VERIFICATION REPORT

IEC 61850 Edition 2 client conformance test in SICAM A8000 CP-8000

Siemens AG

Report no.: 17-1740
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	Verification Report		DNV GL - Energy
Report title:	IEC 61850 Edition 2 client conformance test in SICAM A8000 CP-8000		DNV GL Netherlands B.V. Utrechtseweg 310-B50
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Task and objective:

Does the protocol implementation of the DUT, conform to the IEC 61850 standard and the PICS, MICS, TICS, PIXIT documents 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	P. del Río	G. Akse	P. Cioci

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1 INTRODUCTION

1.1 Identifications

The following table gives the exact identification of the test environment used for this conformance test of an IEC 61850 CLIENT system.

DUT	SICAM A8000 CP-8000 modular device for telecontrol and automation applications Software version: ET85 Rev. 03.04 Hardware version: 6MF21010AB100AA0EE S/N: GF1601504310
MANUFACTURER	Siemens AG Humboldstr. 59 90459 Nuremberg Germany
PICS	"Protocol Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in SICAM A8000 CP-8000, DC8-028-2.00, 2016-12-07"
MICS	"Model Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in SICAM A8000 CP-8000, DC8-027-2.00, 2016-12-07"
TICS	"TISSUES Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in SICAM A8000 CP-8000, DC8-030-2.00, 2016-12-07"
PIXIT	"Protocol Implementation extra Information for Testing (PIXIT) the IEC 61850 Ed.2 Client Interface in SICAM A8000 CP-8000, DC8-029-2.00, 2016-12-07"
SCD	Ed2_REFIED_REPORT_CONTROL_Rev4.scd
TEST INITIATOR	MANUFACTURER, Johann Hahn
TEST FACILITY	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
TEST ENGINEER	Patricia del Río, patricia.rio@dnvgl.com
TEST SESSION	November 2016, Vienna, Austria
SERVER SIMULATOR	UniCA 61850 IED simulator 5.31.00
ANALYSER	UniCA 61850 Analyzer 5.31.00
HMI	To monitor processed data: Client WEB browser To configure DUT and force commands: SICAM TOOLBOX II V6.00
TIME SERVER	DNVGL_SNTP.exe, DNV GL SNTP Master

1.2 Background

The SICAM A8000 series is used for various tasks such as operation, telecontrol, automation, and communication. The SICAM A8000 CP-8000 compact device combines a power supply, display with function keys, and binary inputs and outputs.

The TEST FACILITYs assignment was to answer the following question:

"Does the protocol implementation of the DUT, conform to the IEC 61850 standard and the PICS, MICS, TICS, PIXIT documents 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 by the UCAIug to perform formal IEC 61850 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 implementation in the *DUT*.

The test procedures verify the client system under test against conformant servers.

The described procedures and results are the basis of this verification report, the DNVGL Attestation of Conformity and the UCAIug Level A certificate/conformance statement.

1.4 Contents of this document

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

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

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

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

1.5 Glossary

DUT	Device Under Test
HMI	Human machine interface
MICS	Model Implementation Conformance Statement
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
SNTP	Simple Network Time Protocol
TICS	TISSUES Implementation Conformance Statement
TISSUE	Technical issue
TPCL	Test Procedure Change List
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 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

ISO/IEC 9646-1: OSI-Conformance testing methodology and framework, Part 1: General Concepts; 1994.

UCA International User Group: Quality Assurance Program for IEC Device Implementation Testing and Test System Accreditation and Recognition; Version 2.6, 2007-03.

UCA International User Group: Quality Assurance Program Addendum for IEC 61850 Specific Product Testing; Version 1.0, 2007-03.

UCA International User Group: Test Center Accreditation and Recognition Procedure.

For IEC 61850 Device Testing; V1.1, 2006-08.

UCA International User Group: Conformance Test Procedures for Client System with IEC 61850-8-1 Edition 2 interface; Version 1.0, August 2014.

UCA International User Group: Test Procedures Change List (TPCL) version 1.0 for IEC 61850 Edition 2 client test procedures revision 1.0, November 2014.

http://www.tissues.iec61850.com.

3 THE CONFORMANCE TEST

3.1 Components in the test environment

The test environment consists of the following components:

- DUT
- SERVER SIMULATOR 1..N
- ANALYSER
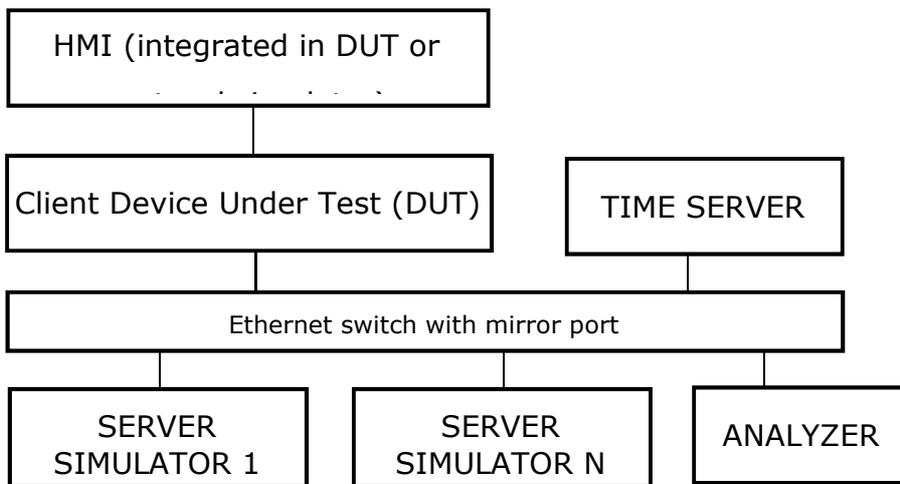- Ethernet switch
- TIME SERVER

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┌─────────────────────────────┐
│  HMI (integrated in DUT or   │
│                              │
└─────────────────────────────┘
         │
┌─────────────────────────────┐      ┌──────────────────┐
│ Client Device Under Test (DUT)│      │   TIME SERVER    │
└─────────────────────────────┘      └──────────────────┘
         │                                    │
┌──────────────────────────────────────────────────────┐
│         Ethernet switch with mirror port              │
└──────────────────────────────────────────────────────┘
      │                    │                   │
┌───────────┐      ┌───────────┐       ┌──────────────┐
│  SERVER   │      │  SERVER   │       │   ANALYZER   │
│SIMULATOR 1│      │SIMULATOR N│       │              │
└───────────┘      └───────────┘       └──────────────┘
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Figure 3.1   The test environment

The HMI can be integrated into the DUT (typically a substation control system) or in case the DUT is a protocol gateway the HMI is a protocol simulator with a HMI.

The server [simulator] requirements are:
- modeling:
  - o contain all common data classes supported by the DUT
  - o contain several new data objects within a standard logical node
  - o contain several new enum types and enum values
- configuration:
  - o one or more servers with preconfigured datasets with data objects
  - o one or more servers with dynamic datasets (when supported by DUT)
  - o one or more servers with report control block indexing
  - o one or more servers without report control block indexing
- communication:
  - o support all conformance blocks supported by the DUT in one or more servers
  - o support all ACSI services supported by the DUT
  - o one or more servers with all supported control models.

3.2 Overview of the test suite

The abstract test cases and detailed test procedures 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
    - Substitution
    - Setting Group Control
    - Unbuffered and Buffered Reporting
    - Logging
    - GOOSE control block
    - Control
    - Time Synchronization
    - File Transfer
    - Service Tracking.

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

In general, if a problem occurs on a connection to one server this shall have no impact on the connections to other servers.

4 TEST RESULTS

Table 4.1 and 4.2 in this Chapter give an overview of the conformance test results. References shown in the table columns refer to references of individual test procedures in appendix 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   Summary of test results for *DUT*

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAssN1, cAssN4, cAssN5, cAssN6	cAssN7, cSrv1, cSrv2, cSrv3, cSrv4, cSrv5, cSrv6, cSrv7, cSrv10, cSrvN1, cSrvN3, cSrvN4, cSrvN5, cSrvN6
2: Data Set		cDs1, cDs2, cDs5, cDs6, cDsN1a, cDsN1b
2+: Data Set Definition		cDs10, cDs12, cDs13, cDsN10a, cDsN11
4: Setting Group Selection	cSg2, cSgN1	cSg1
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRp11, cRp13a, cRp14, cRp15, cRpN2, cRpN5, cRpN6	cRp1, cRp2, cRp6, cRp7, cRp12, cRp13b, cRp16, cRp18, cRpN1
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr13a, cBr14, cBr15, cBr30, cBr31, cBrN2, cBrN5, cBrN6, cBrN20	cBr1, cBr2, cBr6, cBr7, cBr12, cBr13b, cBr16, cBr18, cBr32, cBr33, cBrN1
12a: Direct Control	cCtl4, cCtl5, cDOns1, cDOns2	cCtl1, cCtl2
12c: Enhanced Direct Control	cCtl4, cCtl5, cDOes1, cDOes2	cCtl1, cCtl2
12d: Enhanced SBO Control	cCtl4, cCtl5, cSBOes1, cSBOes2, cSBOes3	cCtl1, cCtl2, cSBOes4
13: Time Sync	cTm1, cTmN1	cTm2
14: File Transfer	cFt1, cFt3, cFtN1	

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

Conformance Block	Inconclusive	Failed	Comment
1: Basic Exchange			cAss1, cAss2, cAss3, cAssN1, cAssN5, cAssN6, cSrv1, cSrv2, cSrv3, cSrv4, cSrv6, cSrv7, cSrvN1, cSrvN3
2: Data Set			cDs2, cDs6, cDsN1
2+: Data Set Definition			cDs13
4: Setting Group Selection			cSg2
5: Unbuffered Reporting			cRp2, cRp7, cRp10, cRp11
6: Buffered Reporting			cBr2, cBr7, cBr10, cBr11, cBr30
12a: Direct Control			cCtl1, cCtl2, cCtl5, cDOns2
12c: Enhanced Direct Control			cCtl1, cCtl2, cCtl5
12d: Enhanced SBO Control			cCtl1, cCtl2, cCtl5
13: Time Sync			cTmN1

5 CONCLUSION AND RECOMMENDATIONS

When all applicable test cases within a conformance block are Passed or Inconclusive the DUT has passed the test for that conformance block.

