response+
Log2	Request GetLogicalNodeDirectory(LCB) and check response+
Log3	Request GetLCBValues with functional constraint LG of all responded LCB's
Log4	Request SetLCBValues with functional constraint LG when LCB is disabled
Log5	Verify that logging is independent of a limited set of external application associations or other communication transactions
Log6	Configure and enable logging and check that the following logging trigger conditions place a correct entry in the log with the correct members of the data set – on integrity – on update (dupd) – on update with integrity – on data change (dchg) – on quality change (qchg) – on data and quality change – on data and quality change with integrity period
Log7	Request QueryLogByTime and check response+
Log8	Request QueryLogByEntry and check response+
Log9	Request GetLogStatusValues and check response+, verify that the responded entries indicate the oldest/newest entry ID/time available in the log

Test case	Test case description
LogN1	Request the following log services with wrong parameters (out of range entries, or non existent Dataset, LCB or Log) and verify response– service error – GetLCBValues (IEC 61850-7-2 Subclause 14.3.2.5) – SetLCBValues (IEC 61850-7-2 Subclause 14.3.2.6) – QueryLogByTime (IEC 61850-7-2 Subclause 14.3.5.2) – QueryLogByEntry (IEC 61850-7-2 Subclause 14.3.5.3) – GetLogStatusValues (IEC 61850-7-2 Subclause 14.3.5.4)
LogN2	Request SetLCBValues with functional constraint LG when LCB is enabled and verify response– service error

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

A4.9 Generic Object Oriented Substation Events (GOOSE)

Compared to IEC 61850-10 the GSE test cases are defined for GOOSE and 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)
Gop10	Verify the DUT can send SendGOOSEmessage's with data attributes and/or data objects

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/without the VLAN tag with new data and check if the message is received and the data has the new value by e.g. check binary output, event list, logging or MMI
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)
Gos4	DUT subscribes to a GOOSE with a dataset containing structured data (FCD)

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 15.2.2.5 IEC 61850-8-1 clause 18.1.2.3		
Expected result 1. DUT sends GetLogicalNodeDirectory(GoCB) response+ with a list of GoCB's. The object reference shall be "LDName/LLN0.GoCBName" 2. DUT sends GetGoCBValues response+		
Test description 1. For each logical node Client requests GetLogicalNodeDirectory(GoCB) 2. For each GoCB Client requests GetGoCBValues()		
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 PIXIT		
Expected result 1. DUT sends initial GOOSE message with stNum one (1) and sqNum as specified in the PIXIT		
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 and test flag	☐ 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 flag set 2. DUT sends a GOOSE messages with test flag not set		
Test description 1. Test engineer enables test mode (Test flag = true in GOOSE header) 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+ and initializes/starts transmitting GOOSE messages. The first message has stNum=1.		
Test description 1. Client requests a SetGoCBValues with GoEna set to FALSE 2. Client requests a SetGoCBValues with GoEna set to TRUE		
Comment GoEna is the only attribute that may be written according to part 8-1.		

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 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 18.1 Tissue #333		
Expected result 2. DUT sends a GetGoCBValues response+ with NdsCom=TRUE		
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		

Gop10	GOOSE with data attributes (FCDA) and data objects (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2 IEC 61850-8-1 clause 18.1 PIXIT		
Expected result a) DUT sends a GOOSE messages with data attributes b) DUT sends a GOOSE messages with data objects		
Test description a) Verify the DUT is able to send GOOSE message with data attributes (FCDA) b) Verify the DUT able to send GOOSE message with data objects (FCD)		
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 that publishes the (changed) value(s) in the data set

As such the analyzer trace file contains the proof when the subscribed GOOSE messages is processed.

Gos1	Subscribe GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3 IEC 61850-8-1 clause 18.1		
Expected result DUT updates the value and sends a GOOSE message or Report with changed status value		
Test description Test engineer configures the DUT with subscribed GOOSE a) Publisher sends GOOSE message with new data value with the VLAN tag b) Publisher sends GOOSE message with new data value without the VLAN tag		
Comment		

Gos2	Subscribe GOOSE with Test or ndsCom set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3 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. Publisher sends GOOSE message with new data value with Test set 3. Publisher 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 15.2.3 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. Publisher sends GOOSE message with sqNum = max–1, max and 1 without status change 2. Publisher sends GOOSE message with sqNum = max–1, max 3. Publisher forces a status change stNum and sends a GOOSE message with incremented stNum and sqNum=0		
Comment		

Gos4	Subscribe to data set with structured data (FCD)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3 IEC 61850-8-1 clause 18.1, PIXIT		
Expected result 2. DUT responds to the status change		
Test description 1. Publisher sends GOOSE message with structured data 2. Publisher sends GOOSE message with a data change in a data attribute in the structured data		
Comment PIXIT specifies to which structured data the DUT can subscribe.		

GosN1	Missing GOOSE message	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 15.2.3 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 15.2.3 IEC 61850-8-1 clause 18.1		
Expected result 1. 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 15.2.3 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 15.2.3 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 15.2.3 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 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 18		
Expected result 1. DUT sends a GetGoReference response+ with the member reference 2. DUT sends a GetGOOSEElementNumber response+ with the same member offset as the GetGoReference() request		
Test description 1. Client requests a GetGoReference() for first member offset 2. Client requests a GetGOOSEElementNumber for responded member reference 3. Repeat 1 and 2 for next member offset in the GoCB		
Comment		

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+ with 2 correct MemberOffset and a NULL offset- 5. DUT sends a GetGOOSEElementNumber response-		
Test description 1. Client requests a GetGoReference with unknown GoCBReference and MemberOffset 1 2. Client requests a GetGoReference with MemberOffset 0, 1 and 2 3. Client requests a GetGoReference with MemberOffset n-1, n, n+1 (n is the number of elements in the dataset) 4. Client requests a GetGOOSEElementNumber with 2 known and 1 unknown GoCBReference 5. Client requests a GetGOOSEElementNumber with unknown MemberReference		
Comment		

