

VERIFICATION REPORT

IEC 61850 Edition 2 server conformance test of SICAM AK3

Siemens AG

Report no.: 17-1746, Rev.

Date: 2017-01-13

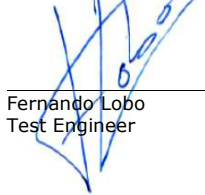


Report title:	IEC 61850 Edition 2 server conformance test of SICAM AK3	DNV GL - Energy Energy Advisory
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Task and objective:

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

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Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
0	2017-01-13	First issue	F. Lobo	G. Akse	P. Cioci

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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.

<i>DUT (fully tested)</i>	SICAM AK 3 Automation Component with modules CP-2016, CP-2019 and SM-2599 Software version: ET25 Rev. 03.04 Module: CP-2016 CP-2019 HW version: BC2-016--.03 BC2-019--.03 S/N: BF1512032572 BF1601022478
<i>MANUFACTURER</i>	Siemens AG Humboldstr. 59 90459 Nuremberg Germany
<i>PICS</i>	"Protocol Implementation Conformance Statement for the IEC 61850 Ed.2 Server Interface in Siemens SICAM AK 3, DC0-168-2.00, 2016-12-22"
<i>MICS</i>	"Model Implementation Conformance Statement for the IEC 61850 Ed.2 Server Interface in Siemens SICAM AK 3, DC0-167-2.00, 2016-12-22"
<i>TICS</i>	"TISSUES Implementation Conformance Statement for the IEC 61850 Ed.2 Server Interface in Siemens SICAM AK 3, DC0-170-2.00, 2016-12-22"
<i>PIXIT</i>	"Protocol Implementation extra Information for Testing (PIXIT) the IEC 61850 Ed.2 Server Interface in Siemens SICAM AK 3, DC0-169-2.00, 2016-12-22"
<i>ICD</i>	ET25.icd (version "1.56 2016-12-14"), IEC_60870_5_104.xsd
<i>SCD</i>	ET25.cid (version "1.56 2016-12-14"), IEC_60870_5_104.xsd
<i>TEST INITIATOR</i>	MANUFACTURER
<i>TEST FACILITY</i>	DNV GL Netherlands B.V. Protocol Competence & Test Center Utrechtseweg 310-B50, Arnhem, The Netherlands Accredited as independent Level A test lab by the UCAiug
<i>TEST ENGINEER</i>	Fernando Lobo, Fernando.lobo@dnvgl.com
<i>TEST SESSION</i>	December 2016, Vienna (Austria)
<i>CLIENT SIMULATOR</i>	UniCA 61850 Client simulator 4.29.03 with test suite 4.31.03
<i>ANALYSER</i>	UniCA 61850 Analyzer 5.31.00
<i>EQUIPMENT SIMULATOR</i>	OPM II Object-oriented process data manager
<i>TIME MASTER</i>	DNV GL SNTP server

1.2 Background

SICAM AK 3, member of the SICAM RTUs product family, is a modular solution that can be used in a variety of ways: front end, gateway, process control applications, automation applications, station control device, sub-node, telecontrol substation.

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

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

To answer this question, *TEST FACILITY* has performed a **conformance test** of the IEC 61850 implementation in the *DUT*. This test has been performed according procedures and conditions set forth in IEC 61850 part 10 and UCAIUG Quality Assurance Program.

TEST FACILITY is accredited/recognized by the UCAIUG to perform formal conformance tests and issue the Level A UCAIUG certificate.

1.3 Purpose of this document

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

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

1.4 Contents of this document

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

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

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

Annex A specifies the detailed test procedures and their outcome.

1.5 Glossary

DUT	Device Under Test
ICD	IED configuration description in SCL-format
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
TICS	Technical Issues Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SCD	System configuration description in SCL-format
SCL	System Configuration Language
SNTP	Simple Network Time Protocol
TISSUE	Technical issue
UCAIUG	UCA International Users Group.

2 REFERENCES

2.1 Normative

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

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

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

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

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

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

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

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

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

2.2 Other

IS 9646 – OSI – Conformance testing methodology and framework.

UCA International User Group: Conformance Test Procedures for Server Devices with IEC 61850-8-1 Edition 2 Interface Revision 1.0, April 2013.

UCA International User Group: Fast Track Test Procedures Change List (TPCL) version 1.2 for IEC 61850 Edition 2 server test procedures revision 1.0

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/.](http://tissues.iec61850.com/)

3 THE CONFORMANCE TEST

3.1 Components in the test environment

The test environment consists of the following components:

- DUT
- CLIENT SIMULATOR
- ANALYSER
- EQUIPMENT SIMULATOR
- Ethernet switch
- Time master

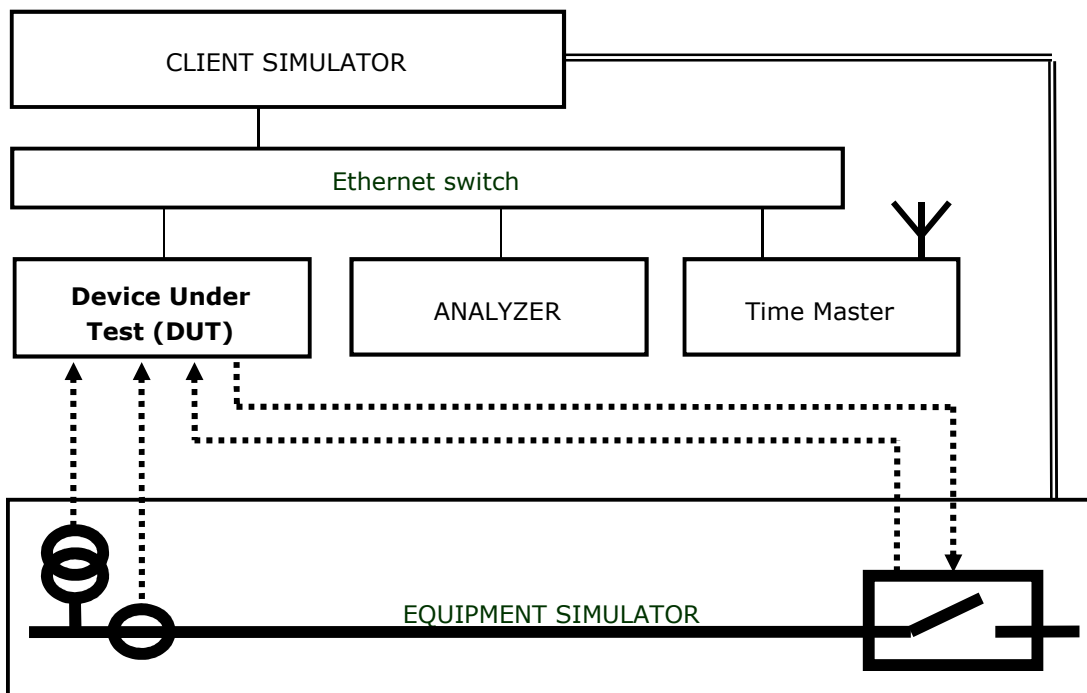



Figure 3.1 The server test environment

3.2 Overview of the test suite

The server test cases are structured as follows:

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

- 
- Control
 - Time and time synchronization
 - File transfer.

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

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	sAss1, sAss2, sAss3, sAssN2, sAssN3, sAssN4, sAssN5, sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrvN1abcd, sSrvN4	sSrv6, sSrv8, sSrv9, sSrv10, sSrv12, sSrvN1e, sSrvN1f, sSrvN3
2: Data Sets	sDs1, sDs10a, sDsN1ae	sDs15
4: Setting Group Selection	sSg1, sSg3, sSgN1	
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp15, sRpN1, sRpN2, sRpN3, sRpN4, sRpN8	sRp11, sRp12, sRpN5
12a: Direct control	sCtl5, sCtl10, sDOs1, sDOs2	
12c: Enhanced Direct Control	sCtl5, sCtl10, sDOes1, sDOes2	sCtl14
12d: Enhanced SBO Control	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl25, sSBOes1, sSBOes2, sSBOes6, sSBOes8	sCtl6, sCtl26
13: Time sync	sTm1, sTm2, sTmN1	

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

Conformance Block	Inconclusive	Failed	Comment
1: Basic Exchange			sAss3, sAssN2, sAssN3, sSrv6, sSrv9, sSrv10, sSrv12, sSrvN3
2: Data Sets			sDs10a, sDsN1ae
5: Unbuffered Reporting			sRp4, sRpN5
12a: Direct control			sCtl5
12c: Enhanced Direct Control			sCtl5, sCtl10, sDOes1, sDOes2
12d: Enhanced SBO Control			sCtl5, sCtl10, sSBOes1, sSBOes2, SBOes6
13: Time sync			sTm2

5 CONCLUSIONS AND RECOMMENDATIONS

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

5.1 Recommendations following from the test

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

- The DUT shall be configured with the allowed IP addresses for the association of a client.
- DUT does not allow multiple clients with the same IP address to associate. It is recommended that in future releases DUT identifies unique clients on IP address and association parameter combinations.

APPENDIX A

Detailed test procedures and results

A1 Documentation (IEC 61850-4)

Test case	Test case description	Verdict
sDoc1	Check if the major/minor software version in the PICS documentation and the DUT do match (IEC61850-4). PICS shall contain the ACSI conformance statement according to IEC 61850-7-2 Annex A	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sDoc2	<p>Check if the major/minor software version in the PIXIT documentation and software version of the DUT does match (IEC61850-4).</p> <p>PIXIT shall indicate the required information as requested in the applicable test cases</p> <p>PIXIT shall keep the entry identifiers from the PIXIT template</p>	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sDoc3	Check if the major/minor software version in the MICS documentation and software version of the DUT does match (IEC61850-4). MICS shall indicate the semantics of all non-standard Logical Nodes, Data Objects and enumerations	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sDoc4	Check if the major/minor software version in the TICS documentation and software version of the DUT does match (IEC61850-4). TICS shall indicate that the mandatory and applicable technical issues are implemented	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive

A2 Configuration file (IEC 61850-6)