Based on the test results described in this verification report, *TEST FACILITY* declares the tested IEC 61850 client interface in the *DUT* has **not shown to be non-conforming** to the IEC 61850 standard, *PICS, MICS, TICS, PIXIT* documents and *SCD* configuration.

5.1 Recommendations following from the test

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

(1) BRCBs/URCBs whose datasets only contains non-supported CDCs are not enabled.

(2) Report settings configuration is imported by the DUT from the SCD file via SICAM TOOLBOX II. However, the user can change it manually by using the same tool. E.g. IntgPd, bufTm, trgOps, etc.

(3) It has been observed that the DUT requests multiple DOs by means of one single GetDataValues request.

(4) The client always executes a GI after enabling a BRCB to avoid losing information in case of Buffer-overflow. Because the client always performs SetBRCBValues of GI=TRUE, even if TrgOps.GI = FALSE, the user is responsible of setting TrgOps.GI = TRUE prior GI during the client configuration.

(5) Only standardized DA names can be processed by the DUT.
E.g.
DUT supports:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01\$MX\$A12345678901\$phsA\$cVal\$mag\$f
DUT does not support:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01\$MX\$AvPPVPhs0102\$mag**010203045**\$f**01020304056**

(6) In the situation where the DUT receives a report with status/measurement or quality changes but "t" attribute is not included, the timestamp is updated with TimeOfEntry.

(7) The DUT performs GetSGCBValues request to read only ActSG value. It is recommended to use one unique GetSGCBValues of LDName/LLN0.SGCB, according to 7-2.

(8) The SICAM A8000 CP-8000 just can handle 100 logical devices and a total of 1000 attributes.

APPENDIX A: DETAILED TEST PROCEDURES AND RESULTS

A1 Documentation and version control (IEC 61850-4)

Id	Test procedure	Verdict
cDoc1	Check if the major/minor software version in the PICS documentation and the DUT do match (IEC61850-4) PICS shall include the ACSI conformance statement from IEC 61850-7-2 Annex A	PASSED
cDoc2	Check if the major/minor software version in the PIXIT documentation and software version of the DUT does match (IEC61850-4). PIXIT shall indicate the applicable extra information for testing as requested in the test cases in this document	PASSED
cDoc3	Check if the major/minor software version in the MICS documentation and software version of the DUT does match (IEC65180-4). MICS shall indicate which CDC's and/or CDC parts are supported by the DUT, for example arrays	PASSED
cDoc4	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 applicable technical issues are supported.	PASSED

A2 Configuration file (IEC 61850-6)

Id	Test procedure	Verdict
cCnf1	Check if the DUT process the data names, data types as configured in the SCL (SCD) configuration file.	PASSED
cCnf2	Change at least 5 end-user configurable parameters that are processed by the DUT in the SCL configuration file, configure the DUT using the SCL configuration file (using the supplied configuration tool) and check the updated configuration. Restore the original SCL file and re-configure the DUT to its original state.	PASSED
cCnf3	Verify that client can handle the ConfigRev management in SCL and exposed by the server in LLN0.NamPlt.configRev as described in *PIXIT Cf1*. On a mismatch the DUT shall behave as described in the PIXIT (note that, if the PIXIT describes that the DUT does not check such a mismatch, no action is required by the DUT)	PASSED
cCnf4	ICD file shall be validated against the SCL schema 2007B Verify the ClientServices declared in ICD services section match the PICS and match the DUT	PASSED

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

Id	Test procedure	Verdict
cMdl1	Verify that the client can handle the maximum name length according to IEC 61850-7-2 Subclause 22.2 and SCSM and expands objects like SDOs correctly (*PIXIT Sr1*)	Note: will be verified by the applicable communication test procedures
cMdl2	Verify that DUT supports the following naming conventions for the supported control blocks a unbuffered report control block – not indexed b unbuffered report control block – indexed c buffered report control block – indexed d buffered report control block – not indexed e setting group control block f GOOSE control block g Log control block	PASSED
cMdl3	Verify that DUT can read and process the mandatory & optional attributes from the CDCs in part 7-3 unless stated otherwise in the MICS	

Compare detailed test procedures

cMdl3 - status	Support of CDC: status information	Passed
MICS		

Expected result
2.   DUT processes the values from GI and/or integrity reports of the supported CDC's (MICS)
3.   DUT sends GetDataValues request and processes the returned values

Test description
When reporting is supported
1.   Configure the DUT and server simulator(s) with datasets and report control blocks with status information from the following CDC's: SPS, DPS, INS, ENS, ACT, ACD, SEC, BCR, HST, VSS
2.   Start SERVER SIMULATOR
3.   Force the DUT to enable the report control blocks and send GI or wait for integrity reports When DUT does not support reporting
4.   the DUT reads status information

Comment

cMdl3 - measurements	Support of CDC: measurement information	Passed
MICS		

Expected result
3.   DUT processes the data from GI and/or integrity reports of the supported CDC's (MICS)
4.   DUT sends GetDataValues request and processes the returned values

Test description
When reporting is supported
1.   Configure the DUT and server simulator(s) with datasets and report control blocks with measurement information from the following CDC's: MV, CMV, WYE, DEL, SEQ, HMV, HWYE, HDEL
2.   Start SERVER SIMULATOR
3.   Force the DUT to enable the report control blocks and send GI or wait for integrity reports
When DUT does not support reporting
4.   the DUT reads status information

Comment

cMdl3 - control	Support of CDC: control	Passed
MICS		

Expected result

4. DUT sends correct operate requests for the supported CDC's and (MICS), DUT processes the status values from the GI and data-change reports of the supported CDC's

Test description

1. Configure the DUT and server simulator(s) with the following controllable CDC's: SPC, DPC, INC, ENC, BSC, ISC, APC, BAC
2. Configure the DUT and server simulator(s) with datasets and report control blocks with status information from the specified control CDC's
3. Start SERVER SIMULATOR
4. Force the DUT to operate the supported control CDC's and the SERVER SIMILATOR to change the status value according to the control value

Comment

cMdl3 - settings	Support of CDC: settings	Passed
MICS		

Expected result

4. DUT sends correct SelectEditSGValues requests for the supported CDC's (MICS)
5. DUT sends correct SetDataValue requests for the supported CDC's (MICS)

Test description

1. Configure the DUT and server simulator(s) with the following setting group CDC's: SPG, ING, ENG, ORG, TSG, CUG, VSG, ASG, CURVE, CSG with FC=SG/SE and FC=SP
2. Start SERVER SIMULATOR
   When setting group editing is supported
3. Force the DUT to edit setting group values, FC=SE
   When setting group editing is not supported
4. Force the DUT to change setting group values, FC=SP

Comment
Setting group editing is not supported, therefore step 3) is not applicable

A4 Mapping on MMS (IEC 61850-7-2 and IEC 61850-8-1)

The test procedures are structured according to conformance blocks. The following table specifies which ACSI services, mapped on MMS, are mandatory/conditional for each conformance block for IEC 61850-8-1 Client systems.

Table A.4.1 ACSI services per conformance block for IEC 61850-8-1 Client systems

Conformance Block	Mandatory	Conditional
1: Basic Exchange	Associate Abort and/or Release	GetAllDataValues SetDataValues GetServerDirectory GetLogicalDeviceDirectory(LD) GetLogicalNodeDirectory(DATA) GetDataDirectory GetDataDefinition GetDataValues
2: Data Set		GetDataSetValues SetDataSetValues GetLogicalNodeDirectory(DATA-SET) GetDataSetDirectory
2+: Data Set Definition	CreateDataSet DeleteDataSet	
3: Substitution	SetDataValues	GetLogicalNodeDirectory(SGCB)
4: Setting Group Selection	SelectActiveSG GetSGCBValues	
4+: Setting Group Definition	SelectEditSG, GetEditSGValue SetEditSGValue ConfirmEditSGValues	
5: Unbuffered Reporting	Receive Report GetURCBValues SetURCBValues	GetLogicalNodeDirectory(URCB)
6: Buffered Reporting	Receive Report GetBRCBValues SetBRCBValues	GetLogicalNodeDirectory(BRCB)
7: Logging	GetLCBValues QueryLogByTime and/or QueryLogAfter	GetLogicalNodeDirectory(LCB) GetLogicalNodeDirectory (LOG) SetLCBValues GetLogStatusValues
9: GOOSE Control Block	GetGoCBValues	GetLogicalNodeDirectory(GOCB) SetGoCBValues
12a: Direct Control	Operate	TimeActivatedOperate
12b: SBO Control	Select, Operate	Cancel, TimeActivatedOperate
12c: Enhanced Direct Control	Operate Receive CommandTermination	TimeActivatedOperate
12d: Enhanced SBO Control	SelectWithValue, Operate Receive CommandTermination	Cancel, TimeActivatedOperate
13: Time Sync	TimeSynchronization	
14: File Transfer	GetServerDirectory(FILE) GetFile	GetFileAttributeValues SetFile DeleteFile
15: Service Tracking	Receive Report	

The following table specifies which test procedures are mandatory/conditional for each conformance block. Conditions refer to the SCL - IED - Services section, the PICS or PIXIT.