A4.10 Control

Abstract test cases

Ctl1	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
Ctl2	Verify that with test flag set no operations to the process are performed.
Ctl3	Select all SBO control objects and cancel them in opposite order
Ctl4	Time Operate a second enhanced security control object before the activation time of the first control object
Ctl5	Change control model using online services >> not applicable for part 8-1
Ctl6	Enable/disable command termination using online services >> not applicable for part 8-1
Ctl7	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)

CtlN1	Operate (without select) for a SBO control object and verify the response- and AddCause (IEC 61850-7.2 clause 17.2.2)
CtlN2	Select twice, second select should fail and verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtlN3	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)
CtlN4	Select the same control object from 2 different clients, verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtlN5	Select / Operate an unknown control object and verify the response- and AddCause (IEC 61850-7-2 clause 17.2.2)
CtlN6	Verify situations to set specific other applicable AddCause values (IEC 61850-7-2 clause 17.5.2.6)
CtlN7	Select an direct operate control object >> not applicable for part 8-1
CtlN8	Operate a direct control object twice from 2 clients
CtlN9	Operate with different value then the SelectWithValue of a SBOes control object
CtlN10	Verify that on LLN0 behaviour Off or Blocked controls are rejected (IEC 61850-7-4 page 80)
CtlN11	Verify that when the IED is in Local operation remote controls are rejected (IEC 61850-7-2 table 40)

Note: For direct and SBO with normal security the PIXIT specifies if the DUT will send an additional MMS InformationReport with LastApplError before the select/operate respond-. In that case the AddCause value should be the same as for enhanced security control

Detailed test procedures

Ctl2	Operate with test flag set	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.5.2.4 IEC 61850-8-1 clause 20, Annex E PIXIT		
Expected result DUT sends all messages without executing the control action, as specified in the PIXIT		
Test description a) DOns; Client sends correct Operate request with the Test flag set b) SBOns, Client sends correct Select and Operate request with the Test flag set c) DOes, Client sends correct Operate request with the Test flag set d) SBOes, Client sends correct SelectWithValue with the Test flag set and Operate with the Test flag set		
Comment This behaviour will change in edition 2 of 61850-7-2		

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 PIXIT		
Expected result DUT sends response+ for non-interlocked objects and response- with AddCause "1-of-n control " for interlocked objects (PIXIT)		
Test description 1. Client request SelectWithValue for some SBOes control objects 2. Client requests Select for some SBOns control objects 3. Client request Cancel for the selected control object in reverse order		
Comment		

Ctl4	Activate second time activated control object	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2		
Expected result DUT responds according to state machine		
Test description 1. TimeActivatedOperate a second enhanced security control object before the activation time of the first control object has expired		
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 passed. The command is not executed when the check failed and for the enhanced control models the DUT returns AddCause = “Blocked-by-interlocking” or “Blocked-by-synchrocheck”		
Test description a) DOns; Client sends correct Operate request with both Check conditions set b) SBOns, Client sends correct Select and Operate request with both Check conditions set c) DOes, Client sends correct Operate request with both Check conditions set d) SBOes, Client sends correct SelectWithValue with both Check conditions set and Operate with both Check conditions set Execute each test with check result passed and failed.		
Comment		

CtlN1	Direct operate a 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 b) DUT responds with Operate response- and the control object stays in the “unselected” state d) DUT responds with Operate response- with AddCause “object-not-selected” and the control object stays in the “unselected” state		
Test description b) Client sends correct Operate once request of an unselected SBOns object d) Client sends correct Operate once request of an unselected SBOes object		
Comment		

CtlN2	Select a 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
PIXIT

Expected result

b) SBOns:

1. DUT responds with Select response+
2. DUT responds with Select response- (recommended) or reset of select timeout
   (Note: TISSUE #334 solved 2008-08 specifies “Select response-“. IEC 61850 edition 2 will make this the only allowed response.)
3. DUT responds with Operate response+

d) SBOes:

1. DUT responds with SelectWithValue response+
2. DUT responds with SelectWithValue response- (recommended) or reset of select timeout
   (Note: TISSUE #334 solved 2008-08 specifies “Select response-“. IEC 61850 edition 2 will make this the only allowed response.)
3. DUT responds with Operate response+ and CommandTermination+

Test description

b) SBOns:

1. Client sends correct Select request of an unselected SBOns object
2. Same client sends correct Select request of the same SBOns object just before the sboTimeout
3. Client sends correct Operate request just before the sboTimeout of step 8

d) SBOes:

1. Client sends correct SelectWithValue request of an unselected SBOes object
2. Same client sends correct SelectWithValue request of the same SBOes object just before the sboTimeout
3. Client sends correct Operate request just before the sboTimeout of step 2

Comment

CtlN3	SelectWithValue 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 PIXIT		
Expected result a) DUT responds as specified in PIXIT b) DUT responds as specified in PIXIT c) DUT responds as specified in PIXIT d) DUT responds as specified in PIXIT		
Test description a) DOns: Client sends Operate request with actual value of a DOns object b) SBOns: Client sends Select and Operate request with actual value of a SBOns object c) DOes: Client sends Operate request with actual value of a DOes object d) SBOes: Client sends SelectWithValue request with actual value of a SBOes object, on response+ request Operate with actual value		
Comment		

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 b) SBOns: 1. DUT responds with Select response+ 2. DUT responds with Select response- 3. DUT responds with Operate response+ d) SBOes: 1. DUT responds with SelectWithValue response+ 2. DUT responds with SelectWithValue response- with Error “Operator Test Not OK” and AddCause “Command-already-in-execution” 3. DUT responds with Operate response+ and CommandTermination+		
Test description b) SBOns: 1. Client1 sends correct Select request of an unselected SBOns object 2. Client2 sends correct Select request of the same SBOns object before the sboTimeout 3. Client1 sends correct Operate request d) SBOes: 1. Client1 sends correct SelectWithValue request of an unselected SBOes object 2. Client2 sends correct SelectWithValue request of the same SBOes object before the sboTimeout 3. Client1 sends correct Operate request		
Comment		