Test case	Test case description	Verdict
sCnf1	Test if the ICD configuration file validates according to the SCL schema: version 2007, revision B	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf2	Check if the SCL configuration file used to configure the DUT corresponds with the actual data object references, data types, data sets and pre-configured data values (settings) exposed by the DUT on the network. When more data objects are exposed, attach a list and set the test result to Passed. When less data objects are exposed the test result is Failed. The format of the pre-configured values in SCL shall match IEC 61850-6 Table 45	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf3	Change at least 5 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.	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf4	Check the ICD if the server capabilities in the IED "services" section(s) do correspond with the ACSI services specified in the PICS (compare TISSUE #901)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf5	In case the control model is fixed (PIXIT) check if the ICD correctly initializes the ctlModel values for all controllable objects	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf6	Check the SCL version = "2007", revision = "B" and nameLength = 64	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sCnf7	Check the "ldName" naming structure when supported. All online object references (including data sets, control block references and object references - CDC ORG) shall start with the "LDevice ldName" value instead of the "IED name" + "LDevice inst"	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive <input checked="" type="checkbox"/> Not applicable
sCnf8	When GOOSE subscription is supported and when SICS I43 is supported, check that the IED does subscribe to the data attributes as specified in the IID or SCD Inputs - ExtRef elements.	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive <input checked="" type="checkbox"/> Not applicable
sCnf9	The BDA for SBOw, Oper and Cancel DAtype's and DA SBO shall be followed by a ProtNS element with type = 8-MMS and its contents = IEC61850-8-1:2003 or IEC61850-8-1:2007 (IEC 61850-8-1 Subclause 25.5, TISSUE #853)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive

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

Test case	Test case description	Verdict
sMdl1	Verify presence of mandatory data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl2	Verify presence of conditional presence true data objects for each LN type and data attributes for each DO type. Passed when all objects/attributes are present	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl3	Verify non-presence of conditional presence false data objects for each LN type and data attributes for each DO type. Passed when these objects/attributes are not present	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl4	Verify data model mapping according to applicable SCSM concerning name length and object expansion. Passed when mapping is according to applicable SCSM	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl5	Verify data model mapping according to applicable SCSM concerning organisation of functional components.	Deprecated
sMdl6	Verify data model mapping according to applicable SCSM concerning naming of control blocks and logs. Passed when mapping is according to applicable SCSM. Compare detailed test procedure	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl7	Verify type of all data objects for each LN type and all data attributes for each DO type. Passed when type of all objects/attributes do match with the IEC 61850-7-3, IEC 61850-7-4 and the applicable SCSM	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl8	Verify that the preconfigured enumerated data attribute values from the device and SCL are in specified range. Passed when all values are in range	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl9	Check if manufacturer specific data model extensions are implemented according to the extension rules in IEC 61850-7-1 clause 14. Compare detailed test procedure	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl10	Check if the order of the data attributes with the same functional constraint of the DO type match with IEC 61850-7-3. Passed when all attributes are in matching order	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl11	Check if the name length of IED, Logical Devices, Logical Nodes, data objects, data attributes, data sets and control blocks do not exceed the maximum length as specified in IEC 61850-7-2 clause 22.2 and SCSM	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl12	Check that the rules for multiple data object instantiation are kept (IEC 61850-7-1 clause 14.6, IEC 61850-7-4).	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl13	Check if the logical device name space or the LLN0 logical node name space refers to Edition 2: IEC 61850-7-4:2007 or a newer revision of edition 2 (e.g. IEC 61850-7-4:2007B)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
sMdl14	Check the correct use of name spaces for non-substation power utility applications like for example Hydro and DER. Compare detailed test procedure	<input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive <input checked="" type="checkbox"/> Not applicable

Detailed data modelling test procedures



sMdl6	Naming of control blocks and logs	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive																																								
IEC 61850-6 Subclause 9.3.8																																										
<p><u>Expected result</u></p> <ul style="list-style-type: none"> Report control blocks may be indexed. The indexing of report control blocks depends on the presence and value of the SCL elements: RptEnabled, max and indexed. According to the SCL schema the default value of indexed=TRUE and max = 1, max = 0 is not allowed. The indexing shall be according to the following table, SCL name="rcbA" <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>RCBName (IED)</th> <th>RptEnabled</th> <th>max=</th> <th>indexed</th> </tr> </thead> <tbody> <tr> <td>rcbA01</td> <td></td> <td></td> <td></td> </tr> <tr> <td>rcbA01</td> <td></td> <td></td> <td>TRUE</td> </tr> <tr> <td>rcbA</td> <td></td> <td></td> <td>FALSE</td> </tr> <tr> <td>rcbA01</td> <td>y</td> <td>1</td> <td></td> </tr> <tr> <td>rcbA01</td> <td>y</td> <td>1</td> <td>TRUE</td> </tr> <tr> <td>rcbA</td> <td>y</td> <td>1</td> <td>FALSE</td> </tr> <tr> <td>rcbA01, rcbA02</td> <td>y</td> <td>2</td> <td></td> </tr> <tr> <td>rcbA01, rcbA02</td> <td>y</td> <td>2</td> <td>TRUE</td> </tr> <tr> <td>rcbA (only unbuffered)</td> <td>y</td> <td>2</td> <td>FALSE</td> </tr> </tbody> </table> <ul style="list-style-type: none"> The report control block attributes owner and resvTms do match with the SCL IED Services element owner and resvTms The setting group control block attribute resvTms does match with the SCL IED Services element SGEdit resvTms The presence of the optional GOOSE control block attributes minTime, maxTime, fixedOffs have no SCL IED Services elements 			RCBName (IED)	RptEnabled	max=	indexed	rcbA01				rcbA01			TRUE	rcbA			FALSE	rcbA01	y	1		rcbA01	y	1	TRUE	rcbA	y	1	FALSE	rcbA01, rcbA02	y	2		rcbA01, rcbA02	y	2	TRUE	rcbA (only unbuffered)	y	2	FALSE
RCBName (IED)	RptEnabled	max=	indexed																																							
rcbA01																																										
rcbA01			TRUE																																							
rcbA			FALSE																																							
rcbA01	y	1																																								
rcbA01	y	1	TRUE																																							
rcbA	y	1	FALSE																																							
rcbA01, rcbA02	y	2																																								
rcbA01, rcbA02	y	2	TRUE																																							
rcbA (only unbuffered)	y	2	FALSE																																							
<p><u>Test description</u></p> <p>Verify the naming and attributes of all control blocks and logs in the DUT.</p>																																										
<p><u>Comment</u></p>																																										

sMdl8	Enumerated Data attribute values	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-6 Subclause 9.5.6 IEC 61850-7-3 Annex D, TISSUE #686 IEC 61850-7-4 Annex H		
<u>Expected result</u> 1. All ENC enumeration types are correctly defined. Not supported enum values are removed for controllable data objects with common data class ENC. 2. All values are in range, when failed attach a list		
<u>Test description</u> 1. Verify that the enumeration types are defined according IEC 61850-7-3 Annex D, IEC 61850-7-4 Annex H and TISSUE #686. Not supported enum values shall not be included in the ICD file for controllable data objects with common data class ENC 2. Verify that preconfigured enumerated data attribute values from the device and SCL are in specified range.		
<u>Comment</u>		

sMdl9	Data model extensions	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-1 Subclause 13.4.5, 14 TISSUE #828		
<u>Expected result</u> <ul style="list-style-type: none"> • Private LN shall have lnNs referring to a non-standard name space • Private DO (not defined in the LN) in a standardized LN shall have a dataNs referring to a non-standard name space • Standardized LN may re-use DO's from another standard LN. The DO may have a dataNs = IEC 61850-7-4:2007[A] or IEC 61850-7-4:2003 • Private DO in a private LN may have a dataNs referring to a non-standard name space • Standardized DO in a private LN <u>may</u> have a dataNs = IEC 61850-7-4:2007[A] or IEC 61850-7-4:2003 • Private CDC are not allowed, private extensions in existing CDC are not allowed • Private data attributes are not allowed • Private ENUM values in a standardized ENUM type shall have a negative ord value • Private ENUM types are only allowed for private DO • Extensions to control blocks are not allowed • Only standardized data types are allowed 		
<u>Test description</u> Scan SCL file for extensions: private LN, private DO, private DA and private ENUMs. Browse DUT for extensions: control blocks		
<u>Comment</u>		

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 Service tracking
- A4.5 Substitution
- A4.6 Setting group
- A4.7 Unbuffered Reporting
- A4.8 Buffered Reporting
- A4.9 Logging
- A4.10 Generic object oriented substation events (GOOSE)
- A4.11 Control
- A4.12 Time and time synchronization
- A4.13 File transfer

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

Table A.4.1: ACSI services per conformance block

Conformance Block	Mandatory	Optional
1: Basic Exchange	Associate, Abort, Release GetServerDirectory(LD) GetLogicalDeviceDirectory GetLogicalNodeDirectory (DATA) GetDataValues GetDataDirectory/GetDataDefinition	GetAllDataValues SetDataValues
2: Data Set	GetLogicalNodeDirectory (DATA-SET) GetDataSetValues GetDataSetDirectory	SetDataSetValues
2+: Data Set Definition	CreateDataSet DeleteDataSet	
3: Substitution	SetDataValues GetDataValues	
4: Setting Group Selection	SelectActiveSG GetSGCBValues	
4+: Setting Group Definition	SelectEditSG GetEditSGValue SetEditSGValue ConfirmEditSGValues	
5: Unbuffered Reporting	Report GetURCBValues SetURCBValues	
6: Buffered Reporting	Report GetBRCBValues SetBRCBValues	

7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	SetLCBValues
9a: GOOSE publish	SendGOOSEMessage (publish)	GetGoCBValues SetGoCBValues
9b: GOOSE subscribe	SendGOOSEMessage (subscribe)	
9c: GOOSE management	GetGoReference GetGOOSEElementNumber	
12a: Direct control	Operate	TimeActivatedOperate
12b: SBO control	Select, Cancel, Operate	TimeActivatedOperate
12c: Enhanced Direct Control	Operate CommandTermination	TimeActivatedOperate
12d: Enhanced SBO control	SelectWithValue, Cancel, Operate CommandTermination	TimeActivatedOperate
13: Time sync	TimeSynchronization	
14: File transfer	GetServerDirectory(FILE) GetFile GetFileAttributeValues	SetFile DeleteFile
15: Service Tracking	<no specific services>	<no specific services>

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

Table A.4.2: Test procedures per conformance block

Conformance Block	Mandatory	Conditional
1: Basic Exchange	sAss1, sAss2, sAss3, sAssN2, sAssN3, sAssN4, sAssN5 sSrv1, sSrv2, sSrv3, sSrv4, sSrv5, sSrvN1abcd, sSrvN4	sAssN6 Semantics: sSrv9, sSrv10 PICS-GetAllDataValues: sSrv8, sSrvN1f PICS-SetDataValues: sSrv6, sSrvN1e, sSrvN2, sSrvN3 SCL-Enum with FC=CF/DC/SP and valKind=Set: sSrvN2 SCL-blkEna: sSrv11 SCL-Mode off/blocked/test: sSrv12 SCL-GrRef: sSrv13
2: Data Sets	sDs1, sDs10a, sDsN1ae	PICS-SetDataSetValues: sDs10b, sDsN1b, sDsN13 SCL-configurable datasets: sDs15