Table A.4.2 Test procedures per conformance block

Conformance Block	Mandatory	Conditional
1: Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6	PIXIT - Automatic startup: cAssN7 GetXxxDirectory : cSrv1, cSrv2, cSrv3, cSrv4, cSrvN1 GetDataValues: cSrv5, cSrv7, cSrvN3 SetDataValues: cSrv6, cSrvN4 GetAllDataValues: cSrv8, cSrvN2 PIXIT - Support setting blkEna: cSrv9 SCL - SupportsLdName: cSrv10 PIXIT - Quality: cSrvN5 PIXIT - TimeQuality: cSrvN6
2: Data Sets		GetLogicalNodeDirectory(DATA-SET): cDs1, cDsN1a GetDataSetDirectory: cDs2, cDs5, cDs6, cDsN1b GetDataSetValues: cDs3, cDsN1c SetDataSetValues: cDs4, cDsN2
2+: Data Set Definition		DeleteDataSet: cDs12, cDsN11 PIXIT-Support persistent datasets: cDs10, cDs13, cDsN10a PIXIT-Support non-persistent datasets: cDs11, cDs14, cDsN10b
3: Substitution	cSub1, cSub3	Source "substituted": cSub2
4: Setting Group Selection	cSg2, cSgN1	GetLogicalNodeDirectory(SGCB): cSg1
4+: Setting Group Definition	cSg11, cSg14	GetDataValues(FC=SG): cSg10 Cancel SG: cSg12 SGCB-ResvTms: cSg13
5: Unbuffered Reporting	cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRp11, cRp13a, cRp14, cRp15, cRpN2, cRpN5, cRpN6	GetLogicalNodeDirectory(URCB): cRp1, cRpN1 SetURCBValues(trgops, optflds): cRp2 Buffer time: cRp6 General interrogation: cRp7 Change dataset: cRp12, cRp13b Non test equipment: cRp16 Owner: cRp17 SCL supportsLdName: cRp18
6: Buffered Reporting	cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr13a, cBr14, cBr15, cBr30, cBr31, cBrN2, cBrN5, cBrN6, cBrN20	GetLogicalNodeDirectory(BRCB): cBr1, cBrN1 SetBRCBValues(trgops, optflds): cBr2 Buffer time: cBr6 General interrogation: cBr7 Change dataset: cBr12, cBr13b Non test equipment: cBr16 Owner: cBr17 SCL supportsLdName: cBr18 Purge buffer: cBr32 ResvTms: cBr33
7: Logging	cLog6, cLog7, cLog8, cLogN4	GetLogicalNodeDirectory(LOG): cLog1, cLogN1 GetLogicalNodeDirectory(LCB): cLog2, cLogN2 GetLogStatusValues/GetLCBValues: cLog4, cLogN3 SetLCBValues: cLog5 SetDataValues(GLOG): cLog9
9: GOOSE Control Block	cGcb1	SetGoCBValues: cGcb2
12a: Direct Control	cCtl4, cCtl5, cDOns1, cDOns2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 TimeActivatedOperate: cDOns3, cDOns4
12b: SBO Control	cCtl4, cCtl5, cSBOns1, cSBOns2, cSBOns3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOns4 TimeActivatedOperate: cSBOns5, cSBOns6
12c: Enhanced Direct Control	cCtl4, cCtl5, cDOes1, cDOes2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 TimeActivatedOperate: cDOes3, cDOes4

Conformance Block	Mandatory	Conditional
12d: Enhanced SBO Control	cCtl4, cCtl5, cSBOes1, cSBOes2, cSBOes3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOes4 TimeActivatedOperate: cSBOes5, cSBOes6
13: Time Sync	cTm1, cTmN1	Time accuracy: cTm2 ClockFailure: cTmN2
14: File Transfer	cFt1, cFt3, cFtN1	GetFileAttributeValues: cFt2, cFtN2 SetFile: cFt4, cFtN3 DeleteFile: cFt5
15: Services Tracking		Buffered Reporting: cTrk1 Unbuffered Reporting: cTrk2 Logging: cTrk3 GOOSE control block: cTrk4 SMV: cTrk5, cTrk6 Setting Group: cTrk7 Control: cTrk8 (SPC), cTrk9 (DPC), cTrk10 (INC), cTrk11 (ENC), cTrk12 (APCf), cTrk13 (APCi), cTrk14 (BSC), cTrk15 (ISC), cTrk16 (BAC) General: cTrk17

Note1: cAssN2 and cAssN3 are not applicable for part 8-1

Note2: cCtl6 is out of scope for IEC 61850 conformance testing

The focus of the conformance test is the application layer. For IEC 61850-8-1 the communication services are mapped on the reliable TCP transport layer. As such the testing of transport related errors like "no response" and "delayed response" are out-of-scope. These are implicitly tested by disconnecting the Ethernet cable between the server and the switch.

In general, if a problem occurs on a connection to one server this may have no impact on the connections to other servers. The following paragraphs describe the abstract test cases and the corresponding detailed test procedures.

A4.1 Block 1: Basic Services

Abstract test cases for Application Association

Test case	Test case description
cAss1	Associate and force the DUT to release or abort a TPAA (IEC 61850-7-2 8.3, 8-1 10.2)
cAss2	Force the DUT to associate with maximum number of servers simultaneously (*PIXIT As1*).
cAss3	Verify the DUT can handle servers with small and large MMS PDU size, the DUT should keep on proposing its original MMS PDU size.

Note1: The client is always considered to be the calling node

Test case	Test case description
cAssN1	Associate and server responds with negative response due to AccessPointReference.
cAssN2	Associate and server responds with negative response due to AuthenticationParameter
cAssN3	Associate and server releases TPAA (IEC 61850-7-2 8.3). DUT should try to re-establish the association after the configured period (*PIXIT As3*).
cAssN4	Associate and server-abort TPAA (IEC 61850-7-2 8.3). DUT should try to re-establish the association after the configured period (*PIXIT As3*).
cAssN5	Associate and server denies TPAA (IEC 61850-7-2 8.3). DUT should try to re-establish the association after the configured period (*PIXIT As3*).
cAssN6	Disconnect the communication interface, the DUT should detect link lost within a specified period (*PIXIT As2*).
cAssN7	Interrupt and restore the power supply, the DUT shall automatically establish the configured associations when ready (*PIXIT As6*).

Note1: cAssN2 and cAssN3 are not applicable for part 8-1

Detailed test procedures for Application Association

cAss1	Associate and force client to release or abort	Passed
IEC 61850-7-2 clause 8.3 IEC 61850-8-1 clause 10.2 *PIXIT As7*		
<u>Expected result</u> 1. DUT accepts Associate response+ from server 2. DUT returns to "state" where it is able to start a new TPAA with the same server		
<u>Test description</u> 1. Set-up a TPAA with one server 2. Force DUT to release or abort TPAA 3. Repeat step 1 and 2, 10 times		
<u>Comment</u> DUT only supports Release		

cAss2	Associate to maximum number of servers	Passed

IEC 61850-7-2 clause 8.3
IEC 61850-8-1 clause 10.2
PIXIT As1

Expected result
1. DUT accepts Associate response+ from all servers
2. DUT returns to "state" where it is able to start new TPAAs with the same servers

Test description
1. Set-up a TPAA with one server
2. Force DUT to release or abort TPAA
3. Repeat step 1 and 2, 10 times

Comment
Tested with 10 servers

cAss3	Verify that the client can handle servers with small and large MMS PDU size	Passed

IEC 61850-7-2 clause 8.3
IEC 61850-8-1 clause 10.2
PIXIT As5

Expected result
1. Client accepts Associate response+ from all servers
2. DUT receives and accepts the Release response+ from all servers or receives and accepts the abort response+ from all servers

Test description
1. Set-up a TPAA with at least two servers where one server has a small PDU size (4k), and the other server has a large PDU size (64k).
2. Force DUT to release or abort all open TPAAs

Comment
Tested with 2 servers

cAssN1	Access point mismatch	Passed

IEC 61850-8-1 clause 10.2, 25.3.1 and table 132

Expected result
2. DUT detects the Association failure and behaves as specified in the PIXIT
4. DUT detects the Association failure and behaves as specified in the PIXIT
6. DUT detects the Association failure and behaves as specified in the PIXIT
8. DUT detects the Association failure and behaves as specified in the PIXIT
10. DUT detects the Association failure and behaves as specified in the PIXIT

Test description
1. Set-up the DUT and one server to have a mismatching Transport Selector
2. Set-up a TPAA between the DUT and the server
3. Set-up the DUT and one server to have a mismatching Presentation Selector
4. Set-up a TPAA between the DUT and the server
5. Set-up the DUT and one server to have a mismatching Session Selector
6. Set-up a TPAA between the DUT and the server
7. Set-up the DUT and one server to have a mismatching AP-title
8. Set-up a TPAA between the DUT and the server
9. Set-up the DUT and one server to have a mismatching AE-qualifier
10. Set-up a TPAA between the DUT and the server

Comment
Timeout IEC61850 connection establishment = 10 sec
After 10 sec, the DUT sends tp0 disconnect request
New Associate request is tried every 20 sec

cAssN4	Server abort	Passed

IEC 61850-7-2 clause 8.3
IEC 61850-8-1 clause 10.2
PIXIT As3

Expected result
1. DUT accepts Associate response+ from server
2. DUT receives and responds correctly to the abort request from the server
3.

Test description
1. Set-up a TPAA with one server
2. Force SERVER SIMULATOR to abort TPAA
3. Repeat step 1 and 2, 10 times

Comment

cAssN5	Server deny	Passed

IEC 61850-7-2 clause 8.3
IEC 61850-8-1 clause 10.2
PIXIT As3

Expected result
2. DUT detects the Association failure and behaves as specified in the PIXIT.