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
PIXIT

Expected result

DUT responds with specific supported AddCause value as specified in the PIXIT

Test description

1. Repeat one or more of previous test procedures, but now force a specific supported AddCause situation as specified in the PIXIT
   - 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 a 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 PIXIT		
Expected result a) DOns 1. DUT responds with Operate response+ 2. DUT responds as specified in PIXIT c) DOes 1. DUT responds with Operate response+ and CommandTermination+ 2. DUT responds as specified in PIXIT		
Test description a) DOns 1. Client1 sends correct Operate request of a DOns object 2. Client2 sends correct Operate request of the same DOns object within 5 milliseconds c) DOes 1. Client1 sends correct Operate request of a DOes object 2. Client2 sends correct Operate request of the same DOes object within 5 milliseconds		
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 responds with Operate response- with error “Operator Test Not OK” and AddCause “Parameter-change-in-execution”. The control object will return to the unselected 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, origin, ctlNum, test and Check 3. Wait until control object returns to the “unselected state”		
Comment		

CtlN10	Control an object when the associated Logical Node or LLN0 is not operable	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3, IEC 61850-7-4 page 80 IEC 61850-8-1 clause 20.6, 20.7 and 20.8 PIXIT		
Expected result a). DUT responds with Operate response- b) DUT responds with Select response-. The control object will return to the unselected state c) DUT responds with Operate response- with error “Operator Test Not OK” and AddCause “Blocked-by-Mode”. d) DUT responds with SelectWithValue or Operate response- with error “Operator Test Not OK” and AddCause “Blocked-by-Mode”. The control object will return to the unselected state		
Test description Client sets the associated logical node Mode = Off or Blocked a) Client sends DOns – Operate request b) Client sends SBOns – Select request c) Client sends DOes – Operate request d) Client sends SBOes – SelectWithValue request, on response+ request Operate Repeat for the associated logical node Mode = On and LLN0.Mod = Off or Blocked		
Comment		

CtlN11	Control an object when the IED is in Local operation	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.5.2.6, table 40 IEC 61850-8-1 clause 20.6, 20.7 and 20.8 PIXIT		
Expected result a) DUT responds with Operate response- b) DUT responds with Select response-. The control object will return to the unselected state c) DUT responds with Operate response- with error “Operator Test Not OK” and AddCause “Blocked-by-switching-hierarchy”. d) DUT responds with SelectWithValue or Operate response- with error “Operator Test Not OK” and AddCause “Blocked-by-switching-hierarchy”. The control object will return to the unselected state		
Test description Test engineer sets the local/remote switch on the DUT to “Local” (LLN0.Loc=True) a) Client sends DOns – Operate request b) Client sends SBOns – Select request c) Client sends DOes – Operate request d) Client sends SBOes – SelectWithValue request, on response+ request Operate		
Comment		

A4.10a Control DOns

DOns1	Path Operate Request[test ok] resp+ Perform a correct Operate request
DOns2	Path TimeActivatedOperate Request [test ok] resp+ Client requests TimeActivatedOperate resulting in Test not ok
DOns3	Path Operate Request[test not ok] resp- Client requests Operate resulting in Test not ok
DOns4	Path TimeActivatedOperate Request[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 TimeActivatedOperate Request[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’

Detailed test procedures for DOns

Note: The TimeActivatedOperate detailed test procedures are not defined in this version.

DOns1	Operate, test ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7		
Expected result 1. DUT responds with Operate response+		
Test description 1. Client sends correct Operate request		
Comment		

DOns3	Operate, test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7 PIXIT		
Expected result 1. DUT responds with Operate response-. This response may optionally be proceeded by a AddCause InformationReport.		
Test description 1. Client requests Operate forcing a “test not ok” as specified in PIXIT		
Comment		

A4.10b Control SBOns

SBOns1	Path 1 Select request[test not ok] resp-: Select the device using Select with improper access rights. Verify the device returns to the Unselected state.
SBOns2	Path Select request[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 TimeActivatedOperate resulting in Test not ok – Client requests Operate resulting in Test not ok – Client requests correct Operate Once
SBOns3	Path Select request[test ok] resp+ and TimeActivatedOperate request[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 Select request[test ok] resp+ and Operate request[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 Select request[test ok] resp+ and TimeActivatedOperate request[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 for SBOns

SBOns1	Incorrect Select	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.2 IEC 61850-8-1 clause 20.4 and 20.7		
Expected result DUT sends a Select response- (MMS read response+ with SBO null value)		
Test description 1. Client sends Select request with unknown control object		
Comment		

SBOns2	Select followed by Cancel, timeout or Operate resulting in test not ok	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.2 IEC 61850-8-1 clause 20.4 and 20.7		
Expected result 1. DUT responds with Cancel response+ 2. DUT sends nothing 3. DUT responds with a TimeActivatedOperate response- with AccessResult indicating failure as defined in IEC 61850-8-1 table 72 4. DUT responds with an Operate response- with AccessResult indicating failure as defined in IEC 61850-8-1 table 72. This response may optionally be proceeded by an AddCause InformationReport. 5. DUT responds with an Operate response+ In all cases the control object returns to the “unselected” state		
Test description Client sends correct Select request followed by: 1. Client sends correct Cancel request 2. Or Client waits for timeout 3. Or force EQUIPMENT SIMULATOR that the Client TimeActivatedOperate request results in “test not ok” 4. Or force EQUIPMENT SIMULATOR that the Client Operate request results in “test not ok” 5. Client sends correct Operate request		

Comment

SBOns3	Select, TimeActivatedOperate once followed by failed wait for action time or cancel	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.2 IEC 61850-8-1 clause 20.4 and 20.7		
Expected result 1. DUT responds with Select response+ 2. DUT responds with TimeActivatedOperate response+ 3. DUT responds nothing 4. DUT responds with Cancel response+ In all cases the control object returns to the “unselected” state		
Test description 1. Client sends correct Select request 2. Client sends correct TimeActivatedOperate 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		

SBOns4	Select and Operate many	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.2 IEC 61850-8-1 clause 20.4 and 20.7		
Expected result In all cases the control object returns to the “ready” state		
Test description Repeat SBOns2, but set the control object sboClass to “operate-many”		
Comment		