2+: Data Set Definition	sDs2, sDs3, sDs4, sDs5, sDs6, sDs7, sDs8, sDs9, sDs11, sDs13, sDs14, sDsN1cd sDsN2, sDsN3, sDsN4, sDsN5 sDsN6, sDsN7, sDsN8, sDsN8, sDsN9, sDsN10,	PICS-Report: sDsN11, sDsN12 SCL-maxAttributes: sDs12
3: Substitution	sSub1, sSub2, sSub3	
4: Setting Group Selection	sSg1, sSg3, sSgN1	SCL-numOfSg>1 or PICS-SGediting: sSg11
4+: Setting Group Definition	sSg2, sSg4. sSg7, sSg8, sSg10, sSgN2, sSgN3, sSgN4, sSgN5	SCL-ResvTms: sSg5, sSg6 SCL-NumOfSg>1: sSg9
5: Unbuffered Reporting	sRp1, sRp2, sRp3, sRp4, sRp5, sRp9, sRp14, sRp15, sRpN1, sRpN2, sRpN3, sRpN4, sRpN8	SCL-DatSet=dyn: sRp6, sRp7 SCL-DatSet=conf/dyn: sRp10 SCL-BufTm=conf/dyn: sRp8, sRp11, sRp12 SCL-Owner: sRp13 SCL-URCB visible to all clients: sRpN5
6: Buffered Reporting	sBr1, sBr2, sBr3, sBr4, sBr5, sBr9, sBr14, sBr15, sBr20, sBr21, sBr22, sBr25. sBr26, sBr27, sBr28 sBrN1, sBrN2, sBrN3, sBrN4, sBrN5, sBrN8	SCL-DatSet=dyn: sBr6, sBr7 SCL-DatSet=conf/dyn: sBr10 SCL-BufTm=conf/dyn: sBr8, sBr11, sBr12 SCL-Owner: sBr13 SCL-ResvTms: sBr23, sBr24
7: Logging	sLog2, sLog3, sLog4, sLog5, sLog6, sLog9, sLog11, sLog12, sLogN1, sLogN2	PICS-QueryLogByTime: sLog7 PICS-QueryLogAfter: sLog8 MICS-GLOG: sLog10
9a: GOOSE publish	sGop2a, sGop3, sGop4, sGop7, sGop9, sGop10, sGop11	PICS-GetGoCBValues: sGop1 SCL-Fixed offset: sGop2b PIXIT-Simulation: sGop5 PICS-SetGoCBValues: sGop6, sGopN1 PIXIT-non test equipment: sGop7 PIXIT-Dataset to large: sGopN2
9b: GOOSE subscribe	sGos1, sGos2, sGos3, sGos5, sGos6a, sGos7, sGosN1, sGosN2, sGosN3, sGosN4, sGosN5, sGosN6	MICS-LGOS: sGos4 PIXIT-Simulation: sGos6b
9c: GOOSE management	sGom1, sGom2, sGomN1	

12: Control general	sCtl5, sCtl8, sCtl9, sCtl10, sCtl11, sCtl14, sCtl25	<p>SCL-Writable control model: sCtl2 PICS-TimOper: sCtl3 MICS-stSeld: sCtl4 SCL-multiple SBO: sCtl6 SCL-CILO: sCtl7 SCL-Select on DO: sCtl13 Operate time: sCtl14 PIXIT-Mode off/blocked: sCtl15 SCL-Loc: sCtl16 SCL-LocSta: sCtl17 SCL-CmdBlk: sCtl18 SCL-blkEna: sCtl19 PIXIT-AddCause:</p> <ul style="list-style-type: none"> • Parameter-change-in-execution: sCtl20 • Step-limit: sCtl21 • Ended-with-overshoot: sCtl23 • Abortion-due-to-deviation: sCtl24 • Command-already-in-execution: sCtl26 <p>SCL-SBO and SBOw: sCtl27</p>
12a Direct control	sDOns1, sDOns2	PICS-TimOper: sDOns4, sDOns5
12b SBO control	sSBOns1, sSBOns2, sSBOns6	PICS-TimOper: sSBOns4, sSBOns5 PIXIT-Operate-Many: sSBOns7
12c Enhanced Direct Control	sDOes1, sDOes2	PICS-TimOper: sDOes4, sDOes5
12d Enhanced SBO control	sSBOes1, sSBOes2, sSBOes6, sSBOes8	PICS-TimOper: sSBOes4, sSBOes5 PIXIT-Operate-Many: sSBOes7
13: Time sync	sTm1, sTm2, sTmN1	PIXIT- COMTRADE: sTm3 SCL-LTIM: sTm4 SCL-LTMS: sTm5 PIXIT-ClockFailure: sTmN2
14: File transfer	sFt1, sFt2ab, sFt4, sFt5, sFtN1ab	PICS-SetFile: sFt3 PICS-DeleteFile: sFt2c, sFtN1c
15: Service tracking		<p>SCL-BrcbTrk: sTrk1 SCL-UrcbTrk: sTrk2 SCL -LocbTrk: sTrk3 SCL -GocbTrk: sTrk4 SCL -MsvcbTrk: sTrk5 SCL -UsvcbTrk: sTrk6 SCL -SgcbTrk: sTrk7 SCL -SpcTrk: sTrk8 SCL -DpcTrk: sTrk9 SCL -IncTrk: sTrk10 SCL -EncTrk: sTrk11 SCL -IscTrk: sTrk12 SCL -BscTrk: sTrk13 SCL -ApcFTrk: sTrk14 SCL -ApcITrk: sTrk15 SCL -BacTrk: sTrk16 SCL -GenTrk: sTrk17</p>

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

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

A4.1 Application association

Abstract test cases

Test case	Test case description
sAss1	Associate and client-release a TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss2	Associate and client-abort TPAA association (IEC 61850-7-2 Subclause 8.3.2)
sAss3	Associate with maximum number of clients simultaneously (PIXIT)

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

Detailed test procedures

sAss1	Associate and client-release a TPAA association	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
<u>Expected result</u> 2. DUT sends Associate response+ 3. DUT sends Release response+		
<u>Test description</u> 1. Configure the Client 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		
<u>Comment</u>		

sAss2	Associate and client-abort TPAA association	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
<u>Expected result</u> 2. DUT sends Associate response+ 3. DUT sends Abort response+		

<u>Test description</u> 1. Configure the Client 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
<u>Comment</u>

sAss3	Associate with maximum number of clients simultaneously	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
<u>Expected result</u> 2. DUT sends Associate response+ for each client 3. DUT sends Release response+ for each client		
<u>Test description</u> 1. Configure the Client and DUT with the correct association and authentication parameters 2. Client 1 to max requests Associate 3. Client 1 to max requests Release 4. Repeat step 2 and 3 250 times		
<u>Comment</u>		

sAssN2	Associate with incorrect association parameters	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As5, As6		
<u>Expected result</u> 1. DUT sends Associate response+ 2. DUT sends Release response+ 4. DUT sends Associate response- when PIXIT indicates the DUT verifies the parameter, otherwise the dUT sends Associate response+		
<u>Test description</u> 1. Configure the Client and DUT with correct association and authentication parameters and request Associate 2. Client requests Release 3. Configure the Client and DUT with correct authentication parameters and one of the following incorrect configurable association parameters: <ul style="list-style-type: none"> • called / calling transport selector • called / calling session selector • called / calling presentation selector • called / calling AP title • called / calling AE qualifier 4. Client requests Associate 5. When DUT sends Associate response+, Client sends Release request 6. Repeat step 1 to 5 for the next association parameter till all parameters are verified		
<u>Comment</u> The following table indicates the associate response results with incorrect: <ul style="list-style-type: none"> • called / calling transport selector + / + • called / calling session selector + / + • called / calling presentation selector + / + • called / calling AP title + / + • called / calling AE qualifier + / + “-” = associate failed, DUT does check the incorrect parameter and sends response- “+” = associate succeeded, DUT does not check the incorrect parameter and sends response+		

sAssN3	Associate with maximum+1 number of clients simultaneously	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2		
<u>Expected result</u>		
2. DUT sends Associate response+ for at least the maximum server associates as defined in the PIXIT and response- for the last associate 3. DUT sends Release response+		
<u>Test description</u>		
1. Configure the Client and DUT with the correct association and authentication parameters 2. Client 1 to N send Associate requests until the DUT sends response- 3. Client 1 to N-1 send release 4. Repeat step 2 and 3 250 times		
<u>Comment</u>		

sAssN4	Detection of lost link	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 8.3.2 IEC 61850-8-1 Subclause 10.2, PIXIT: As2, As3		
<u>Expected result</u>		
2. DUT sends Associate response+ 3. DUT sends GetDataValues response+ 4. DUT sends KEEP ALIVE messages according to PIXIT specified interval 7. DUT sends no response		
<u>Test description</u>		
1. Configure the Client and DUT with the correct association and authentication parameters 2. Client requests Associate 3. Client requests a correct GetDataValues 4. Wait multiple KEEP ALIVE timeouts 5. Disable TCP communication between the Client and the DUT. E.g. disconnect the physical link, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the KEEP ALIVE timeout specified in the PIXIT 6. Enable TCP communication. E.g. connect the physical link 7. Verify the DUT has lost the association by sending a correct GetDataValues request		
<u>Comment</u>		

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



Comment

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

Abstract test cases

Test case	Test case description
sSrv1	Request GetServerDirectory(LOGICAL-DEVICE) and check response (IEC 61850-7-2 Subclause 7.2.2)
sSrv2	For each GetServerDirectory(LOGICAL-DEVICE) response issue a GetLogicalDeviceDirectory request and check response (IEC 61850-7-2 Subclause 9.2.1)
sSrv3	For each GetLogicalDeviceDirectory response issue a GetLogicalNodeDirectory(DATA) request and check response (IEC 61850-7-2 Subclause 10.2.2)
sSrv4	For each GetLogicalNodeDirectory(DATA) response issue a GetDataDirectory request and check response (IEC 61850-7-2 Subclause 11.4.4) GetDataDefinition request and check response (IEC 61850-7-2 Subclause 11.4.5) GetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.2)
sSrv5	Issue one GetDataValues request with different data reference hierarchy
sSrv6	For each write enabled DATA object issue a SetDataValues request and check response (IEC 61850-7-2 Subclause 11.4.3)
sSrv7	Issue one SetDataValues request with the maximum number of data values and check response. (Deprecated, this is not a valid SetDataValues request)
sSrv8	Request GetAllDataValues for each functional constraint and check response (IEC 61850-7-2 Subclause 10.2.3)
sSrv9	Evaluate the semantic of selected (volt/amp) analogue measurements: Verify analogue value (plausibility check, not accuracy) Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy) Verify scaling, range and units, change a setting and verify resulting value Verify dead band, change dead band and verify result Verify limit indications
sSrv10	Evaluate the semantic of selected status points: Verify status value Verify quality bits, force situations to set specific quality bits Verify (UTC) timestamp value and quality (plausibility check, not accuracy)
sSrv11	Verify that when blkEna is set to true by an operator the quality bit oldData and operatorBlocked is set by the server and the process data is not updated anymore (IEC 61850-7-3 Subclause 6.2.6)
sSrv12	Verify Mod/Beh values: off, test, blocked When Mod/Beh is off process data is not updated, Mod and Beh are updated, quality is set to invalid When Mod/Beh is test or test-blocked the process data quality test is set When Mod/Beh is on-blocked the process data quality is valid (IEC 61850-7-4 Annex A, TISSUE #712)
sSrv13	Verify logical device hierarchy; the LLN0.GrRef shall reference a valid logical device the reference shall not result in a hierarchy loop Beh value at higher level influences the lower levels correctly (i.e. like LD Beh influences LN behaviour dependent on LN Mod)