Test description
1. Set-up test configuration with at least two servers
2. Force the DUT to perform an Associate request for all servers, The SERVER SIMULATOR denies the association for one server caused by a mismatching transport, session or presentation selector
3. Repeat step 1 and 2, 10 times

Comment
Tested with 2 servers
Timeout IEC61850 connection establishment = 10 sec
After 10 sec, the DUT sends tp0 disconnect request
New Associate request is tried every 35 sec

cAssN6	Detection of lost link	Passed

IEC 61850-7-2 clause 8.3
IEC 61850-8-1 clause 10.2
PIXIT As2, As3

Expected result
3. DUT shall detect the lost link and shall try to reconnect to the server
4. DUT shall set-up a TPAA with the server

Test description
1. Connect the DUT and one server to a hub
2. Set-up a TPAA with the server
3. Disconnect the physical link, between the two switches/hubs, some seconds longer than the timeout specified in the PIXIT
4. Reconnect the Ethernet cable

Comment
Lost connection detection measured ~60 sec

cAssN7	Power supply interrupt	Passed
IEC 61850-7-2 clause 8.3 IEC 61850-8-1 clause 10.2 *PIXIT As6*		
<u>Expected result</u> 3. DUT behaves as specified in the PIXIT.		
<u>Test description</u> 1. Set-up a TPAA between DUT and all servers as configured in SCL 2. Interrupt the power supply to DUT 3. Restore the power supply to DUT		
<u>Comment</u> 		

Abstract test cases for server, logical device, logical node and data

Test case	Test case description
cSrv1	If the DUT implements Autodescription, (See Note 1) force the DUT to start the autodescription and check the DUT requests a GetServerDirectory(LOGICAL-DEVICE) to all the logical devices of the configured servers (see Note 2) (IEC 61850-7-2 Subclause 7.2.2)
cSrv2	If the DUT implements Autodescription, for each GetServerDirectory(LOGICAL-DEVICE) response check the DUT issues a GetLogicalDeviceDirectory request (IEC 61850-7-2 Subclause 9.2.1)
cSrv3	If the DUT "implements Autodescription", for each GetLogicalDeviceDirectory response check the DUT issues a GetLogicalNodeDirectory(DATA) request (IEC 61850-7-2 Subclause 10.2.2)
cSrv4	If the DUT "implements Autodescription", for a subset of the GetLogicalNodeDirectory(DATA) response check the DUT issues at least one of the following services: a GetDataDirectory request and check response (IEC 61850-7-2 Subclause 11.4.4) b GetDataDefinition request and check response (IEC 61850-7-2 Subclause 11.4.5)
cSrv5	Verify that after start-up the DUT is able to update the process values of the configured servers.
cSrv6	Request a SetDataValues of the different basic types (with for example FC=CF) and check the services (IEC 61850-7-2 Subclause 11.4.3)
cSrv7	Request GetDataValues and check if the DUT updates its model (IEC 61850-7-2 Subclause 11.4.2)
cSrv8	Request GetAllDataValues for the required functional constraints and check if the DUT updates its model (IEC 61850-7-2, 9.2.3)
cSrv9	Verify that the client is able to set/reset blkEna (IEC 61850-7-3 Subclause 6.2.6)
cSrv10	Verify that the client is able to support a server with ldName

NOTE 1   Implement Autodescription means that there is a way to configure the DUT to update the image of the model of one of the servers it has to communicate with using the ACSI services.

NOTE 2   Configured servers means the servers the client DUT is configured to communicated with. The client DUT at least needs to know the parameters to establish an association with them.

Test case	Test case description
cSrvN1	If the DUT implements autodescription, force the DUT to start the autodescription and check the DUT still communicates with other servers when it requests the following services with negative response: a GetServerDirectory(LOGICAL-DEVICE), b GetLogicalDeviceDirectory, c GetLogicalNodeDirectory(DATA), d GetDataDirectory, e GetDataDefinition.
cSrvN2	Check that the DUT is able to communicate with other connected servers after a request for GetAllDataValues fails in the following circumstances: a The response is negative. b The response comes with mismatching data objects.
cSrvN3	Check that the DUT is able to communicate with other connected servers after a request for GetDataValues fails in the following circumstances: a The response is negative. b The response comes with mismatching data objects. c The value is out of the valid range for this data.
cSrvN4	Check that the DUT is able to communicate with other connected servers after a request for SetDataValues fails in the following circumstances:

Test case	Test case description
	The response is negative. One of the data values is read-only
cSrvN5	If DUT detects/notify changes in the "Quality" attribute, force the SERVER SIMULATOR to change the values in the Quality of the measured/status values monitored by the DUT and check the behaviour described in the PIXIT.
cSrvN6	If DUT detects/notify changes in the timestamp's "TimeQuality" attribute, force a server to change the values in the TimeQuality of the measured/status values monitored by the DUT and check the behaviour described in the PIXIT.

Detailed test procedures for server, logical device, logical node and data

cSrv1	GetServerDirectory(LOGICAL-DEVICE)	Passed

IEC 61850-7-2 Subclause 7.2.2
IEC 61850-8-1 Subclause 9.3

Expected result
2.   DUT accepts a GetServerDirectory response+ from the server

Test description
1.   Set-up a TPAA with at least two servers
2.   DUT request for each server a GetServerDirectory(LOGICAL-DEVICE)
3.   Continue with cSrv2

Comment
Tested with 2 servers

cSrv2	GetLogicalDeviceDirectory	Passed

IEC 61850-7-2 Subclause 9.2.1
IEC 61850-8-1 Subclause 11

Expected result
1.   DUT accepts a GetLogicalDeviceDirectory response+ from the server

Test description
1.   DUT request for each responded LogicalDevice a GetLogicalDeviceDirectory
2.   Continue with cSrv3

Comment
Tested with 2 servers

cSrv3	GetLogicalNodeDirectory	Passed

IEC 61850-7-2 Subclause 10.2.2
IEC 61850-8-1 Subclause 12.3.1

Expected result
1.   DUT accepts a GetLogicalNodeDirectory(DATA) response+ from the server

Test description
1.   DUT request for each responded LogicalNode a GetLogicalNodeDirectory(DATA)
2.   Continue with cSrv4

Comment
Tested with 2 servers

cSrv4	GetDataDirectory / GetDataDefinition	Passed

IEC 61850-7-2 Subclause 11.4.4 and 11.4.5
IEC 61850-8-1 Subclause 13.3.3 and 13.3.4

Expected result
1. DUT accepts a GetDataDirectory/GetDataDefinition response+ from the server

Test description
1. DUT request for responded dataobjects a GetDataDirectory/GetDataDefinition
2. Release the TPAA with all servers

Comment
Tested with 2 servers
It has been observed that the DUT establishes association with both servers in parallel but the data models are retrieved sequentially. It means that the second data model is retrieved after finishing completely the first one.

cSrv5	Update object model	Passed

IEC 61850-7-2 clause 17.2.3, 17.2.5, 17.3.5
IEC 61850-8-1 clause 17.2.1, 17.3.4
PIXIT Sr3

Expected result
2-3. DUT receives the object model either by Reporting or by GetDataValues+ response and handles the values as stated in the PIXIT.

Test description
1. Set-up a TPAA with one server
2. DUT request either GetDataValues of at least two data attributes or data objects
3. Alternatively DUT receives a Report of at least two data attributes or data objects

Comment

cSrv6	SetDataValues	Passed

IEC 61850-7-2 clause 11.4.3
IEC 61850-8-1 clause 13.4.2
PIXIT Sr7

Expected result
2. DUT accepts a SetDataValues response+ from server

Test description
1. Set-up a TPAA with one server
2. DUT request SetDataValues on a writable data attribute with FC = CF, DC, SP or on a non-standard EX with one of the basic type: boolean, integer, float, bitstring or enumerated.

Comment
SetDataValues request supported only for FC=SP

cSrv7	GetDataValues	Passed

IEC 61850-7-2 clause 11.4.2
IEC 61850-8-1 clause 13.4.1
PIXIT Sr8

Expected result
2-3. DUT accepts a GetDataValues response+ from server

Test description
1. Set-up a TPAA with one server
2. DUT request GetDataValues of at least two data attributes
3. DUT request GetDataValues of at least two data objects

Comment
During startup, the DUT requests multiple DOs in one GetDataValues request. No GetDataValues requests of DAs are used.

cSrv10	ldName	Passed

IEC 61850-6 clause 8.5.3

Expected result
2. DUT request services with data object references with the ldName value

Test description
1. Set-up a TPAA with one server
2. DUT request ACSI services on data objects identified by ldName

Comment

cSrvN1	GetLogicalDeviceDirectory & GetDataDefinition negative	Passed

IEC 61850-7-2 clause 9.2.1, 11.4.5
IEC 61850-8-1 clause 11, 12, 13
PIXIT Sr2, Sr11

Expected result
1,3,4,5,7,9,11. DUT associates with the server and responds as specified in PIXIT. DUT shall continue with the other servers
2. DUT uses autodescription to prevent sending the request or DUT accepts a GetLogicalDeviceDirectory response- from the server and continues as specified in PIXIT
6., 8. DUT uses autodescription to prevent sending the request or DUT accepts a GetDataDefinition response- from the server and continues as specified in PIXIT
10., 12. DUT receives a GetDataDefinition response and continues as specified in PIXIT

Test description
1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. DUT requests GetLogicalDeviceDirectory of the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. DUT requests GetLogicalDeviceDirectory of the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. DUT requests GetDataDefinition of the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. DUT requests GetDataDefinition of the previously known data attribute
9. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server
10. DUT requests GetDataDefinition of a known data object with more data attributes then expected
11. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server
12. DUT requests GetDataDefinition of a known data object with less attributes then expected