SBOns5	Select, TimeActivatedOperate many	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2.2 IEC 61850-8-1 clause 20.4 and 20.7		
Expected result In all cases the control object returns to the “ready” state		
Test description Repeat SBOns2, but set the control object sboClass to “operate-many”		
Comment		

A4.10c Control DOes

DOes1	Path TimeActivatedOperate request[test not ok] resp-: Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test not Ok'.
DOes2	Path Operate request[test not ok] resp-: Send an Operate request, thereby making sure the device will generate a 'test not Ok'.
DOes3	Path TimeActivatedOperate request[test ok] resp+: Send a correct TimeActivatedOperate 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 TimeActivatedOperate request[test ok] resp+ and Timer expired [test ok] resp+: 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 Ready state: – The output of the device moves to its new state, resulting in a state new, CommandTermination+ – Force the output of the device such that the output keeps its old state, resulting in a state old, CommandTermination- – Force the output of the device such that the output keeps reaches the 'between' state, resulting in a state between, CommandTermination -
DOes5	Path Operate request[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, CommandTermination+ – Force the output of the device such that the output keeps its old state, resulting in a state old, CommandTermination- – Force the output of the device such that the output keeps reaches the 'between' state, resulting in a state between, CommandTermination-

Detailed test procedures for DOes

Note: The TimeActivatedOperate detailed test procedures are not defined in this version.

DOes2	Operate test not OK	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.3.3 IEC 61850-8-1 clause 20.7 and 20.8 PIXIT		
Expected result 1. DUT responds with Operate response- with LastApplError with error “Operator Test Not OK” and AddCause as specified in PIXIT		
Test description 1. Client sends incorrect Operate once request		
Comment		

DOes5	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 20.7 and 20.8		
Expected result 1. DUT responds with Operate response+ 2. DUT reports CommandTermination+ 3. After timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and AddCause “Invalid position” or “Time-limit-over” 4. After timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and AddCause “Invalid position”		
Test description 1. Client sends correct Operate once 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		
Comment		

A4.10d Control SBOes

SBOes1	Path 1 (returning to Unselected state): Select device using SelectWithValue 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 SelectWithValue Verify each of these paths will return the device to the Unselected state: – Client requests Cancel (3a) – Client waits for timeout (3b) – Client requests TimeActivatedOperate 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 SelectWithValue 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 SelectWithValue 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 SelectWithValue 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 SelectWithValue 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 [SelectWithValue] 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)

Detailed test procedures for SBOes

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 sends SelectWithValue response- with AddCause “Select-failed” or “Not-supported”		
Test description 1. Client sends SelectWithValue request with incorrect access right by setting an incorrect originator category		
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 sends TimeActivatedOperate response- with error “Test Not OK” 4. DUT sends Operate response- with error “Operator Test Not OK” 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 TimeActivatedOperate 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 CommandTermination+ 4. After timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and AddCause “invalid position” or “Time-limit-over” 5. After timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and 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 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		

SBOes4	SelectWithValue, TimeActivatedOperate 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 TimeActivatedOperate response+ 3. After wait time DUT reports TimeActivatedOperate response-- with error “Timeout Test Not Ok” and AddCause “Blocked-by-interlocking” 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 TimeActivatedOperate once request 3. During wait for activation 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, TimeActivatedOperate 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 TimeActivatedOperate response+ 3. After wait time DUT reports timer expired test ok 4. DUT reports command termination+ 5. After wait for change timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and AddCause “Invalid position” or “Time-limit-over” 6. After wait for change timeout DUT reports CommandTermination- with error “Timeout Test Not OK” and 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 TimeActivatedOperate 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 many 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 In all cases the control object returns to the “ready” state		
Test description Repeat SBOes3, but set the control object sboClass to “operate-many”		
Comment		

SBOes7	SelectWithValue, TimeActivatedOperate many 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 In all cases the control object returns to the “ready” state		
Test description Repeat SBOes5, but set the control object sboClass to “operate-many”		
Comment		

A4.11 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
Tm3	Verify that when the device supports time zones and daylight saving the time stamp of events and disturbance files are UTC time

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)	☐ 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 UTC 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		

Tm3	Time zone and daylight saving	☐ 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 is still UTC time		
Test description 1. Configure DUT with a Time zone and Repeat Tm1		
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 quality ClockNotSynchronized		
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		

A4.12 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
Ft4	Request a GetFile from several clients simultaneously if more than one client association will be supported

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 for File transfer

Ft1	GetServerDirectory(FILE)	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 6.2.2 IEC 61850-8-1 clause 23, Tissue #118, PIXIT		
Expected result 1. DUT sends GetServerDirectory(FILE) response+ with a list of files and/or directories according to the PIXIT. If the Filename (for instance MMS FileSpecification) is not present in the FileDirectory.request, then the responding server shall return the filenames present in the root directory		
Test description 1. 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		

Ft4	Simultaneous GetFile from 2 clients	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 20.2.1 IEC 61850-8-1 clause 23.2.1 PIXIT		
Expected result 1. DUT sends GetFile response+ 2. DUT sends GetFile response+ or response- "file busy" (PIXIT)		
Test description 1. Client1 requests GetFile 2. Client2 requests GetFile of the same file while the first GetFile is still in progress		
Comment		

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- b1) DUT shall return MMS service error "file file-non-existent" b2) DUT shall return the files in the root directory c) DUT sends DeleteFile response-		
Test description a) Client requests GetFile with unknown file b1) Client requests GetFileAttributeValues with unknown file b2) Client requests GetFileAttributeValues with no file parameter in the request c) Client requests DeleteFile with unknown file		
Comment		

A4.13 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 UCAIUG. The UCAIUG decides if and how to include the test case.

ANNEX B DETAILED DESCRIPTION OF TEST RESULTS

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

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

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

ANNEX C TICS TEMPLATE FOR SERVER

Introduction

This document provides a template for the tissues conformance statement. According to the UCA IUG QAP the tissue conformance statement is required to perform a conformance test and is referenced on the certificate.