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

Detailed test procedures

sSrv1	GetServerDirectory(LOGICAL-DEVICE)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 7.2.2 IEC 61850-8-1 Subclause 9.3		
<u>Expected result</u>		
<ol style="list-style-type: none"> DUT sends Association response+ DUT sends GetServerDirectory(LOGICAL-DEVICE) response+ with a list of logical devices 		
<u>Test description</u>		
<ol style="list-style-type: none"> Client requests correct Association Client requests GetServerDirectory(LOGICAL-DEVICE) Continue with sSrv2 		
<u>Comment</u>		

sSrv2	GetLogicalDeviceDirectory	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 9.2.1 IEC 61850-8-1 Subclause 11.1		
<u>Expected result</u>		
<ol style="list-style-type: none"> DUT sends GetLogicalDeviceDirectory response+ with a list of logical nodes within the logical device 		
<u>Test description</u>		
<ol style="list-style-type: none"> For each responded logical device Client requests GetLogicalDeviceDirectory Continue with sSrv3 		
<u>Comment</u>		

sSrv3	GetLogicalNodeDirectory(DATA)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 9.2.2
IEC 61850-8-1 Subclause 12.3.1

Expected result

1. DUT sends GetLogicalNodeDirectory(DATA) response+ with a list of data

Test description

1. For each responded logical node directory Client requests GetLogicalNodeDirectory(DATA)
2. Continue with sSrv4

Comment

sSrv4

GetDataDirectory, GetDataDefinition and GetDataValues

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 11.4.4, 11.4.5 and 11.4.2
IEC 61850-8-1 Subclause 13.4.3, 13.4.4 and 13.4.1

Expected result

1.
 - a) DUT sends GetDataDirectory response+
 - b) DUT sends GetDataDefinition response+
 - c) DUT sends GetDataValues response+

Test description

1. For each responded data object Client requests a:
 - a) GetDataDirectory
 - b) GetDataDefinition
 - c) GetDataValues

Comment

sSrv5

GetDataValues with data hierarchy

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 11.4.2
IEC 61850-8-1 Subclause 13.2.1

Expected result

1. DUT sends GetDataValues response+ with requested data hierarchy

Test description

1. Client requests one GetDataValues of at least the following data objects for the supported data hierarchy level:
 - Functional constrained data: LLN0\$ST\$Mod
 - Functional constrained data attribute: LLN0\$ST\$Mod\$stVal
 - Functional constrained data attribute type attribute

Comment

sSrv6

SetDataValues

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 11.4.3
IEC 61850-8-1 Subclause 13.2.2

Expected result

1. DUT sends SetDataValues response- with data access error "object-access-denied"
2. DUT sends SetDataValues(FC=BL, CF,SP, DC) response- for read-only data and response+ for write enabled data as specified in the ICD using valKind="RO" for read-only and "Set" for write enabled data attributes.
3. DUT sends SetDataValues response+
4. DUT sends GetDataValues response+ with requested value, the value does match
5. DUT sends SetDataValues response+
6. DUT sends GetDataValues response+ with requested value, the value does match

Test description

1. For each data object with FC=ST, MX or EX client sends a SetDataValues request with the current value
2. For each data object with FC=BL, CF, SP or DC client sends a SetDataValues request with the current value

For each type of write-enabled data objects

3. Client sends a SetDataValues with a valid new value
4. Client sends a GetDataValues request and check the value does match
5. Client sends a SetDataValues with the original value
6. Client sends a GetDataValues request and check the value does match

Comment

The DUT has writable attributes with FC = SP

sSrv8	GetAllDataValues	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 10.2.3 IEC 61850-8-1 Subclause 12.3.2		
<u>Expected result</u> <ol style="list-style-type: none">1. DUT sends GetAllDataValues response+2. DUT sends GetAllDataValues response+		
<u>Test description</u> <ol style="list-style-type: none">1. For each Logical Node and supported functional constraint the Client sends a GetAllDataValues request using MMS Alternate Access where the alternate access contains at least an allowed Data FC = ST, MX, CF, SP, DC, EX, BL, OR.2. For each Logical node the Client sends a GetAllDataValues request using object reference <IED><LD>/<LN>§<FC> where FC = ST, MX, CF, SP, DC, EX, BL, OR.		
<u>Comment</u>		

sSrv9	Semantic of measured value (MV)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-3 Subclause 6.2, 6.3, 6.4, 6.5 and 7.4.2, Table 3 PIXIT: Sr1		
<u>Expected result</u> <ol style="list-style-type: none">2. DUT sends GetDataValues Response+, the instantaneous / dead banded value does match the forced change4. DUT sends GetDataValues Response+. The quality shall match the forced value.5. DUT sends GetDataValues Response+. verify differences in the instantaneous and dead banded value For all above steps: <ul style="list-style-type: none">• Default quality attribute value shall be supplied when the functionality of the related quality attribute is not supported (PIXIT)• When supported the scaling, range, units and dead band functionality shall be supplied• The quality validity shall follow the quality details according to table 3		

Test description

1. Force EQUIPMENT SIMULATOR to change the measured value.
2. Client request GetDataValues
3. Force situation to set the following supported quality values for this measured value:
 - validity: good, invalid, questionable
 - detail: overflow, out of range, bad reference, failure, old data, inaccurate, inconsistent
 - source: process
4. Change the scale, range and units and repeat steps 1 and 2
5. Change the dead band and repeat steps 1 and 2

Comment

PIXIT indicates that the following quality bits are supported: Validity: Good, Invalid, Questionable, Overflow; Source: Process, Test
The following quality bits could be forced for the specified data object:
ET25__FLOAT/MMXU1.MX.PPV.phsAB: Good, Invalid, Questionable, Overflow, Process
Note: quality source substituted is tested during Substitution, quality test is tested in sSrv12, quality operatorBlocked at sSrv11.

sSrv10

Semantic of single and double point status value

- Passed
 Failed
 Inconclusive

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

Expected result

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

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

Test description

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

Comment

PIXIT indicates that the following quality bits are supported: Validity: Good, Invalid, Questionable, Overflow; Source: Process, Test
The following quality bits could be forced for the specified data object:
ET25__IND/GGIO2.ST.DPCSO1: Good, Invalid, Questionable, Process
Note: quality source substituted is tested during Substitution, quality test is tested in sSrv12, quality operatorBlocked at sSrv11.

sSrv12

Mode / Behaviour: off, test and/or blocked

- Passed
 Failed
 Inconclusive

IEC 61850-7-4 Table 10, Annex A
IEC 61850-8-1 Subclause 13.4.1, 13.4.2
TISSUE #712

Expected result

2. Mode and behaviour values are updated, quality of process data is invalid
4. Mode and behaviour values are updated, quality bit "test" is set in process data
6. Mode and behaviour values are updated, quality bit "test" is set in process data
8. Mode and behaviour values are updated, quality is the same as in Mode = On (TISSUE #712)
10. Mode and behaviour values are updated, all quality bits are cleared in process data

Test description

1. Force DUT into Mode = Off for one logical node (when supported)
2. Client requests GetDataValues of the Mode, Behaviour and process data
3. Force DUT into Mode = Test for one logical node (when supported)
4. Client requests GetDataValues of the Mode, Behaviour and process data
5. Force DUT into Mode = Test-blocked for one logical node (when supported)
6. Client requests GetDataValues of the Mode, Behaviour and process data
7. Force DUT into Mode = blocked for one logical node (when supported)
8. Client requests GetDataValues of the Mode, Behaviour and process data
9. Force DUT into Mode = On for one logical node
10. Client requests GetDataValues of the Mode, Behaviour and process data

Comment

The DUT supports mode On, Blocked, Test and Off.

sSrvN1

LD/LN/Data services with incorrect parameters

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 7.2.2, 8.2.1, 10.2-3, 11.4.2-5
IEC 61850-8-1 Subclause 8.1.3.4

Expected result

1.
 - a) DUT sends MMS service error with error class access "object-non-existent"
 - b) DUT sends MMS service error with error class access "object-non-existent"
 - c) DUT sends MMS service error with error class access "object-non-existent"
 - d) DUT sends response with data access error "object-non-existent"
 - e) DUT sends response with data access error "object-non-existent"
 - f) DUT sends response with data access error "object-non-existent"

Test description

1. Client requests the following data services with wrong parameters (unknown object, logical device and/or logical node, known object but with a name case mismatch when applicable):
 - a) GetLogicalDeviceDirectory
 - b) GetLogicalNodeDirectory(DATA)
 - c) GetDataDirectory / GetDataDefinition (same for part 8-1)
 - d) GetDataValues
 - e) SetDataValues
 - f) GetAllDataValues

Comment

sSrvN3

SetDataValues with mismatching data type

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 11.4.3
IEC 61850-8-1 Subclause 8.1.3.4.4.2, Table 23

Expected result

1. DUT sends response with data access error "type-inconsistent"
2. DUT sends response with data access error "type-inconsistent"
3. DUT sends response with data access error "type-inconsistent"
4. DUT sends response with data access error "type-inconsistent"

Test description

1. Client sends a SetDataValues request with an integer data object with a float value
2. Client sends a SetDataValues request with a float data object with an integer value
3. Client sends a SetDataValues request with a boolean data object with a float value
4. Client sends a SetDataValues request with a bitstring data object with a float value

Comment

The DUT has implemented writable float

sSrvN4

SetDataValues of read-only FCDA

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 11.4.3
IEC 61850-8-1 Subclause 8.1.3.4.4.2, Table 23