Comment
DUT implements autodescription to prevent sending wrong GetDataDirectory/GetDataDefinition requests.

cSrvN3	GetDataValues negative	Passed

IEC 61850-7-2 clause 11.4.2
IEC 61850-8-1 clause 13.4.1
PIXIT Sr2, Sr11

Expected result
1,3,5,7,9,11.	DUT associates with the server and responds as specified in PIXIT. DUT shall continue with the other servers
2,4,6,8.	DUT uses autodescription to prevent sending the request or DUT accepts a GetDataValues response- from the server and continues as specified in PIXIT
10,12.	DUT receives a GetDataValues response and continues as specified in PIXIT

Test description
1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. DUT requests GetDataValues of a data object in the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. DUT requests GetDataValues of a data object in the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. DUT requests GetDataValues of the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. DUT requests GetDataValues of the previously known data attribute
9. Reconfigure CDC type of a data object (more data attributes then expected) for one server only and restart the server
10. DUT requests GetDataValues of a known data object with more data attributes then expected
11. Reconfigure CDC type of a data object (less attributes then expected) for one server only and restart the server
12. DUT requests GetDataValues of a known data object with less attributes then expected

Comment
DUT implements autodescription to prevent sending wrong GetDataValues requests.

cSrvN4	SetDataValues negative	Passed

IEC 61850-7-2 clause 11.4.3
IEC 61850-8-1 clause 13.4.2
PIXIT Sr2, Sr11

Expected result
1,3,5,7.	DUT associates with the server and responds as specified in PIXIT. DUT shall continue with the other servers
2,4,6,8,9.	DUT uses autodescription to prevent sending the request or DUT accepts a SetDataValues response- from the server and continues as specified in PIXIT

Test description
1. Reconfigure/rename the LogicalDevice for one server only and restart the server
2. DUT requests SetDataValues of the previously known logical device
3. Reconfigure/rename the LogicalNode (in a valid existing logical device) for one server only and restart the server
4. DUT requests SetDataValues of a data attribute in the previously known logical node
5. Reconfigure/rename a data object (in a valid existing logical node) for one server only and restart the server
6. DUT requests SetDataValues of a data attribute in the previously known data object
7. Reconfigure/rename a data attribute (in a valid existing data object) for one server only and restart the server
8. DUT requests SetDataValues of the previously known data attribute
9. DUT requests SetDataValues of an existing previously writable but now read-only data attribute

Comment

cSrvN5	Quality values	Passed

IEC 61850-7-2 clause 11.4.2
IEC 61850-8-1 clause 13.4.1
PIXIT Sr4, Sr5, Sr6

Expected result
1.   DUT processes the quality as specified in the PIXIT

Test description
1.   Change the value of attribute q of a data object of one server to:
   −   Validity: Invalid
   −   Validity: Questionable – Failure = true
   −   Validity: Questionable – OldData = true
   −   Source = Substituted (by another client)
   −   Test = true
   −   OperatorBlocked = true

Comment

cSrvN6	Time Quality values	Passed

IEC 61850-7-2 clause 11.4.2
IEC 61850-8-1 clause 13.4.1
PIXIT Sr12, Sr13

Expected result
1-3. DUT processes the time quality as specified in the PIXIT

Test description
1.   Force server to respond with data object with time quality "clock failure"
2.   Force server to respond with data object with time quality "clock not synchronised"
3.   Force server to respond with data object with time quality "leap seconds known"
4.   Force server to respond with data object with time quality accuracy = 10 bits

Comment

A4.2 Block 2: Data Set

Test case	Test case description
cDs1	If the DUT implements autodescription, force it to start autodescription and check if it requests a GetLogicalNodeDirectory(DATA-SET) of the Logical Nodes of the configured servers (IEC 61850-7-2 Subclause 10.2.2)
cDs2	If the DUT implements autodescription, force it to start autodescription and check it requests a GetDataSetDirectory of all the DataSets of the server (IEC 61850-7-2 Subclause 13.3.6)
cDs3	Check the DUT can request a GetDataSetValues and handle the response (IEC 61850-7-2 Subclause 13.3.2)
cDs4	Check the DUT can request a SetDataSetValues and handle the response (IEC 61850-7-2 Subclause 13.3.3)
cDs5	Verify that the DUT checks the pre-configured datasets in the SCD file. If any deviation is detected the DUT behaves as specified in the PIXIT
cDs6	Verify that the DUT can handle a pre-configured data set with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)

Test case	Test case description
cDsN1	If the DUT implements autodescription, force the DUT to start the autodescription and check the DUT still communicates with other servers when it requests the following services with negative response: a GetLogicalNodeDirectory (DATA-SET) b GetDataSetDirectory c GetDataSetValues
cDsN2	Check that the DUT still communicates with other servers properly when it requests a SetDataSetValues to one of them and the response is negative.

Detailed test procedures for Data Set

cDs1	**GetLogicalNodeDirectory(DATA-SET)**	**Passed**
IEC 61850-7-2 clause 10.2.2 IEC 61850-8-1 clause 12.3.1		
Expected result 1. DUT accepts the response		
Test description 1. Force DUT to perform a GetLogicalNodeDirectory(DATA-SET) request for each server and logical device		
Comment		

cDs2	**GetDataSetDirectory**	**Passed**
IEC 61850-7-2 clause 13.3.6 IEC 61850-8-1 clause 14.3.5		
Expected result 1. DUT accepts the response		
Test description 1. Force DUT to perform a GetDataSetDirectory request for the data sets used by the DUT		
Comment It has been checked that during startup, by means of Autodescription the DUT only performs GetDataSetDirectory requests for those datasets that are used in RCBs. Nevertheless, GetDataSetDirectory for ALL datasets defined in the server can be forced via WEB browser: Overview->Connections->request NV.		

cDs5	Pre-configured dataset element deviations	Passed

IEC 61850-7-2 clause 13.3
IEC 61850-8-1 clause 14.3
PIXIT Ds4

Expected result
3.   DUT responds as specified in PIXIT on the reconfigured datasets

Test description
1.   Stop one server
2.   Reconfigure the server to force the following mismatches in different datasets:
    −   Insert a new dataset element in the middle of a dataset
    −   Delete a dataset element in the middle of a dataset
    −   Reorder 2 dataset members in a dataset of a different data type
    −   Reorder 2 dataset members in a dataset of the same data type
3.   Start the server and force the DUT to perform a GetDataSetDirectory request on all the datasets used
    by the DUT

Comment

cDs6	Pre-configured dataset name length	Passed

IEC 61850-7-2 clause 13.3
IEC 61850-8-1 clause 14.3
PIXIT Ds7

Expected result
2.   DUT can handle the response and updates the dataset member with the maximum name length
    correctly

Test description
1.   Configure the server having a dataset:
    −   With maximum name length for the dataset name
    −   With maximum name length for one of the dataset members
2.   Start the server and force the DUT to perform a GetDataSetDirectory for this dataset

Comment
Only standardized DA names can be processed by the DUT.
E.g.
DUT supports:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXA1234
5678901$phsA$cValmagf
DUT does not support:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXAvPPV
Phs0102$mag**010203045**$f**01020304056**

cDsN1	GetLogicalNodeDirectory(DATA-SET) response- and GetDataSetDirectory response- and GetDataSetValues response-	Passed

IEC 61850-7-2 clause 10.2.2, 13.3.6, 13.3.2
IEC 61850-8-1 clause 12.3.1, 14.3.5, 14.3.1
PIXIT Sr2, Ds5

Expected result
4. DUT uses autodescription to prevent sending the request or DUT processes the negative response and continues as specified in PIXIT
5. The DUT processes the response as specified in the PIXIT
6. DUT uses autodescription to prevent sending the request or DUT processes the negative response and continues as specified in PIXIT
7. DUT uses autodescription to prevent sending the request or DUT processes the negative response and continues as specified in PIXIT

Test description
a)
1. Stop one server
2. Reconfigure the server in the following way:
   o Rename a dataset in logical device1
   o Add a dataset in logical device2
   o Rename logical device3
3. Start the server
4. Force the DUT to perform a GetLogicalNodeDirectory(DATA-SET) request for the previously known logical device
5. Force the DUT to perform a GetLogicalNodeDirectory(DATA-SET) request for the logical device which contains the dataset that was newly added
b)
6. Force the DUT to perform a GetDataSetDirectory request for the previously known dataset
c)
7. Force the DUT to perform a GetDataSetValues request for the previously known dataset

Comment
Step c) is not applicable because GetDataSetValues is not supported

4.2+ Block 2+: Data Set Definition

Test case	Test case description
cDs10	If the DUT creates persistent datasets dynamically after starting up check that the DUT sends the CreateDataSet services according to configuration. PIXIT (IEC 61850-7-2 Subclause 13.3.4)
cDs11	If the DUT creates non-persistent datasets dynamically after starting up check that the DUT sends the CreateDataSet services according to configuration. PIXIT (IEC 61850-7-2 Subclause 13.3.4)
cDs12	Request a DeleteDataSet service and check the DUT sends the request properly and is able to process the response of the server (IEC 61850-7-2 Subclause 13.3.5)
cDs13	Verify that the DUT can create a persistent data set with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)
cDs14	Verify that the DUT can create a non-persistent data set with the maximum name length for data set and a data set member (IEC 61850-7-2 Subclause 22.2)

Test case	Test case description
cDsN10	If the DUT creates persistent / non-persistent datasets dynamically after starting up check the DUT still communicates with other servers when it requests a CreateDataSet with negative response
cDsN11	If the DUT configures the datasets dynamically after starting up check the DUT still communicates with other servers when it requests a DeleteDataSet with negative response

Detailed test procedures for Data Set definition

cDs10	CreateDataSet (persistent)	Passed
IEC 61850-7-2 clause 13.3.4 IEC 61850-8-1 clause 14.3.3 *PIXIT Ds11*		
<u>Expected result</u> 1.　The DUT sends a correct CreateDataSet request		
<u>Test description</u> 1.　Force DUT to perform a CreateDataSet request to create a persistent dataset		
<u>Comment</u>		

cDs12	DeleteDataSet	Passed
IEC 61850-7-2 clause 13.3.5 IEC 61850-8-1 clause 14.3.4 *PIXIT Ds12*		
<u>Expected result</u> 1.　DUT sends correct DeleteDataSet request 2.　DUT sends correct DeleteDataSet request		
<u>Test description</u> 1.　When supported, force DUT to request a DeleteDataSet on a non-persistent dataset 2.　Force DUT to request a DeleteDataSet on a persistent dataset		
<u>Comment</u>		

cDs13	Persistent dataset name length	Passed

IEC 61850-7-2 clause 13.3
IEC 61850-8-1 clause 14.3
PIXIT Ds6

Expected result
2. DUT can handle the response and updates the dataset member with the maximum name length correctly.