This document is applicable for <device> with firmware version <version>.

Mandatory IntOp Tissues

During the October 2006 meeting IEC TC57 working group 10 decided that:

- green Tissues with the category “IntOp” are mandatory for IEC 61850 edition 1
- Tissues with the category “Ed.2” Tissues should not be implemented.

Below table gives an overview of the implemented IntOp Tissues.

Part	Tissue Nr	Description	Implemented Y/na
8-1	**116**	GetNameList with empty response?	Y
	165	Improper Error Response for GetDataSetValues	Y
	183	GetNameList error handling	Y
7-4	None		
7-3	**28**	Definition of APC	Y/na
	54	Point def xVal, not cVal	Y/na
	55	Ineut = Ires ?	Y/na
	60	Services missing in tables	Y/na
	63	mag in CDC CMV	Y/na
	219	operTm in ACT	Y/na
	270	WYE and DEL rms values	Y/na
7-2	**30**	control parameter T	Y/na
	31	Typo	na
	32	Typo in syntax	na
	35	Typo Syntax Control time	na
	36	Syntax parameter DSet-Ref missing	Y/na
	37	Syntax GOOSE "T" type	Y/na
	39	Add DstAddr to GoCB	Y/na
	40	GOOSE Message “AppID” to “GoID”	Y/na
	41	GsCB “AppID” to “GsID”	Y/na
	42	SV timestamp: “EntryTime” to “TimeStamp"	Y/na
	43	Control "T" semantic	Y/na
	44	AddCause - Object not sel	Y/na

Part	Tissue Nr	Description	Implemented Y/na
	45	Missing AddCauses (neg range)	Y/na
	46	Synchro check cancel	Y/na
	47	"." in LD Name?	Y/na
	49	BRCB TimeOfEntry (part of #453)	-
	50	LNName start with number?	Y/na
	51	ARRAY [0..num] missing	Y/na
	52	Ambiguity GOOSE SqNum	Y/na
	53	Add DstAddr to GsCB, SV	Y/na
	151	Name constraint for control blocks etc.	Y/na
	166	DataRef attribute in Log	Y/na
	185	Logging - Integrity periode	Y/na
	189	SV Format	na
	190	BRCB: EntryId and TimeOfEntry (part of #453)	-
	191	BRCB: Integrity and buffering reports (part of #453)	-
	234	New type CtxInt (Enums are mapped to 8 bit integer)	Y/na
	275	Confusing statement on GI usage (part of #453)	-
	278	EntryId not valid for a server (part of #453)	-
Part 6	**1**	Syntax	Y/na
	5	tExtensionAttributeNameEnum is restricted	Y/na
	8	SIUnit enumeration for W	Y/na
	10	Base type for bitstring usage	Y/na
	17	DAI/SDI elements syntax	Y/na
	169	Ordering of enum differs from 7-3	Y/na

NOTE: Tissue 49, 190, 191, 275 and 278 are part of the optional tissue #453, all other technical tissues in the table are mandatory if applicable.

NOTE: Editorial tissues are marked as “na”.

NOTE: Final proposal on tissue 45 is not defined yet

Optional IntOp Tissues

After the approval of the server conformance test procedures version 2.2 the following IntOp tissues were added or changed. It is optional to implement these tissues.

Part	Tissue Nr	Description	Implemented Y/N/na
8-1	246	Control negative response (SBOns) with LastApplError	Y/N/na
8-1	545	Skip file directories with no files	Y/N/na
7-2	333	Enabling of an incomplete GoCB	Y/N/na

Part	Tissue Nr	Description	Implemented Y/N/na
7-2	453	Combination of all reporting and logging tissues	Y/N/na
6	245	Attribute RptId in SCL is optional	Y/N/na
6	529	Replace sev - Unknown by unknown	Y/N/na

Other Implemented Tissues

<Complete below table of other implemented tissues, these tissues should have no impact on interoperability>

Part	Tissue Nr	Description

Instruction and comments on using this template

Comments

- Tissue 235 “Extension of name length” for datset references has been changed from IntOp to Ed.2 and has been removed from the IntOp list, Tissue 235 shall not be implemented for Ed1 devices
- Tissue 38 “Change AppId into GoId" to match part 7-2 with part 8-1 has been changed from IntOp to Ed.2 and has been removed from the IntOp list
- Tissue 45 “Additional AddCauses" has been changed from green to red
- Tissue 65 category has been changed from IntOp to Ed2
- Even intop tissues may change. Compare http://www.tissues.iec61850.com for most recent status
- Questions and comments can be e-mailed to: helpdesk@ucausersgroup.org

Instructions

- format of the document may be changed into your company format
- enter the applicable IED name and firmware version
- update the Y/na values in the Mandatory tissue table
- update the Y/N/na values in the Optional tissue table
- remove the instructions, comments and revision history of the template

Revision history

Revision	Remarks
0.1	First version of the UCAIUG template
0.2 (okt 2008)	Removed tissue 38 from the list Added a note on tissue 45
0.3 (okt 2010)	Tissue 65 category has been changed from IntOp to Ed2. Removed tissue 65 from the IntOp list
Version 2.3	Included in the test procedures document,

ANNEX D PIXIT template for Server

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 interface in <device> with firmware version <version>.
Together with the PICS and the MICS the PIXIT forms the basis for a conformance test according to IEC 61850-10.

Contents of this document

Each chapter specifies the PIXIT for each applicable ACSI service model as structured in IEC 61850-10.