Expected result

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

Test description

1. Client sends a SetDataValues request with an read-only FCDA

Comment

A4.3 Data set

Abstract test cases

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

Test case	Test case description
sDsN1	Request following data set services with wrong parameters (unknown object, name case mismatch, wrong logical device or wrong logical node) and verify response- service error: GetDataSetValues (IEC 61850-7-2 Subclause 13.3.2) SetDataSetValues (IEC 61850-7-2 Subclause 13.3.3) CreateDataSet (IEC 61850-7-2 Subclause 13.3.4) DeleteDataSet (IEC 61850-7-2 Subclause 13.3.5) GetDataSetDirectory (IEC 61850-7-2 Subclause 13.3.6)
sDsN2	Create a persistent dataset with the same name twice, and verify response- service error
sDsN3	Create a non-persistent dataset with the same name twice, and verify response- service error
sDsN4	Continue to create persistent data sets until a correct response- service error is returned

Test case	Test case description
sDsN5	Continue to create non-persistent data sets until a correct response- service error is returned
sDsN6	Create a persistent dataset with unknown member verify response- service error
sDsN7	Create a non-persistent dataset with unknown member verify response- service error
sDsN8	Delete a (pre-defined) non-deletable dataset, and verify response- service error
sDsN9	Delete a persistent dataset twice, and verify response- service error
sDsN10	Delete a non-persistent dataset twice, and verify response- service error
sDsN11	Delete a persistent dataset referenced by a (report) control class, and verify response- service error (IEC 61850-7-2 Subclause 13.1)
sDsN12	Delete a non-persistent dataset referenced by a (report) control class, and verify response- service error (IEC 61850-7-2 Subclause 13.1)
sDsN13	Request SetDataSetValues with a dataset with one or more read-only members, and verify response- service error

Detailed test procedures

sDs1	GetLogicalNodeDirectory, GetDataSetDirectory, GetDataSetValues	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6 IEC 61850-8-1 Subclause 14.3		
<u>Expected result</u>		
1. DUT sends a GetLogicalNodeDirectory (DATA-SET) response+ 2. DUT sends a GetDataSetDirectory response+ 3. DUT sends a GetDataSetValues response+		
<u>Test description</u>		
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		
<u>Comment</u>		

sDs10	GetDataSetValues, SetDataSetValues	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 13.3.2, 13.3.3 IEC 61850-8-1 Subclause 12.3.1, 14.3.1, 14.3.3, 14.3.4		
<u>Expected result</u>		
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+		

<u>Test description</u> a) Select or create a data set with read-only elements Client requests a GetDataSetValues Client requests a GetDataValues for each member of the dataset. b) Select or create a data set with writable elements Client requests a GetDataSetValues Client requests a GetDataValues for each member of the dataset. Client requests a SetDataSetValues with different values than received by GetDataValues Client requests a GetDataSetValues Client requests a SetDataValues for each member of the dataset with different values than received by GetDataSetValues Client request GetDataSetValues
<u>Comment</u> Only step a) is applicable and tested.

sDs15	Dataset with most to least data hierarchy FCDA elements	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6 IEC 61850-8-1 Subclause 14.3 TISSUE #1174		
<u>Expected result</u> 1. In the SCL file the FCDA doName contains maximum one dot (for example doName="neut.phsA" and daName="cVal.mag.f") 2. DUT sends a GetDataSetDirectory response+ 3. DUT sends a GetDataSetValues response+		
<u>Test description</u> 1. Configure DUT with one or more datasets with the least detailed data hierarchy to the most detailed data hierarchy available in the DUT data model. For example: <ul style="list-style-type: none"> • MMXU.PhV • MMXU.A.phsA • MMXU.A.phsB.cVal • MMXU.A.phsC.cVal.mag • MMXU.A.neut.cVal.mag.f 2. Client requests a GetDataSetDirectory for these datasets 3. Client requests a GetDataSetValues for these datasets		
<u>Comment</u>		

sDsN1	DataSet services with illegal parameters	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 13.3.2, 13.3.3, 13.3.4, 13.3.5, 13.3.6 IEC 61850-8-1 Subclause 8.1.3.4		
<u>Expected result</u> a) DUT sends ServiceError with errorClass=access errorCode=object-non-existent b) DUT sends ServiceError with errorClass=access errorCode=object-non-existent c) DUT sends ServiceError with errorClass=access errorCode=object-non-existent d) DUT sends DeleteDataSet response- with numberMatched=0, numberDeleted=0 e) DUT sends ServiceError with errorClass=access errorCode=object-non-existent		

Test description

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

Comment

Only steps a) and e) are applicable and tested.
Steps 4) and 6) are applicable due to DUT contains more than one Logical Devices in the DUT.

A4.6 Setting group control

Abstract test cases

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

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

Detailed test procedures

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

sSg3	SelectActiveSG	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 16.2, 16.3 IEC 61850-8-1 Subclause 16.2.1, 16.2.5		
<u>Expected result</u> 1. DUT sends SelectActiveSG response+ 2. DUT has updated the activated setting group value and last activation time (when the setting group value has changed) 3. DUT sends GetDataValues response+		
<u>Test description</u> 1. Client requests SelectActiveSG of the first setting group 2. Client requests GetSGCBValues 3. Client requests GetDataValues to verify the SG values in the first setting group when available 4. Repeat steps 1 to 3 for other setting groups for this SGCB		
<u>Comment</u>		

sSgN1	Setting group selection services with wrong parameters	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 16.2, 16.3 IEC 61850-8-1 Subclause 16.2		
<u>Expected result</u> a) DUT sends SelectActiveSG response- with data access error=object-value-invalid b) DUT sends GetSGCBValues response- with data access error=object-non-existent		
<u>Test description</u> a) Client requests SelectActiveSG with 0 and then NumOfSg+1 setting group b) Client requests GetSGCBValues with unknown object		
<u>Comment</u>		

A4.7 Unbuffered Reporting

Abstract test cases

Test case	Test case description
sRp1	Request GetLogicalNodeDirectory(URCB) and check response Request GetURCBValues of all responded URCB's
sRp2	Verify the reporting of optional fields of a URCB Configure/enable a URCB with all optional fields combinations: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, and/or data-reference (IEC 61850-7-2 Subclause 17.2.3.2.2.1), force/trigger a report and check the reports contain the enabled optional fields
sRp3	Verify the trigger options of a URCB Configure and enable a URCB with optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name and data-reference and check the reports are transmitted according to the following trigger options: on integrity on update (dupd) on update with integrity on data change (dchg) on data and quality change on data and quality change with integrity period Verify the validity of the ReasonCode (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that when more trigger options are met preferably only one report is generated (IEC 61850-7-2 Subclause 17.2.3.2.3.2) Verify that reports are only sent when RptEna is set to True. (IEC 61850-7-2 Subclause 17.2.2.5), when reporting is disabled no reports shall be transmitted
sRp4	General interrogation (IEC 61850-7-2 Subclause 17.2.2.13) Setting the GI attribute of an URCB shall start the general-interrogation process. One report with the current data values will be sent. After initiation of the general-interrogation, the GI attribute is reset to False.
sRp5	Segmentation of reports Verify that if a long report does not fit in one message, the report is split into sub-reports. Enable sequence-number and report-time-stamp optional field and check validity of: (IEC 61850-7-2 Subclause 17.2.3.2.2.5) SqNum (not changed) SubSqNum (0 for first report, incrementing, roll-over) MoreSeqmentsFollow TimeOfEntry (not changed as SqNum is not altered) (IEC 61850-7-2 Subclause 17.2.3.2.2.9) Verify that an update of a data value during sending of a segmented report caused by an integrity or general-interrogation trigger can be interrupted by a report with change of one of the data values with a new sequence number. (IEC 61850-7-2 Subclause 17.2.3.2.3.5) A new request for general-interrogation shall stop the sending of remaining segments of the GI-report that is still going on. A new GI-report shall start with a new sequence number and the sub-sequence number shall be 0 (IEC 61850-7-2 Subclause 17.2.3.2.3.4)
sRp6	Configuration revision (IEC 61850-7-2 Subclause 17.2.2.7) Verify that ConfRev represents a count of the number of times the configuration of the data set referenced by DataSet has been changed. Changes that are counted are: deletion of a member of the data-set re-ordering of members in the data-set Verify that the server increments the ConfRev in case the data sets changes due to processing of ACSI services ConfRev shall never be 0 (zero) in case DataSet is not null.
sRp7	Verify that after a restart of the server, the value of ConfRev is restored to its original value of the base local configuration OR the value is retained from the configuration prior to restart (PIXIT)

Test case	Test case description
sRp8	<p>Buffer Time (IEC 61850-7-2 Subclause 17.2.2.9) Verify that in the case where a second internal notification of the same member of a DATA-SET has occurred prior to the expiration of BufTm, the server: (IEC 61850-7-2 Subclause 17.2.2.9) shall for status information behave as if BufTm has expired and immediately send the report, restart the timer with value BufTm and process the second notification or may for analogue information behave as if BufTm has expired and immediately transmit the report for transmission, restart the timer with value BufTm and process the second notification or for analogue information substitute the current value in the pending report with the new one. Configure Buffer Time to 1.000 ms and force a data value change of multiple dataset members within buffer time. Server shall send not more than one report per buffer time with all the data values changes since last report. Verify that the value 0 for buffer time indicates that the buffer time attribute is not used. (IEC 61850-7-2 Subclause 17.2.2.9) Verify that the BufTm value can contain at least the value 360.0000 (= 1 h in ms)</p>
sRp9	Verify the DUT can send reports with data objects
sRp10	Verify the DUT can send reports with data attributes
sRp11	Verify the DUT send any buffered events before the integrity report
sRp12	Verify the DUT send any buffered events before the GI report
sRp13	Verify that the server sets URCB Owner to a non-NULL value when the URCB is configured by a client and reset to NULL when a client releases the URCB. For a pre-assigned URCB the server resets the Owner to the pre-assigned client address
sRp14	Verify that the DUT can process an URCB with maximum name length for RptID and DataSet (IEC 61850-7-2 Subclause 22.2)
sRp15	Verify report with dataset with most to least data hierarchy FCDA elements

Test case	Test case description
sRpN1	Request GetURCBValues with wrong parameters and verify response- service error (IEC 61850-7-2 Subclause 17.2.5.3)
sRpN2	Configure reporting with trigger option GI (not dchg, qchg, dupd, integrity). When enabled only GI reports are transmitted. No reports shall be send when generating events (IEC 61850-7-2 Subclause 17.2.3.2.3.4)
sRpN3	Setting the integrity period to 0 with TrgOps = integrity will result in no integrity reports will be sent (IEC 61850-7-2 Subclause 17.2.3.2.3.3)
sRpN4	Incorrect configuration of a URCB: configure when enabled, configure ConfRev and SqNum and configure with unknown data set
sRpN5	Exclusive use of URCB and lost association Configure a URCB and set the Resv attribute and enable it. Verify another client cannot set any attribute of that URCB (IEC 61850-7-2 Subclause 17.2.4.5)
sRpN6	Configure unsupported URCB options (PIXIT); Configure unsupported trigger options, optional fields and related parameters
sRpN7	Verify another client can not configure a pre-assigned URCB
sRpN8	Verify that when TrgOps - GI is not set the device does not send reports with reason code GI when RptEna=FALSE setting the GI=TRUE will fail when RptEna=TRUE resetting the GI=FALSE is accepted with no impact (no GI report)

Note: sRpN6 and sRpN7 are not applicable for part 8-1.