Test description
1. Configure the DUT to create a persistent dataset:
    − With maximum supported name length for the dataset name itself
    − With maximum name length for one of the dataset members
2. Start the server and force the DUT to perform a GetDataSetDirectory for this dataset

Comment
Max namelength dataset cannot be tested because the DUT always use a standardized dataset name = Client MAC address + number, where number starts from 0 to 65535

cDsN10	CreateDataSet response-	Passed

IEC 61850-7-2 clause 13.3.4
IEC 61850-8-1 clause 14.3.3
PIXIT Ds11, Ds12

Expected result
1. DUT behaves as specified in the PIXIT

Test description
a   Force DUT to send a CreateDataSet request with a persistent dataset and force the SERVER SIMULATOR to return a CreateDataSet response-
b   Force DUT to send a CreateDataSet request with a non-persistent dataset and force the SERVER SIMULATOR to return a CreateDataSet response-

Comment

cDsN11	DeleteDataSet response-	Passed

IEC 61850-7-2 clause 13.3.5
IEC 61850-8-1 clause 14.3.4
PIXIT Ds13

Expected result
1. DUT behaves as specified in the PIXIT

Test description
1. Force DUT to send a DeleteDataSet request and force the SERVER SIMULATOR to return a DeleteDataSet response-

Comment

A4.4 Block 4: Setting Group Selection

cSg1	If the DUT implements autodescription, force it to start autodescription and check if it requests GetLogicalNodeDirectory(SGCB) and check response+
cSg2	Verify the DUT can select a setting group (IEC 61850-7-2 clause 16 figure 22). – SelectActiveSG of the first setting group (IEC 61850-7-2 Clause 16.3.2) – GetSGCBValues to verify active setting group (IEC 61850-7-2 Clause 16.3.7) – Repeat for another setting group

cSgN1	Force SERVER SIMULATOR to return response- for the following services and verify the DUT continues as before: - SelectActiveSG (IEC 61850-7-2 Subclause 16.3.2) - GetSGCBValues (IEC 61850-7-2 Subclause 16.3.7)

Detailed test procedures for Setting group selection

cSg1	GetLogicalNodeDirectory(SGCB)	Passed
IEC 61850-7-2 clause 10.2.2 IEC 61850-8-1 clause 12.3.1 *PIXIT Sg1*		
Expected result 1. The DUT sends a correct GetLogicalNodeDirectory(SGCB) request		
Test description 1. Force the DUT to send a GetLogicalNodeDirectory(SGCB) request for each logical device in each server		
Comment		

cSg2	Select setting group	Passed
IEC 61850-7-2 clause 16.3.2, 16.3.7 IEC 61850-8-1 clause 16.2.1, 16.2.6 *PIXIT Sg2*, *Sg3*		
Expected result 1. The DUT sends a correct SelectActiveSG request 2. The DUT sends a correct GetSGCBValues request		
Test description 1. Force the DUT to perform a SelectActiveSG request to select first setting group of a SGCB 2. Force the DUT to perform a GetSGCBValues request to read the active setting group 3. Repeat step 1 and 2 for the other setting groups in the SGCB		
Comment The DUT performs GetSGCBValues request to read only ActSG value. It is recommended to use one unique GetSGCBValues of LDName/LLN0.SGCB, according to 7-2.		

cSgN1	Pre-configured setting group deviations	Passed

IEC 61850-7-2 clause 9.2.2, 13.3.2
IEC 61850-8-1 clause 12.3.1, 16.2.1
PIXIT Sg5

Expected result
1. DUT uses autodescription to prevent sending the request or DUT responds as specified in PIXIT to the negative responses from the server

Test description
1. Force the DUT to send the following request and the SERVER SIMULATOR to return a negative respond for:
    − SelectActiveSG
    − GetSGCBValues

Comment

A4.5 Block 5: Unbuffered Reporting

Test case	Test case description
cRp1	If the DUT implements autodescription, force it to start autodescription and check if it requests a GetLogicalNodeDirectory(URCB) of the logical nodes declared in the PIXIT of all configured servers.
cRp2	If the DUT configures the server's Unbuffered ReportControlBlock parameters after startup using SetURCBValues, check that the GetURCBValues/SetURCBValues are sent with the configured values. (IEC 61850-7-2 Subclause 17.2.5.4)
cRp3	Verify the DUT is able to process the reports with different optional fields: Force the DUT to configure/enable a URCB with useful optional fields combinations: sequence-number, configuration-revision, report-time-stamp, reason-for-inclusion, data-set-name and/or data-reference, force/trigger a report and check the DUT is able to process the reports and updates its database. (IEC 61850-7-2 Subclause 17.2.2.8)
cRp4	Verify the DUT is able to process the reports with the following trigger conditions (IEC 61850-7-2 Subclause 17.2.2.11) Configure and enable a URCB with all supported optional fields and check the reports are processed according to the following (supported) trigger conditions: a on integrity b on data update c on data update and integrity d on data change e on data change and quality change f on data change, quality change and integrity
cRp5	Verify the DUT is able to process segmented reports
cRp6	Verify DUT can change the Buffer Time (IEC 61850-7-2 clause 17.2.2.9)
cRp7	Verify DUT can force a General interrogation (IEC 61850-7-2 Subclause 17.2.2.13)
cRp8	Verify that after start up the DUT configures and enables the URCBs as specified in the SCD file. The DUT only may write to the "Dyn" URCB fields in the SCL.
cRp9	Verify that the DUT can process reports with complex structured data (for example WYE and DEL data objects)
cRp10	Verify that the DUT can handle reports with basic data (for example stVal and quality)
cRp11	Verify that the DUT can handle a URCB, RptID and DatSet with maximum name length (IEC 61850-7-2 Subclause 22.2)
cRp12	Verify that the DUT can change the dataset elements of a dynamic dataset previously used in a URCB
cRp13	Verify that the DUT configures another indexed URCB when another client has reserved the indexed URCB before
cRp14	Verify that the DUT supports non-indexed URCB
cRp15	Verify DUT can accept a report with a dataset elements of arrays and service tracking and Unicode strings (even if those types are unsupported)
cRp16	Verify the DUT can handle pre-assigned URCBs
cRp17	Verify the DUT sends a GetURCBValues(owner) requests
cRp18	Verify the DUT can process reports from an URCB and data set in a logical device with ldName

Test case	Test case description
cRpN1	If the configured RCB was renamed or deleted, verify that the DUT does not send the GetURCBValues request (prevent) OR when it sends the request it behaves as specified in the PIXIT. In any case verify that the DUT still communicates with other servers.
cRpN2	Check that the DUT still works properly when it performs a SetURCBValues request while the URCB attribute(s) have a dynamic/configurable mismatch: dynamic in the client SCL and configurable in the server SCL
cRpN3	Report with not supported OptFlds. Check that the DUT does not collapse if it receives a Report with a non-configured or non-supported OptFlds.
cRpN4	Report with not supported TrgOps. Check that the DUT does not collapse if it receives a report with a non-configured or non-supported Trigger Option.
cRpN5	Mismatching reports: a Report with unknown DataSet. b Report with unknown RptID c Report with incorrect references of the Data. d Report with incorrect types in the Data. Check the behaviour described in the PIXIT.
cRpN6	Verify that the DUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 17.2.2.7) of the Report Control Block. When the DUT does not perform the ConfRev check it should check the dataset elements. The means of detection need to be specified in the PIXIT.

Note: cRpN3 and cRpN4 are not applicable because clients shall support all OptFlds and all TrgOps.

Detailed test procedures for Unbuffered Reporting

cRp1	GetLogicalNodeDirectory(URCB)	Passed

IEC 61850-7-2 clause 10.2.2
IEC 61850-8-1 clause 12.3.1
PIXIT Rp1

Expected result
1.   DUT correctly requests GetLogicalNodeDirectory(URCB)

Test description
1.   Force the DUT to perform a GetLogicalNodeDirectory(URCB)

Comment

cRp2	GetURCBValues and SetURCBValues	Passed

IEC 61850-7-2 clause 17.2.5.4
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp2

Expected result
4.   The DUT sends a correct request
5.   The DUT changes the trigger options, optional fields and integrity period and enables the reporting

Test description
1.   Stop DUT
2.   Configure at least one report control block in the SCL file, the trigger options, optional fields and integrity period are different in the server then expected by the client
3.   The applicable ReportSettings are "Dyn"
4.   Start DUT and force DUT to send GetURCBValues request(s)
5.   Force DUT to perform SetURCBValues request(s) to set trigger options and optional fields, enable reporting and GI

Comment
The DUT performs GetURCBValues request to read: RptEna, DatSet and RptID.

cRp3	DUT is able to process unbuffered reports with different optional fields	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT Rp5		

Expected result
3. The DUT sets the configured optional fields before enabling the URCB.
4. The DUT is able to process the report.
5. The DUT does not change the optional fields and is able to process the report.