PIXIT for Association model

ID	Description	Value / Clarification
As1	Maximum number of clients that can set-up an association simultaneously	…
As2	TCP_KEEPALIVE value	… seconds
As3	Lost connection detection time	… seconds
As4	Is authentication supported	Y/N
As5	What association parameters are necessary for successful association	Transport selector Y/N Session selector Y/N Presentation selector Y/N AP Title Y/N AE Qualifier Y/N
As6	If association parameters are necessary for association, describe the correct values e.g.	Transport selector 0001 Session selector 0001 Presentation selector 00000001 AP Title <value> AE Qualifier <value>
As7	What is the maximum and minimum MMS PDU size	Max MMS PDU size … Min MMS PDU size …
As8	What is the maximum start up time after a power supply interrupt	… seconds
	<additional items>	

PIXIT for Server model

ID	Description	Value / Clarification
Sr1	Which analogue value (MX) quality bits are supported (can be set by server)	Validity: Y/N Good, Y/N Invalid, Y/N Reserved, Y/N Questionable Y/N Overflow Y/N OutofRange Y/N BadReference Y/N Oscillatory Y/N Failure Y/N OldData Y/N Inconsistent Y/N Inaccurate Source: Y/N Process Y/N Substituted Y/N Test Y/N OperatorBlocked
Sr2	Which status value (ST) quality bits are supported (can be set by server)	Validity: Y/N Good, Y/N Invalid, Y/N Reserved, Y/N Questionable Y/N BadReference Y/N Oscillatory Y/N Failure Y/N OldData Y/N Inconsistent Y/N Inaccurate Source: Y/N Process Y/N Substituted Y/N Test Y/N OperatorBlocked

ID	Description	Value / Clarification
Sr3	What is the maximum number of data values in one GetDataValues request	
Sr4	What is the maximum number of data values in one SetDataValues request	
Sr5	Which Mode / Behaviour values are supported	On Y/N Blocked Y/N Test Y/N Test/Blocked Y/N Off Y/N
	<additional items>	

PIXIT for Data set model

ID	Description	Value / Clarification
Ds1	What is the maximum number of data elements in one data set (compare ICD setting)	
Ds2	How many persistent data sets can be created by one or more clients	
Ds3	How many non-persistent data sets can be created by one or more clients	
	<additional items>	

PIXIT for Substitution model

ID	Description	Value / Clarification
Sb1	Are substituted values stored in volatile memory?	Y/N
	<additional items>	

PIXIT for Setting group control model

ID	Description	Value / Clarification
Sg1	What is the number of supported setting groups for each logical device (compare NumSG in the SGCB)	

ID	Description	Value / Clarification
Sg2	What is the effect of when and how the non-volatile storage is updated (compare IEC 61850-8-1 $16.2.4)	
Sg3	Can multiple clients edit the same setting group	Y/N
Sg4	What happens if the association is lost while editing a setting group	Y/N
Sg5	Is EditSG value 0 allowed?	Y/N
	<additional items>	

PIXIT for Reporting model

ID	Description	Value / Clarification
Rp1	The supported trigger conditions are (compare PICS)	integrity Y/N data change Y/N quality change Y/N data update Y/N general interrogation Y/N
Rp2	The supported optional fields are	sequence-number Y/N report-time-stamp Y/N reason-for-inclusion Y/N data-set-name Y/N data-reference Y/N buffer-overflow Y/N entryID Y/N conf-rev Y/N segmentation Y/N
Rp3	Can the server send segmented reports	Y/N
Rp4	Mechanism on second internal data change notification of the same analogue data value within buffer period (Compare IEC 61850-7-2 $14.2.2.9)	Send report immediately OR Replace analogue value in pending report

ID	Description	Value / Clarification
Rp5	Multi client URCB approach (compare IEC 61850-7-2 $14.2.1)	Each URCB is visible to one client only or Each URCB is visible to all clients
Rp6	What is the format of EntryID	
Rp7	What is the buffer size for each BRCB or how many reports can be buffered	
Rp8	Pre-configured RCB attributes that cannot be changed online when RptEna = FALSE (see also the ICD report settings)	
Rp9	May the reported data set contain: - structured data objects? - data attributes?	 Y/N Y/N
Rp10	What is the scan cycle for binary events? Is this fixed, configurable	…. Mseconds Fixed or Configurable
Rp11	Does the device support to pre-assign a RCB to a specific client in the SCL	Y/N
	<additional items>	

PIXIT for Logging model

ID	Description	Value / Clarification
Lg1	What is the default value of LogEna (Compare IEC 61850-8-1 $17.3.3.2.1, the default value should be FALSE)	TRUE/FALSE
Lg2	What is the format of EntryID (Compare IEC 61850-8-1 $17.3.3.3.1)	
Lg3	If there are multiple Log Control Blocks that specify the Journaling of the same MMS NamedVariable and TrgOps and the Event Condition (Compare IEC 61850-8-1 $17.3.3.3.2)	Single Journal Entry (specify the event condition) or Multiple Journal Entries
Lg4	Pre-configured LCB attributes that cannot be changed online	
	<additional items>	

PIXIT for Generic substation events model

ID	Description	Value / Clarification
Go1	What elements of a subscribed GOOSE header are checked to decide the message is valid and the allData values are accepted? If yes, describe the conditions. Note: the VLAN tag may be removed by a ethernet switch and should not be checked	Y/N source MAC address Y/N destination MAC address Y Ethertype = 0x88B8 Y/N APPID Y/N gocbRef Y/N timeAllowedtoLive Y/N datSet Y/N goID Y/N t Y/N stNum Y/N sqNum Y/N test Y/N confRev Y/N ndsCom Y/N numDatSetEntries
Go2	Can the test flag in the published GOOSE be turned on / off	Y/N
Go3	What is the behaviour when the GOOSE publish configuration is incorrect	DUT will send GOOSE with NdsCom=T or DUT keeps GoEna=F
Go4	When is a subscribed GOOSE marked as lost? (TAL = time allowed to live value from the last received GOOSE message)	a) message does not arrive prior to TAL b) message does not arrive by 2x TAL c) message does not arrive by TAL plus configurable time d) other (describe)
Go5	What is the behaviour when one or more subscribed GOOSE messages isn't received or syntactically incorrect (missing GOOSE)	
Go6	What is the behaviour when a subscribed GOOSE message is out-of-order	
Go7	What is the behaviour when a subscribed GOOSE message is duplicated	
Go8	Does the device subscribe to GOOSE messages with/without the VLAN tag?	Y/N, with the VLAN tag Y/N, without the VLAN tag