Detailed test procedures

sRp1	GetLogicalNodeDirectory(URCB) and GetURCBValues	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 10.2.2 and 17.2.5.3 IEC 61850-8-1 Subclause 12.3.1 and 17.2.4		
<u>Expected result</u>		
<ol style="list-style-type: none"> 1. DUT sends GetLogicalNodeDirectory(URCB) response+ with a list of URCB's 2. DUT sends GetURCBValues response+ 		
<u>Test description</u>		
<ol style="list-style-type: none"> 1. For each logical node Client requests GetLogicalNodeDirectory(URCB) 2. For each URCB Client requests GetURCBValues 		
<u>Comment</u>		

sRp2	Reporting of optional fields for a URCB	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 17.2.2.8 IEC 61850-8-1 Subclause 17.2		
<u>Expected result</u>		
<ol style="list-style-type: none"> 1. DUT sends SetURCBValues response+ 2. DUT sends SetURCBValues response+ 3. DUT sends SetURCBValues response+ and sends a correct report according to IEC 61850-8-1 table 64 with all data set members for reason general-interrogation and for reason data-change only the changed data set members. The configured and reported optional fields shall match and the sequence number starts with 0 the report time stamp has UTC value and matches the trigger time the reason for inclusion matches the trigger option the configured and reported data set name do match the data-reference(s) match the data set member(s) Configuration revision matches the URCB configuration 4. DUT sends SetURCBValues response+ and sends no reports anymore 		
<u>Test description</u>		
<ol style="list-style-type: none"> 1. Client configures an available URCB using SetURCBValues with all combinations of the following optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference and conf-rev 2. Client enables the URCB (set RptEna to True) 3. Client requests a GI report (trigger option general-interrogation) or EQUIPMENT SIMULATOR triggers a report (trigger option data change) 4. Client disables the URCB (set RptEna to False) 5. Repeat step 1 to 4 for next combination of optional fields 		
<u>Comment</u>		

sRp3	Trigger options for a URCB	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 17.2.3.2.3 IEC 61850-8-1 Subclause 8.1.3.9, 17.2, TISSUE #780, PIXIT: Rp10		

Expected result

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

Test description

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

Comment

sRp4

General interrogation URCB and RptID

- Passed
 Failed
 Inconclusive

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

Expected result

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

Test description

1. Client configures and enables an available URCB
 2. Client requests SetURCBValues to trigger the GI report
 3. Client requests GetURCBValues
 4. Client disables the URCB
- When the URCB RptID is dynamic ("dyn")
5. Client configures the URCB RptID with an empty string
 6. Client enables the URCB and triggers the GI report
 7. Client disables the URCB
 8. Client configures the URCB RptID with a non-empty string
 9. Client enables the URCB and triggers the GI report
 10. Client disables the URCB

Comment

sRp5

Segmentation of reports URCB

- Passed
 Failed
 Inconclusive

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

Expected result

2. DUT sends associate respond+ for minimum PDU size. DUT may send associate respond- for smaller PDU size
4. The DUT sends the integrity reports in two or more segments. The segmented report messages have the same SqNum, the same report time stamp, incremented SubSqNum starting with 0 and MoreSegmentsFollow is set except for the last report segment

Test description

1. Select a data set of which the reported values do not fit in one MMS PDU (reduce the MMS PDU size when necessary)
 2. Client associates with the minimum PDU size. In case the minimum PDU size does not cause segmentation use an smaller PDU size
- When association succeeds
3. Client configures an available URCB with the data set, trigger-condition integrity, and at least the optional fields sequence-number and report-time-stamp
 4. Client enables the RCB and waits for several integrity reports
 5. Client disables the RCB

Comment

sRp9

Report data objects (FCD)

- Passed
 Failed
 Inconclusive

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

Expected result

2. Verify the DUT does report the whole data object

Test description

1. Client configures an available URCB using SetURCBValues with a data-set that contains at least one data object, and all optional fields with the trigger option: data-change. Client enables the URCB.
2. Change a data attribute within one data object in the data-set

Comment

sRp11

Send buffered events before integrity report

- Passed
 Failed
 Inconclusive

IEC 61850-7-2 Subclause 17.2.3.2.3.3
IEC 61850-8-1 Subclause 17.2

Expected result

3. DUT does send 2 reports: first a report with the buffered data-change and then the integrity report

Test description

1. Client configures an available URCB using SetURCBValues with a valid BufTm, a valid IntgPd whose value is smaller than the BufTm value and all optional fields with the trigger options: data-change and integrity
2. Client enables the URCB, set RptEna to True
3. EQUIPMENT SIMULATOR forces a data change in the data set, wait for integrity report
4. Client disables the URCB

Comment

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

sRp14	Max URCB name length	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 22.2 IEC 61850-8-1 Subclause 17.1.3		
<u>Expected result</u>		
2. DUT sends SetURCBValues response+ 3. DUT sends SetURCBValues response+ 4. DUT sends GI report with correct data set name and report ID value		
<u>Test description</u>		
1. Configure DUT with URCB with maximum name length (32 including the index), with maximum name length of the data set (32 chars) and report ID (129 chars) when these attributes are not fixed ("fix") 2. Client requests SetURCBValues of another URCB with maximum length data set and maximum length report ID when these attributes are dynamic ("dyn") 3. Client enables both URCBs with at least OptFlds data-set-name and trigger condition GI 4. Client requests SetURCBValues with GI=true 5. Client disables both URCBs		
<u>Comment</u>		



sRp15	Report with dataset with most to least data hierarchy FCDA elements	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 10.2.2, 13.3.2, 13.3.6, TISSUE #1174 IEC 61850-8-1 Subclause 14.3		
<u>Expected result</u> 1. In the SCL file the FCDA doName contains maximum one dot (for example doName="neut.phsA" and daName="cVal.mag.f") 2. DUT sends a SetURCBValues response+ 3. DUT sends the GI report with correct data references		
<u>Test description</u> 1. Configure one or more URCBs with one or more datasets with the least detailed data hierarchy to the most detailed data hierarchy available in the DUT data model. For example: - MMXU.PhV - MMXU.A.phsA - MMXU.A.phsB.cVal - MMXU.A.phsC.cVal.mag - MMXU.A.neut.cVal.mag.f 2. Client enables the URCB with all supported optional fields and trigger condition GI 3. Client request GI		
<u>Comment</u>		

sRpN1	Incorrect GetURCBValues	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 17.2.5.3 IEC 61850-8-1 Subclause 17.2		
<u>Expected result</u>		
1. DUT sends response with data access error "object-non-existent"		
<u>Test description</u>		
1. Client request GetURCBValues with unknown URCB object		
<u>Comment</u>		

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

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

sRpN4	Incorrect configuration of URCB	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 17.2.5.4 IEC 61850-8-1 Subclause 17.1.3, 8.1.3.4.3, Table 61		
<u>Expected result</u> 2. DUT sends SetURCBValues response- with data access error "temporarily-unavailable" 4. DUT sends SetDataValues response- with data access error "object-access-denied" 5. DUT sends SetURCBValues response- with data access error "object-access-denied" 6. DUT sends SetURCBValues response- with data access error "object-value-invalid" 7. DUT sends SetURCBValues response+ 8. DUT sends SetURCBValues response- with data access error "temporarily-unavailable"		
<u>Test description</u> 1. Client configures and enables an available URCB 2. Client requests SetURCBValues with one of the following "dyn" attributes: RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd 3. Client disables the URCB 4. Client requests SetDataValues with one of the following attributes: ConfRev, SqNum, TimeOfEntry and Owner (when available) 5. Client requests SetURCBValues with the "fix" or "conf" attributes from step 2 When datSet="dyn" then perform the following steps 6. Client requests SetURCBValues with unknown DatSet 7. Client changes datSet to empty 8. Client enables an URCB with empty DatSet		
<u>Comment</u>		

sRpN5	Exclusive use of URCB	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 17.2.1 IEC 61850-8-1 Subclause 17.2 PIXIT: As2		
<u>Expected result</u> 2. DUT sends SetURCBValues response- with data access error = temporarily-unavailable 4. DUT sends SetURCBValues response+ 8. DUT sends SetURCBValues response+ 11. DUT sends SetURCBValues response- with data access error = temporarily-unavailable 14. DUT sends SetURCBValues response+		
<u>Test description</u> 1. Client1 reserves an available URCB 2. Client2 reserves and configures the same URCB by requesting SetURCBValues with one of the following dynamic ("dyn") attributes Resv, RptID, DatSet, OptFlds, BufTm, TrgOps, IntgPd 3. Client1 resets the reservation of the URCB 4. Client2 reserves and configures the URCB 5. Client2 resets the reservation of the URCB 6. Client1 reserves the URCB 7. Client1 aborts and re-establishes the association 8. Client1 configures the URCB 9. Client1 resets the reservation of the URCB 10. Client1 reserves the URCB 11. Client2 requests SetURCBValues of a "dyn" attribute 12. Disable the TCP communication between Client1 and the DUT. E.g. disconnect the physical link, between two Ethernet switches (preventing Ethernet hardware error detection at both client and server), some seconds longer than the KEEP ALIVE timeout specified in the PIXIT and then enable TCP communication. E.g. connect the physical link 13. Client2 reserves the URCB 14. Client2 requests SetURCBValues of a "dyn" attribute		

Comment

Step 12: Tested with a KEEP ALIVE timeout of 17 seconds.