Test description
1. Stop DUT
2. Configure the minimum optional fields supported by the DUT for a report control block in the DUT SCL file for one server.
3. Start DUT and force DUT to enable a URCB
4. Generate a report for the configured URCB
5. Repeat step 1 to 4, this time configuring all optional fields in step 2 and change SCL report settings OptFlds="Conf"

Comment

cRp4	DUT is able to process unbuffered reports with different trigger conditions	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp4*		

Expected result
4. DUT is able to process the reports send by the server.

Test description
1. Stop DUT
2. Configure the following (combination of) trigger conditions by the DUT for several URCBs in the DUT SCL file for one server:
   a on integrity
   b on data update
   c on data update and integrity
   d on data change
   e on data change and quality change
   f on data change, quality change and integrity
3. Start DUT and force DUT to enable the URCBs.
4. Force events related to the trigger conditions configured in step 2, that are related to members in the dataset of the RCB. If the trigger condition "Integrity" was configured in step 2, wait for the configured integrity period to expire.

Comment

cRp5	DUT can process segmented unbuffered reports	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp6*		
Expected result 1. DUT can process the reported values		
Test description 1. Force the DUT to send a GI and the SERVER SIMULATOR to send a segmented report with new values		
Comment		

cRp6	Change buffer time	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp14*		
Expected result 1. DUT successfully sends the SetURCBValues request.		
Test description 1. Force the DUT to perform a SetURCBValues request to change the bufTm of an URCB		
Comment		

cRp7	Verify client can force a General interrogation on an unbuffered report control block	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp16*		
Expected result 1. DUT successfully performs a general interrogation request		
Test description 1. Force the DUT to perform a general interrogation request on an URCB		
Comment Client always performs SetURCBValues of GI=TRUE, even if TrgOps.GI = FALSE. The user is responsible of setting TrgOps.GI = TRUE prior GI during the client configuration. Because this is well defined in the server, no issue is found at this point. See 7-2: "If a URCB contains TrgOps.GI = FALSE then an attempt to set the GI attribute to TRUE shall cause a SetURCBValues positive response. No GI report shall be generated."		

cRp8	SetURCBValues() only on "dyn" fields	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp17*		
Expected result 1. The DUT only may write to the "Dyn" URCB fields in the SCL.		
Test description 1. Force DUT to enable multiple URCBs that are configured in the SCL for the DUT		
Comment		

cRp9	Reports with complex structured data	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp8*		
Expected result 1. DUT successfully configures and enables the report control block 2. DUT processes the report as normal 3.		
Test description 1. Force DUT to Configure and enable an URCB which contains complex structured data (e.g. WYE or DEL). 2. Force the SERVER SIMULATOR to send a report for URCB		
Comment		

cRp10	Reports with basic data	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp8*		
Expected result 1. DUT successfully configures and enables the report control block 2. The DUT processes the report as normal 3.		
Test description 1. Force the DUT to Configure and enable an URCB which contains basic (unstructured) data (e.g. stVal or q) 2. Force the SERVER SIMULATOR to send a report for the URCB.		
Comment In the situation where the DUT receives a report with status/measurement or quality changes but "t" attribute is not included, the timestamp is updated with TimeOfEntry.		

cRp11	URCB, RptID and DatSet with maximum name length	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2

Expected result
1. DUT successfully configures and enables the report control block
2. The DUT processes the report as normal

Test description
1. Force the DUT to configure and enable an URCB which has:
   - Maximum possible LD, LN and URCB name length
   - Maximum possible LD, LN and DataSet name length
   - Maximum RptID length
   - Maximum available DatSet ObjectReference length
   - Maximum available DataRef length
2. Force the SERVER SIMULATOR to send a report for the URCB.

Comment
The maximum length for RCB is   117 (64 / 16 $ RP $ 32)
The maximum length for DataSets is   114 (64 / 16 $ 32)
The maximum length for RptID is   129 (VisString129)
The maximum length for DataSet ObjectReference is   114 (64 / 16 $ 32)
The maximum length for Data Reference is   123 (64 / 16 $ 2 $ 12 $ 12 $12)

Only standardized DA names can be processed by the DUT.
E.g.
DUT supports:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXA12345678901$phsA$cValmagf
DUT does not support:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXAvPPVPhs0102$mag**010203045**$f**01020304056**

cRp12	DataSet update	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp13

Expected result
1. DUT creates the DataSet and updates the DatSet object reference
5. DUT deletes the old DataSet and creates the new DataSet
6. DUT creates the DataSet and updates the DatSet object reference
8. DUT processes the report as normal

Test description
If the DUT supports dynamic DataSets:
1. Start the DUT and force it to create a DataSet in the SERVER SIMULATOR
2. Force the DUT to enable a ReportControlBlock with this DataSet
3. Force the DUT to disable the ReportControlBlock
4. The DUT may restart the association
5. Force the DUT to delete the DataSet in the ReportControlBlock and the DataSet
6. Force the DUT to create a changed DataSet in the SERVER SIMULATOR
7. Force DUT to enable the reconfigured ReportControlBlock with the changed DataSet
8. Force the SERVER SIMULATOR to send a report for the URCB.

Comment

cRp13	Indexed URCB usage (static & dynamic)	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp3, Rp9

Expected result
1.   DUT enables the URCB
3.   DUT behaves as specified in PIXIT Rp9
4.   DUT enables the URCB
6.   DUT behaves as specified in PIXIT Rp9
7.   DUT enables the URCB
9.   DUT behaves as specified in PIXIT Rp9

Test description
a1) Static reporting with max>1
1.   Start the DUT and force it to enable an indexed URCB
2.   Stop the DUT and force another client to enable this URCB
3.   Start the DUT
a2) Static reporting with max=1
4.   Start the DUT and force it to enable an URCB with max=1
5.   Stop the DUT and force another client to enable this URCB
6.   Start the DUT
b) Dynamic reporting
7.   Start the DUT and force it to enable an URCB not configured in SCL
8.   Stop the DUT and force another client to enable this URCB
9.   Start the DUT

Comment

cRp14	Non Indexed URCB usage	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp3

Expected result
3.   DUT enables the non-indexed URCB
4.   DUT processes the report as normal

Test description
1.   Configure a non-indexed URCB in SERVER SIMULATOR
2.   Load the SCL file with the non-indexed URCB into the DUT configuration tool
3.   Start the DUT and force it to enable the non-indexed URCB
4.   Force the SERVER SIMULATOR to send a report
5.
Comment

cRp15	Extended DataSet Elements	Passed

IEC 61850-7-4 clause 5.3.10, 5.10.4
IEC 61850-8-1 clause 17.1, 17.2

Expected result
2.   DUT enables the URCB
3.   DUT processes the report and supported CDC as normal

Test description
1.   Configure the SERVER SIMULATOR with a DataSet containing supported CDC classes as well as CDCs which may not be supported:
   − Tracking (all tracking DO CDCs within logical node LTRK: SpcTrk (CTS), UrcbTrk (UTS), BrcbTrk (BTS), LocbTrk (LTS), GocbTrk (GTS), MsvcbTrk (MTS), UsvcbTrk (NTS), SgcbTrk (STS)
   − Complete arrays (harmonic values with CDC "HDEL") with FC "MX"
2.   Configure and start the DUT with a report control using this DataSet
3.   Force the SERVER SIMULATOR to send a GI or integrity report

Comment

cRp16	Pre-assigned URCBs	Passed

IEC 61850-6 clause 9.3.8
IEC 61850-7-2 clause 17.2, TISSUE #1276
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp7

Expected result
3.   DUT does use the URCBs assigned to DUT and does not use the URCBs assigned to another client(s)

Test description
1.   Configure firstURCB01 assigned to DUT and firstURCB02 to another client, and secondURCB01 to another client and secondURCB02 to DUT and start the SERVER SIMULATOR
2.   Load the SCD in DUT
3.   Start the DUT

Comment

cRp18	URCB in logical device with ldName	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2

Expected result
1.   DUT enables the URCB
2.   DUT processes the report as normal

Test description
1.   Start the DUT and force it to enable an URCB in a logical device with ldName
2.   Force the SERVER SIMULATOR to send a report

Comment

cRpN1	Renamed or deleted URCB	Passed

IEC 61850-7-2 clause 10.2.2, 17.2
IEC 61850-8-1 clause 12.3.1, 17.1, 17.2
PIXIT Rp18

Expected result
4. DUT does send the GetLogicalNodeDirectory(URCB) request and it process the respond as specified in the PIXIT
5. DUT does not send the GetURCBValues request (prevent) OR when it sends the request it behaves as specified in the PIXIT

Test description
1. Stop a SERVER SIMULATOR
2. Rename an URCB in the SERVER SIMULATOR SCL with a new valid name that was used by the client
3. Start SERVER SIMULATOR
4. Either force the DUT to perform a GetLogicalNodeDirectory(URCB) request for the LD that contains the URCB
5. Or force the DUT to do a GetURCBValues request on the missing URCB

Comment

cRpN2	SetURCBValues Response-	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp19

Expected result
3. The DUT processes the SetURCBValues response- as specified in the PIXIT

Test description
1. Stop a SERVER SIMULATOR
2. Change the SERVER SIMULATOR configuration so that one or more of the following URCB elements which were previously writable become read-only: datSet, rptID, optFlds, bufTm, trgOps, intgPd
3. Start SERVER SIMULATOR and force the DUT to perform a SetURCBValues request for one or more of the read-only URCB elements

Comment

cRpN5	DUT is able to handle report control blocks with a mismatching dataset configuration	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp12

Expected result
4. The DUT behaves as described in the PIXIT.