ID	Description	Value / Clarification
Go9	May the GOOSE data set contain: - structured data objects (FCD)? - timestamp data attributes? Note: data attributes (FCDA) is mandatory	Subscribed Published Y/N Y/N Y/N Y/N
Go10	Published FCD supported common data classes are	<list of common data classes>
Go11	Subscribed FCD supported common data classes are	<list of common data classes>
Go12	What is the slow retransmission time? Is it fixed or configurable?	… mseconds with TAL = … Fixed or Configured by ….
Go13	What is the fast retransmission scheme? Is it fixed or configurable?	1) … mseconds with TAL = … 2) … mseconds with TAL = … 3) … mseconds with TAL = … 4) … mseconds with TAL = … 5) … mseconds with TAL = … 6) … mseconds with TAL = … Fixed or Configured by ….
Go14	Can the Goose publish be turned on / off by using SetGoCBValues(GoEna)	Y/N
	<additional items>	

TAL = Time Allowed to Live

PIXIT for Control model

ID	Description	Value / Clarification
Ct1	What control models are supported (compare PICS)	Y/N status-only Y/N direct-with-normal-security Y/N sbo-with-normal-security Y/N direct-with-enhanced-security Y/N sbo-with-enhanced-security
Ct2	Is the control model fixed, configurable and/or online changeable?	Fixed / Configurable / Online changeable
Ct3	Is TimeActivatedOperate supported	Y/N
Ct4	Is “operate-many” supported	Y/N

ID	Description	Value / Clarification
Ct5	Will the DUT activate the control output when the test attribute is set in the SelectWithValue and/or Operate request (when N test procedure Ctl2 is applicable)	Y/N
Ct6	What are the conditions for the time (T) attribute in the SelectWithValue and/or Operate request	e.g. DUT ignores the time value and execute the command as usual
Ct7	Is pulse configuration supported	Y/N
Ct8	What is the behaviour of the DUT when the check conditions are set Is this behaviour fixed, configurable, online changeable?	Y/N synchrocheck Y/N interlock-check DUT ignores the check value and always perform the check or DUT uses the check value to perform the check Fixed / Configurable / Online changeable
Ct9	What additional cause diagnosis are supported	Y/N Blocked-by-switching-hierarchy Y/N Select-failed Y/N Invalid-position Y/N Position-reached Y/N Parameter-change-in-execution Y/N Step-limit Y/N Blocked-by-Mode Y/N Blocked-by-process Y/N Blocked-by-interlocking Y/N Blocked-by-synchrocheck Y/N Command-already-in-execution Y/N Blocked-by-health Y/N 1-of-n-control Y/N Abortion-by-cancel Y/N Time-limit-over Y/N Abortion-by-trip
Ct10	How to force a “test-not-ok” respond with SelectWithValue request?	

ID	Description	Value / Clarification
Ct11	How to force a “test-not-ok” respond with Select request?	
Ct12	How to force a “test-not-ok” respond with Operate request?	DOns: SBOns: DOes: SBOes:
Ct13	Which origin categories are supported?	
Ct14	What happens if the orCat value is not supported?	DOns: SBOns: DOes: SBOes:
Ct15	Does the IED accept a SelectWithValue/Operate with the same ctlVal as the current status value?	DOns: Y/N SBOns: Y/N DOes: Y/N SBOes: Y/N
Ct16	Does the IED accept a select/operate on the same control object from 2 different clients at the same time?	DOns: Y/N (default Y) SBOns: Y/N (default N) DOes: Y/N (default Y) SBOes: Y/N (default N)
Ct17	Does the IED accept a Select/SelectWithValue from the same client when the control object is already selected (tissue 334)	SBOns: Y/N SBOes: Y/N
Ct18	Is for SBOes the internal validation performed during the SelectWithValue and/or Operate step?	SelectWithValue / Operate / SelectWithValue and Operate
Ct19	Can a control operation be blocked by Mod=Off or Blocked	Y/N
Ct20	Does the IED support local / remote operation?	Y/N
Ct21	Does the IED send an InformationReport with LastApplError as part of the Operate response- for control with normal security?	SBOns: Y/N DOns: Y/N
	<additional items>	

PIXIT for Time and time synchronisation model

ID	Description	Value / Clarification
Tm1	What quality bits are supported (may be set by the IED)	Y/N LeapSecondsKnown Y/N ClockFailure Y/N ClockNotSynchronized
Tm2	Describe the behaviour when the time synchronization signal/messages are lost	
Tm3	When is the time quality bit "ClockFailure" set?	
Tm4	When is the time quality bit "Clock not synchronised" set?	
Tm5	Is the timestamp of a binary event adjusted to the configured scan cycle?	Y/N
Tm6	Does the device support time zone and daylight saving?	Y/N
Tm7	Which attributes of the SNTP response packet are validated?	Y/N Leap indicator not equal to 3? Y/N Mode is equal to SERVER Y/N OriginateTimestamp is equal to value sent by the SNTP client as Transmit Timestamp Y/N RX/TX timestamp fields are checked for reasonableness Y/N SNTP version 3 and/or 4 Y/N other (describe)
	<additional items>	

PIXIT for File transfer model

ID	Description	Value / Clarification
Ft1	What is structure of files and directories?	
Ft2	Directory names are separated from the file name by	"/" or "\"
Ft3	The maximum file name size including path (recommended 64 chars)	… chars
Ft4	Are directory/file name case sensitive	Case sensitive

ID	Description	Value / Clarification
Ft5	Maximum file size	
Ft6	Is the requested file path included in the MMS fileDirectory respond file name?	Y/N
Ft7	Is the wild char supported MMS fileDirectory request?	Yes, wild card = * No
Ft8	Is it allowed that 2 clients get a file at the same time?	Y/N
	<additional items>	

Instruction and comments on using the PIXIT template

Comments

- The template is updated according to the PIXIT references in the server conformance test procedures version 2.3
- Questions and comments can be e-mailed to: helpdesk@ucausersgroup.org

Instructions

- format of the document may be changed into your company format
- enter the applicable IED name and firmware version
- remove the non-applicable clauses
- remove the <additional items> row
- add new rows when/where applicable to describe additional functionality important for testing