sRpN8

Trigger option GI not set

- Passed
- Failed
- Inconclusive

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

Expected result

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

Test description

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

Comment

A4.11 Control

Abstract test cases

Test case	Test case description
sCtl1	Force and check each path in control state machine for several control objects with control models a direct with normal security (IEC 61850-7-2 Subclause 20.2.1) b SBO-control with normal security (IEC 61850-7-2 Subclause 20.2.2) c direct with enhanced security (IEC 61850-7-2 Subclause 20.3.2) d SBO-control with enhanced security (IEC 61850-7-2 Subclause 20.3.3) e Compare detailed test cases for each control model
sCtl2	Change control model using online services and verify that the control object responds according to the new control model
sCtl3	Time Operate a second enhanced security control object before the activation time of the first control object (PIXIT)
sCtl4	Verify that the stSeld attribute value is set/reset as specified in the state machines
sCtl5	Verify test flag in SelectWithValue/Operate and Beh = test (IEC 61850-7-4 Annex A Table A.1) <ul style="list-style-type: none"> When LN Beh is "on" the control Requests are rejected with AddCause "Blocked-by-mode" When LN Beh is "test/blocked" the control requests are accepted When LN Beh is "test" the control requests are accepted
sCtl6	Select all SBO control objects and cancel them in opposite order. In case a control action is blocked because another control is already running the AddCause shall be "1-of-n-control"
sCtl7	Verify that with interlock or synchro check conditions the specified checks are performed and the command is executed accordingly (IEC 61850-7-2 Subclause 20.5.2.5) <ul style="list-style-type: none"> When the interlock check fails with AddCause "Blocked-by-interlocking" When the interlock check passes When the synchro check fails with AddCause "Blocked-by-synchrocheck" When the synchro check passes
sCtl8	Operate (without select) a SBO control object and verify that the request is rejected with AddCause "Object-not-selected" (IEC 61850-7.2 table 47)
sCtl9	Select the same control object twice, verify that the second select request is rejected with AddCause "Object-already-selected" (IEC 61850-7-2 table 47) and the object remains in selected state (Operate.req is accepted)
sCtl10	Operate control value is the same as the actual status value (On-On or Off-Off) and verify that the control request is rejected with AddCause "Position-reached" (IEC 61850-7-2 table 47, PIXIT)
sCtl11	Select the same control object from 2 different clients. Verify that the control requests from the second client are rejected with AddCause "Locked-by-other-client" (IEC 61850-7-2 table 47)
sCtl12	Select / Operate a unknown control object and verify that the control requests are rejected with AddCause "Unknown" (IEC 61850-7-2 table 47)
sCtl13	Verify that the Select request on a direct operate control object is rejected with AddCause "Not-supported" (IEC 61850-7-2 table 47)
sCtl14	Operate the same direct control object twice from 2 clients (IEC 61850-7-2 table 54, PIXIT) and verify that the last control request is rejected with AddCause "Command-already-in-execution"
sCtl15	Verify that on LN behaviour off or on/blocked control requests are rejected with AddCause "Blocked-by-Mode" (IEC 61850-7-4 Annex A)
sCtl16	Verify that when Loc is set remote control requests are rejected with AddCause "Blocked-by-switching-hierarchy"
sCtl17	Verify that with station level control authority (LocSta=T) remote control requests are rejected with AddCause "Blocked-by-switching-hierarchy".
sCtl18	Verify that on CmdBlk.stVal is set the control requests are rejected with AddCause "Blocked-by-command" (IEC 61850-7-2 table 54)

sCtl19	Verify that when the blkEna is set the control requests are terminated with AddCause "Time-limit-over"
sCtl20	Verify that when parameters are changed after the select respond, the operate request is rejected with AddCause "Parameter-change-in-execution" (IEC 61850-7-2 table 54)
sCtl21	Verify that when tap changer has reached the limit (EndPosR or EndPosL in YLTC) control requests are rejected with AddCause "Step-limit" (IEC 61850-7-2 table 54)
sCtl22	Verify that with insufficient access authority control requests are rejected with AddCause "No-access-authority". (IEC 61850-7-2 table 54)
sCtl23	Verify that when an APC control action end position has overshoot the command terminates with AddCause "Ended-with-overshoot". (IEC 61850-7-2 table 54)
sCtl24	Verify that when an APC control action is aborted due to deviation between the command value and the measured value the control terminates with AddCause "Abortion-due-to-deviation". (IEC 61850-7-2 table 54)
sCtl25	Verify that a cancel request is successful when the control object is in the unselected state (IEC 61850-7-2 table 47)
sCtl26	Verify that when the control object is in the WaitForChange state the cancel or SelectWithValue request is rejected with AddCause "Command-already-in-execution" (IEC 61850-7-2 table 54)
sCtl27	Verify that the SelectWithValue request on a SBOs control object is rejected with AddCause "Not-supported" (IEC 61850-7-2 table 54)

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

Detailed test procedures

sCtl5	Operate with test flag and test mode	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.2 and 20.3 IEC 61850-7-4 Annex A IEC 61850-8-1 Subclause 20		
<u>Expected result</u> 1. Commands are not accepted with AddCause = blocked-by-mode 2. Control commands are accepted and executed 3. Commands are not accepted with AddCause = blocked-by-mode 4. Control commands are accepted, however output is not activated (blocked) 5. Commands are not accepted with AddCause = blocked-by-mode For normal security the AddCause is optional		
<u>Test description</u> a) DOns 1. LN.Beh = on and client sends correct control command with test flag set If Beh = test is supported perform steps 2 and 3 2. LN.Beh = test and client sends correct control command with test flag set 3. LN.Beh = test and client sends correct control command without test flag set If Beh = test-blocked is supported perform step 4 and 5 4. LN.Beh = test-blocked and client sends correct control command with test flag set 5. LN.Beh = test-blocked and client sends correct control command without test flag set b) Repeat step 1 to 5 for SBOs c) Repeat step 1 to 5 for DOes b) Repeat step 1 to 5 for SBOes		

Comment

Note 1: Step 1 is mandatory
Note 2: To change the Beh the client can operate the Mod. The Mod.Operate.Test attribute value shall be ignored by the DUT
The DUT does not support Beh = test-blocked.
The DUT does not support SBOs.

sCtl6	Select/Cancel multiple SBO control objects	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 20
IEC 61850-8-1 Subclause 20, PIXIT: Ct9, Ct21

Expected result

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

Test description

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

Comment

The DUT does not support SBOs.

sCtl8	Direct operate a SBO control object	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 20.3.3
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

- b) DUT responds with Operate response- with optional AddCause "object-not-selected" and the stSeld=F or the DUT sends Select response+ or Operate response□ with AddCause "object□not□selected"
- d) DUT responds with Operate response- with AddCause "object-not-selected" and the stSeld=F or the DUT sends SelectWithValue response+ or Operate response□ with AddCause "object□not□selected"

Test description

- b) Client sends correct Operate request of an unselected SBOs object
 - d) Client sends correct Operate request of an unselected SBOes object
- To verify the unselected state client requests either GetDataValues(stSeld) or Select resp. SelectWithValue

Comment

The DUT does not support SBOs.

sCtl9	Select a SBO control object twice	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 20.3.3
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8

Expected result

- b) SBOns:
 - 1. DUT responds with Select response+
 - 2. DUT responds with Select response-
 - 3. DUT responds with Operate response+
- d) SBOes:
 - 1. DUT responds with SelectWithValue response+
 - 2. DUT responds with SelectWithValue response- with AddCause = object-already-selected
 - 3. DUT responds with Operate response+
 - 4. DUT sends CommandTermination+

Test description

- b) SBOns:
 - 1. Client sends correct Select request of an unselected SBOns object
 - 2. Same client sends correct Select request of the same SBOns object before the sboTimeout
 - 3. Client sends correct Operate request before the sboTimeout of step 1
- d) SBOes:
 - 1. Client sends correct SelectWithValue request of an unselected SBOes object
 - 2. Same client sends correct SelectWithValue request of the same SBOes object before the sboTimeout
 - 3. Client sends correct Operate request before the sboTimeout of step 1
 - 4. EQUIPMENT SIMULATOR moves to the new position

Comment

The DUT does not support SBOns.

sCtl10	SelectWithValue or Operate value is same as actual value	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 20
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8, PIXIT: Ct5

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
- Allowed AddCause values are "position-reached" or "time-limit-over"

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

The DUT sends CommandTermination with AddCAuse "Time-limit-over".
The DUT does not support SBOns.

sCtl11	Select a SBO control object twice from 2 clients	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
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IEC 61850-7-2 Subclause 20.3.3 Table 47
IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8
PIXIT:Ct6

Expected result

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

Test description

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

Comment

The DUT does not support SBOs.

sCtl14	Operate a direct control object twice from 2 clients	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8 PIXIT: Ct16		
<u>Expected result</u> c) DOes <ul style="list-style-type: none">1. DUT responds with Operate response+2. DUT responds as specified in PIXIT In case of Operate response- the AddCause = command-already-in-execution		
<u>Test description</u> c) DOes <ul style="list-style-type: none">1. Client1 sends correct Operate request of a DOes object2. Client2 sends correct Operate request of the same DOes object within the operate timeout		
<u>Comment</u>		

sCtl25	Cancel unselected object	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, table 47 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
<u>Expected result</u> b) DUT responds with Cancel response+ d) DUT responds with Cancel response+		
<u>Test description</u> b) Client sends a Cancel request to an unselected SBOs control object d) Client sends a Cancel request to an unselected SBOes control object		
<u>Comment</u> The DUT does not support SBOs.		

sCtl26	Cancel at WaitForChange state	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.5.2.6, table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
<u>Expected result</u> c) DUT responds with Operate response+ and Cancel response- with AddCause "Command-already-in-execution". d) SBOes 1. DUT responds with SelectWithValue and Operate response+ and Cancel response- with AddCause "Command-already-in-execution" 2. DUT responds with SelectWithValue and Operate response+ and SelectWithValue response- with AddCause "Command-already-in-execution"		
<u>Test description</u> Force EQUIPMENT SIMULATOR to keep the position c) Client sends DOes – Operate and Cancel request before Operate timeout d) SBOes 1. Client sends SelectWithValue, Operate and Cancel request before Operate timeout 2. Client sends SelectWithValue, Operate and SelectWithValue request before Operate timeout		
<u>Comment</u>		

A4.11a Control DOns

Abstract test cases

Test case	Test case description
sDOns1	Send a correct Operate request
sDOns2	Send an Operate request, resulting in 'Test not ok'
sDOns3	Send an TimeActivatedOperate, request resulting in response-
sDOns4	Send a correct TimeActivatedOperate request Verify the TimeActivatedOperateTermination+
sDOns5	Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: – Force a 'Test not ok' – Send a correct Cancel request

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

Detailed test procedures for DOns

sDOns1	Operate	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7		
<u>Expected result</u> 1. DUT responds with Operate response+		
<u>Test description</u> 1. Client sends correct Operate request		
<u>Comment</u>		

sDOns2	Operate response-	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.2.1 IEC 61850-8-1 Subclause 20.7, PIXIT: Ct12		
<u>Expected result</u> 1. DUT responds with Operate response-		
<u>Test description</u> 1. Client requests Operate forcing a "test not ok" as specified in PIXIT		
<u>Comment</u>		