PIXIT Revision history

Revision	Remarks
1.1 draft	Added default values for the control entries related to CtlN4 and CtlN8 test cases
	Added APPID to first GOOSE entry
Version 2.3	Included into server test procedures version 2.3, Added IDs for easier referencing and PIXIT review, added Ct21; Added GOOSE supported FCD entries

ANNEX E Server Certificate Template

IEC 61850 Certificate Level A/B[1]

No. << certificate number>>

Issued to:
<<TEST INITIATOR>>
<<FULL ADDRESS>>

For the product:
<<PRODUCT NAME>>
<<VERSION NUMBER>>
<<ADDITIONAL INFO>>

Issued by: <<test tlab>>

The product has not shown to be non-conforming to:

IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1

Communication networks and systems in substations

The conformance test has been performed according to IEC 61850-10 with product's protocol, model and technical issue implementation conformance statements: "<<PICS>>", "<<MICS>>", "<<TICS>>" and product's extra information for testing: "<<PIXIT>>".

The following IEC 61850 conformance blocks have been tested with a positive result (number of relevant and executed test cases / total number of test cases as defined in the UCA International Users Group Device Test procedures v2.3 with TPCL version 1.2):

1 Basic Exchange (../24)	9a GOOSE Publish (../13)
2 Data Sets (../6)	9b GOOSE Subscribe (../11)
2+ Data Set Definition (../23)	12a Direct Control (../12)
3 Substitution (../4)	12b SBO Control (../14)
4 Setting Group Selection (../3)	12c Enhanced Direct Control (../13)
4+ Setting Group Definition (7/7)	12d Enhanced SBO Control (../19)
5 Unbuffered Reporting (../19)	13 Time Synchronization (../5)
6 Buffered Reporting (../21)	14 File Transfer (../7)

This Certificate includes a summary of the test results as carried out at <<CITY>> in <<COUNTRY>> with <<CLIENT SIMULATOR> <<VERSION>> with test suite <<VERSION>> and <<ANALYZER>> <<VERSION>>. The test is based on the UCA International Users Group Device Test Procedures version 2.3. This document has been issued for information purposes only, and the original paper copy of the <<TESTLAB>> report: No. <<TESTREPORT NUMBER>> will prevail.

The test has been carried out on one single specimen of the product as referred above and submitted to <<TESTLAB>> by <<TEST INITIATOR>>. The manufacturer's production process has not been assessed. This certificate does not imply that <<TESTLAB>> has certified or approved any product other than the specimen tested.

<<CITY>>, <<DATE>>

<<Manager NAME>>
<<JOB TITLE>>

<<Tester NAME>>
<<JOB TITLE>>

1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System

Applicable Test Procedures from the UCA International Users Group Device Test Procedures version 2.3

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Ass1, Ass2, Ass3, AssN2, AssN3, AssN4, AssN5 Srv1, Srv2, Srv3, Srv4, Srv5, SrvN1abcd, SrvN4	AssN6 Srv6, Srv7, Srv8, Srv9, Srv10, SrvN1e, SrvN1f, SrvN2, SrvN3
2: Data Sets	Dset1, Dset10a, DsetN1ae	Dset10b, DsetN1b, DsetN16
2+: Data Set Definition	Dset2, Dset3, Dset4, Dset5, Dset6, Dset7, Dset8, Dset9 DsetN1cd, DsetN2, DsetN3, DsetN4, DsetN5, DsetN6, DsetN7, DsetN8, DsetN9, DsetN10, DsetN11, DsetN12, DsetN13, DsetN14, DsetN15	
3: Substitution	Sub1, Sub2, Sub3, SubN1	
4: Setting Group Selection	Sg1, SgN1a	Sg3
4+: Setting Group Definition	Sg2, Sg4, SgN1b, SgN2, SgN3, SgN4, SgN5	
5: Unbuffered Reporting	Rp1, Rp2, Rp3, Rp4, Rp7, Rp10, Rp12 RpN1, RpN2, RpN3, RpN4	Rp5, Rp6, Rp8, Rp9, Rp11, RpN5, RpN6, RpN7
6: Buffered Reporting	Br1, Br2, Br3, Br4, Br7, Br8, Br9, Br12, Br14 BrN1, BrN2, BrN3, BrN4, BrN5	Br5, Br6, Br10, Br11, Br13, BrN6, BrN7
6+: Enhanced buffered reporting	BrE1, BrE2, BrE3, BrE6, BrE7, BrE8, BrE9, BrE10, BrE11	BrE4, BrE5, BrE12
9a: GOOSE publish	Gop2, Gop3, Gop4, Gop7, Gop10a	Gop1, Gop5, Gop6, Gop8, Gop9, Gop10b, GopN1, GopN2
9b: GOOSE subscribe	Gos1a, Gos2, Gos3, GosN1, GosN2, GosN3, GosN4, GosN5, GosN6	Gos1b, Gos4
12a: Direct control	CtlN3, CtlN8 DOns1, DOns3	Ctl2, Ctl4, Ctl7, CtlN10, CtlN11 DOns2, DOns4, DOns5
12b: SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, SBOns2	Ctl2, Ctl4, Ctl7, CtlN10, CtlN11 SBOns3, SBOns4, SBOns5
12c: Enhanced Direct Control	CtlN3, CtlN8 DOes2, DOes5	Ctl2, Ctl4, Ctl7, CtlN6, CtlN10, CtlN11 DOes1, DOes3, DOes4
12d: Enhanced SBO control	Ctl3, CtlN1, CtlN2, CtlN3, CtlN4, CtlN9 SBOes1, SBOes2, SBOes3	Ctl2, Ctl4, Ctl7, CtlN6, CtlN10, CtlN11 SBOes4, SBOes5, SBOes6, SBOes7
13: Time sync	Tm1, Tm2, TmN1	Tm3, TmN2
14: File transfer	Ft1, Ft2ab, Ft4, FtN1ab	Ft2c, Ft3, FtN1c

[All configuration file and data model tests have been successfully performed for the product variants using the same hardware and software version: <<Variant2>>, <<Variant3>>]