A4.11c Control DOes

Abstract test cases

Test case	Test case description
sDOes1	Send a correct Operate request Verify each of these paths will return the device to the Ready state and verify the CommandTermination: <ul style="list-style-type: none"> - force the equipment simulator to move to the requested new state - force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) - force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sDOes2	Send an Operate request, resulting in 'Test not ok'.
sDOes3	Send a TimeActivatedOperate request, resulting in response-
sDOes4	Send a correct TimeActivatedOperate request Verify the TimeActivatedOperateTermination+ Verify each of these paths will return the device to the Ready state and verify the CommandTermination: <ul style="list-style-type: none"> - force the equipment simulator to move to the requested new state - force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) - force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sDOes5	Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: <ul style="list-style-type: none"> - Force a 'Test not ok' - Send a correct Cancel request

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

Detailed test procedures for DOes

sDOes1	Operate and CommandTermination	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.3.2 IEC 61850-8-1 Subclause 20.7 and 20.8		
<u>Expected result</u>		
<ol style="list-style-type: none"> 1. DUT responds with Operate response+ 2. DUT reports CommandTermination+ 3. After timeout DUT reports CommandTermination- with AddCause "Invalid-position" or "Time-limit-over" 4. After timeout DUT reports CommandTermination- with AddCause "Invalid-position" 		
<u>Test description</u>		
<ol style="list-style-type: none"> 1. Client sends correct Operate request followed by 2. Force EQUIPMENT SIMULATOR to go to the new state 3. Or force EQUIPMENT SIMULATOR to keep the old state 4. Or force EQUIPMENT SIMULATOR to go to the in between state (when DPC is supported) 		
<u>Comment</u>		
Step 3: The DUT sets Command Termination with AddCause "Invalid-position"		



sDOes2	Operate response-	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.7 and 20.8 PIXIT: Ct12		
<u>Expected result</u> 1. DUT responds with Operate response- and AddCause (PIXIT)		
<u>Test description</u> 1. Client sends incorrect Operate once request as specified in the PIXIT		
<u>Comment</u> The DUT sets Command Termination with AddCause "Not-supported"		

A4.11d Control SBOes

Abstract test cases

Test case	Test case description
sSBOes1	Send a correct SelectWithValue and Operate request Verify each of these paths will return the device to the Unselected state and verify the CommandTermination: <ul style="list-style-type: none"> - force the equipment simulator to move to the requested new state - force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) - force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sSBOes2	Send a correct SelectWithValue request Verify each of these paths will return the device to the Unselected state: <ul style="list-style-type: none"> - Send a correct Cancel request - Wait for select timeout - Send a Release request - Send an Operate request resulting in 'Test not ok'
sSBOes3	Send a correct SelectWithValue and TimeActivatedOperate request, resulting in response-
sSBOes4	Send a correct SelectWithValue request Send a correct TimeActivatedOperate Once request Verify the TimeActivatedOperateTermination+ Verify each of these paths will return the device to the Unselected state and verify the CommandTermination: <ul style="list-style-type: none"> - force the equipment simulator to move to the requested new state - force the equipment simulator to keep the old state (AddCause: Time-limit-over or Invalid-position) - force the equipment simulator to move to the 'between' state (AddCause: Invalid-position)
sSBOes5	Send a correct SelectWithValue request Send a correct TimeActivatedOperate request Verify each of these paths will return the device to the Ready state and the TimeActivatedOperateTermination-: <ul style="list-style-type: none"> - Force a 'Test not ok' - Send a correct Cancel request
sSBOes6	Select device using SelectWithValue with improper access rights. Access shall be denied (IEC 61850-7-2 Subclause 20.2.2) or send incorrect SelectWithValue request
sSBOes7	Send a correct SelectWithValue request Verify that sending multiple Operate Many requests will return the device to the Ready state Verify that sending a Cancel request will return the device to the Unselected state
sSBOes8	Verify that the Operate or Cancel request with different control parameters than the SelectWithValue is rejected with AddCause: Inconsistent-parameters

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

Detailed test procedures for SBOes

sSBOes1	SelectWithValue, Operate and CommandTermination	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
<u>Expected result</u> 1. DUT responds with SelectWithValue response+ 2. DUT responds with Operate response+ 3. DUT reports CommandTermination+ 4. The control object returned to the "Unselected" state: stSeld=F or DUT sends SelectWithValue response+ or Operate response□ with AddCause "Object□not□selected" 5. After operate timeout DUT reports CommandTermination- with AddCause "Invalid-position" or "Time-limit-over" 6. After operate timeout DUT reports CommandTermination□ with AddCause "Invalid-position"		
<u>Test description</u> 1. Client sends correct SelectWithValue request 2. Client sends correct Operate request followed by 3. Force EQUIPMENT SIMULATOR to go to the new state 4. To verify the control object returned to the unselected state Client requests either GetDataValues(stSeld), SelectWithValue + Cancel or Operate 5. Repeat steps 1 to 4 but at step 3 force EQUIPMENT SIMULATOR to keep the old state (when possible) 6. Repeat steps 1 to 4 but at step 3 force EQUIPMENT SIMULATOR to go to the intermediate state (when DPC is supported)		
<u>Comment</u> Step 5: The DUT sets Command Termination with AddCause "Invalid-position"		

sSBOes2	SelectWithValue followed by Cancel, timeout or Operate response-	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
<u>Expected result</u> 1. DUT responds with Cancel response+ 2. DUT sends nothing 3. DUT sends Operate response- with a valid AddCause 4. DUT sends no control respond The control object returns to the "Unselected" state: stSeld=F or DUT sends SelectWithValue response+ or Operate response□ with AddCause "object□not□selected"		
<u>Test description</u> Client sends correct SelectWithValue request followed by: 1. Client sends correct Cancel request 2. Or Client waits for select timeout 3. Or Client forces an Operate request resulting in "Test not ok" 4. Or Client releases and associates again Client requests either GetDataValues(stSeld) or SelectWithValue to verify the unselected state		
<u>Comment</u> Step 3: The DUT sets Command Termination with AddCause "Inconsistent-parameters"		

sSBOes6	Incorrect SelectWithValue	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 20.3.3 IEC 61850-8-1 Subclause 20.6 and 20.8.4, PIXIT: Ct10, Ct14		
<u>Expected result</u>		
1. DUT sends SelectWithValue response- with AddCause "Select-failed" or "Not-supported"		
<u>Test description</u>		
1. Client sends SelectWithValue request with incorrect originator category		
<u>Comment</u>		
The DUT sets Command Termination with AddCause "Not-supported"		

sSBOes8	Operate with different value then the SelectWithValue of a SBOes control object	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 table 54 IEC 61850-8-1 Subclause 20.6, 20.7 and 20.8		
<u>Expected result</u>		
1. DUT responds with SelectWithValue response+ 2. DUT responds with Operate response- with AddCause "Inconsistent-parameters" 3. The control object will return to the unselected state: stSeld=F or SelectWithValue response+ or Operate response□ with AddCause "object□not□selected"		
<u>Test description</u>		
1. Client sends correct SelectWithValue request of an unselected SBOes object 2. Client sends Operate request of the selected object changing one of the following attributes to another value than the SelectWithValue: ctIVal, origin, ctINum, test and Check 3. Wait until control object returns to the "unselected state", client requests either GetDataValues(stSeld) or SelectWithValue 4. Repeat step 1-3 for the other attributes in step 2		
<u>Comment</u>		

A4.12 Time synchronization

Abstract test cases

Test case	Test case description
sTm1	Verify the DUT supports and executes the SCSM time synchronisation as configured in SCL
sTm2	Check report/logging timestamp accuracy and leap seconds known matches the documented timestamp quality of the server
sTm3	Verify that when the device supports time zones and daylight saving the time stamp of events and disturbance records are UTC time
sTm4	Verify the time management settings in logical node LTIM
sTm5	Verify the time master supervision in logical node LTMS

Test case	Test case description
sTmN1	Verify that when time synchronisation communication lost is detected after a specified period
sTmN2	On synchronisation error, deviation beyond time stamp tolerance shall be detected

Detailed test procedures

sTm1	SCSM time synchronisation (SNTP)	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-8-1 Subclause 21 and 6.4.2 PIXIT: Tm3, Tm8		
<u>Expected result</u> 2. DUT sends the base UTC time value in the report timestamp or GOOSE timestamp or data value timestamp. Verify that the timestamp value is accurate +/-10 seconds compared to the time in the time server and that the LeapSecondsKnown is set 4. and 6. DUT sends the new UTC time value in the report data value timestamp or GOOSE timestamp or GetDataValues responddata value data value timestamp. Sending reports or GOOSE shall not be delayed by a time change.		
<u>Test description</u> 1. Configure <ul style="list-style-type: none"> • One SNTP time master • A non-zero UTC offset (when time zone is supported). • An URCB or BRCB with all optional fields with trigger option data-change and BufTm = 0 with FCD dataset elements or with FCDA (including the value, q and t) controllable by the EQUIPMENT SIMULATOR • Or a GoCB with adataset element controllable by the EQUIPMENT SIMULATOR • Or Client requests GetDataValues after each event (when reporting or GOOSE is not supported and when GetDataValues is supported) 2. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used) 3. Test engineer changes the time at least +2 minutes in the TIME MASTER and wait till DUT takes over the new time (PIXIT) 4. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used) 5. Test engineer changes the time at least -2 minutes in the TIME MASTER and wait till DUT takes over the new time (PIXIT) 6. Force an event using the EQUIPMENT SIMULATOR and Client requests GetDataValues of the DO (if used)		
<u>Comment</u>		

sTm2	Time stamp quality	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-8-1 Subclause 21 and 6.4.2, table 32 PIXIT: Tm1		
<u>Expected result</u> 2. The TimeStamp – TimeQuality – TimeAccuracy matches with the documented resolution (PICS-T2) and the TimeStamp – TimeQuality – LeapSecondsKnown matches with the PIXIT		
<u>Test description</u> 1. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message 2. Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change		
<u>Comment</u> Verifying the timestamp accuracy is out-of-scope for the conformance test.		

sTmN1	Lost time synchronisation	<input checked="" type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive
IEC 61850-7-2 Subclause 21 and 6.1.2.9.3 IEC 61850-8-1 Subclause 21 and 6.4.2 PIXIT: Tm2, Tm5		
<u>Expected result</u> 1. DUT detects the lost time synch 2. DUT updates the event 3. DUT sends GetDataValues response+ or Report/GOOSE with time quality "ClockNotSynchronized"		
<u>Test description</u> 1. Test engineer disconnects all time masters and waits specified period 2. Force an event using the EQUIPMENT SIMULATOR or subscribed GOOSE message 3. Client requests GetDataValues of the event or waits for a Report/GOOSE message with the state change		
<u>Comment</u>		



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