Test description
1. Stop a SERVER SIMULATOR
2. Configure several URCBs in the SERVER SIMULATOR SCL file in the following way (one change per URCB) and keep the ConfRev value the same:
   a Change the referenced dataset into a new valid dataset
   b Change the RptID
   c Configure the dataset linked to a URCB in the SERVER SIMULATOR SCL file in the following way:
   − change the order of dataset members, without changing the order of the data types
   − change the order of dataset members, hereby changing the order of the data types
   − remove a dataset element from the middle of the dataset
   − add a dataset element in the middle of a dataset
3. Set datSet and rptID in the ReportSettings (for the SERVER SIMULATOR containing the URCB) to "Conf"
4. Start the SERVER SIMULATOR and force the DUT to enable the URCB

Comment

cRpN6	DUT is able to detect a change in ConfRev	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp13

Expected result
3. The DUT behaves as described in the PIXIT.
4. The DUT behaves as described in the PIXIT.

Test description
1. Stop a SERVER SIMULATOR
2. Increment the value for confRev of a URCB in the SERVER SIMULATOR SCL and remove a member from the referenced dataset
3. Start the SERVER SIMULATOR and force DUT to enable the URCB
4. Repeat step 1 to 3, this time without changing the referenced dataset in step 2

Comment

A4.6 Block 6: Buffered Reporting

Test case	Test case description
cBr1	If the DUT implements autodescription, force it to start autodescription and check if it requests a GetLogicalNodeDirectory(BRCB) of the logical nodes declared in the PIXIT of all configured servers.
cBr2	If the DUT configures the server's Buffered ReportControlBlock parameters after startup using SetBRCBValues, check that the GetBRCBValues/SetBRCBValues are sent with the configured values (IEC 61850-7-2 Subclause 17.2.3.4)
cBr3	Verify the DUT is able to process the reports with different optional fields: Force the DUT to configure/enable a BRCB with the useful optional fields combinations: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer-overflow, entryID and configuration-revision , force/trigger a report and check the DUT is able to process the reports and updates its database (IEC 61850-7-2 Subclause 17.2.2.8)
cBr4	Verify the DUT is able to process buffered reports with the following supported trigger conditions (IEC 61850-7-2 Subclause 17.2.2.11). Configure and enable a BRCB with all supported optional fields and check the reports are processed according to the following (supported) trigger conditions: a on integrity b on data update c on data update and integrity d on data change e on data change and quality change f on data change, quality change and integrity
cBr5	Verify the DUT is able to process segmented reports
cBr6	Verify client can change the Buffer Time (IEC 61850-7-2 clause 17.2.2.9)
cBr7	Verify the DUT can force a General interrogation (IEC 61850-7-2 Subclause 17.2.2.13)
cBr8	Verify that the DUT configures and enables the BRCBs as configured in the SCD file. The DUT only may write to the "Dyn" BRCB fields in the SCL.
cBr9	Verify that the DUT can handle reporting of complex structured data (for example WYE and DEL data objects)
cBr10	Verify that the DUT can handle reporting of basic data (for example stVal and quality)
cBr11	Verify that the DUT can handle a BRCB, RptID and DatSet with maximum name length (IEC 61850-7-2 Subclause 22.2)
cBr12	Verify that the DUT can change the dataset elements of a dynamic dataset previously used in a BRCB resulting in a ConfRev increment by the server.
cBr13	Verify that the DUT configures another indexed BRCB when another client has configured the indexed BRCB before
cBr14	Verify that the DUT supports non-indexed BRCB
cBr15	Verify DUT can accept a report with a dataset elements of arrays and service tracking and Unicode strings (even if those types are unsupported).
cBr16	Verify the DUT can handle pre-assigned BRCBs
cBr17	Verify the DUT sends a GetBRCBValues(owner) requests
cBr18	Verify that the DUT can process reports from a BRCB and dataset in a logical device with ldName
cBr30	Verify the DUT is able to process reports buffered during a lost association a without buffer overflow (PIXIT) b with buffer overflow
cBr31	Verify the DUT is able to request specific buffered reports after restoring a lost association by setting the EntryID
cBr32	Verify the DUT is able to purge buffered reports
cBr33	Verify the client first sets the ResvTms attribute if this attribute is available and if it 0

Test case	Test case description
cBrN1	If the configured RCB was renamed or deleted, verify that the DUT does not send the GetBRCBValues request (prevent) OR when it sends the request it behaves as specified in the PIXIT. In any case verify that the DUT still communicates with other servers.
cBrN2	Check that the DUT still works properly when it performs a SetBRCBValues request while the BRCB attribute(s) have a dynamic/configurable mismatch: dynamic in the client SCL and configurable in the server SCL.
cBrN3	Report with not supported OptFlds. Check that the DUT does not collapse if it receives a Report with a non-configured or non-supported OptFlds.
cBrN4	Report with not supported TrgOps. Check that the DUT does not collapse if it receives a Report with a non-configured or non-supported Trigger Option.
cBrN5	Mismatching reports: a Report with a mismatching DataSet. b Report with a mismatching RptID c Report with mismatching references of the Data d Report with incorrect types in the Data. Check the behaviour described in the PIXIT.
cBrN6	Verify that the DUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 17.2.2.7) of the Report Control Block. When the DUT does not perform the ConfRev check it should check the dataset members. The means of detection needs to be specified in the PIXIT.
cBrN20	Verify the DUT can handle a buffer overflow with SetBRCBValues(EntryID) response-

Note: cBrN3 and cBrN4 are not applicable because clients shall support all OptFlds and all TrgOps.

Detailed test procedures for Buffered Reporting

cBr1	GetLogicalNodeDirectory(BRCB)	Passed
IEC 61850-7-2 clause 10.2.2 IEC 61850-8-1 clause 12.3.1 *PIXIT Rp1*		
Expected result 1. DUT correctly requests GetLogicalNodeDirectory(BRCB)		
Test description 1. Force the DUT to perform a GetLogicalNodeDirectory(BRCB)		
Comment		

cBr2	SetBRCBValues and SetBRCBValues	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp2*		
Expected result 4. The DUT sends a correct request 5. The DUT changes the trigger options, optional fields and integrity period and enables the reporting		
Test description 1. Stop DUT 2. Configure at least one report control block in the SCL file, the trigger options, optional fields and integrity period are different in the server then expected by the client 3. The applicable ReportSettings are "Dyn" 4. Start DUT and force DUT to send GetBRCBValues request(s) 5. Force DUT to perform SetBRCBValues request(s) to set trigger options and optional fields, enable reporting and GI		
Comment The DUT performs GetBRCBValues request to read: RptEna, DatSet, RptID, and ResvTms if available.		

cBr3	DUT is able to process buffered reports with different optional fields	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp5

Expected result
3　The DUT sets the configured optional fields before enabling the BRCB.
4.　The DUT is able to process the report.
5.　The DUT does not change the optional fields and is able to process the report.

Test description
1.　Stop DUT
2.　Configure the minimum optional fields supported by the DUT for a report control block in the DUT SCL file for one server.
3.　Start DUT and force DUT to enable a BRCB
4.　Generate a report for the configured BRCB
5.　Repeat step 1 to 4, this time configuring all optional fields in step 2 and change SCL report settings OptFlds="Conf

Comment

cBr4	DUT is able to process buffered reports with different trigger conditions	Passed

IEC 61850-7-2 clause 17.2.2.11
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp4

Expected result
4.　　DUT is able to process the reports sent by the server.

Test description
1.　Stop DUT
2.　Configure the following (combination of) trigger conditions by the DUT for several BRCBs in the DUT SCL file for one server:
　a　on integrity
　b　on data update
　c　on data update and integrity
　d　on data change
　e　on data change and quality change
　f　on data change, quality change and integrity
3.　Start DUT and force DUT to enable the BRCBs.
4.　Force events related to the trigger conditions configured in step 2, which are related to members in the dataset of the RCB. If the trigger condition "Integrity" was configured in step 2, wait for the configured integrity period to expire.

Comment

cBr5	DUT can process segmented buffered reports	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp6

Expected result
1. DUT can process the reported value change(s)

Test description
1. Force to send a GI and the SERVER SIMULATOR to send a segmented report with new values

Comment

cBr6	Change buffer time	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT 14

Expected result
1. DUT successfully sends the SetBRCBValues request.

Test description
1. Force the DUT to perform a SetBRCBValues request to change the bufTm of a BRCB

Comment

cBr7	Verify DUT can force a General interrogation on a buffered report control	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp16

Expected result
1. DUT successfully performs a general interrogation request

Test description
1. Force the DUT to perform a general interrogation request on a BRCB

Comment
Client always performs SetBRCBValues of GI=TRUE, even if TrgOps.GI = FALSE. The user is responsible of setting TrgOps.GI = TRUE prior GI during the client configuration.
Because this is well defined in the server, no issue is found at this point. See 7-2: "If a BRCB contains TrgOps.GI = FALSE then an attempt to set the GI attribute to TRUE shall cause a SetBRCBValues positive response. No GI report shall be generated."

cBr8	SetBRCBValues() only on "dyn" fields	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp17*		
<u>Expected result</u> 1. The DUT only may write to the "Dyn" BRCB fields in the SCL.		
<u>Test description</u> 1. Force DUT to enable multiple BRCBs that are configured in the SCL for the DUT		
<u>Comment</u> 		

cBr9	Reports with complex structured data	Passed
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp8*		
<u>Expected result</u> 1. DUT successfully configures and enables the report control block 2. The DUT processes the report as normal		
<u>Test description</u> 1. Force the DUT to configure and enable a BRCB which contains complex structured data (e.g. WYE or DEL). 2. Force the SERVER SIMULATOR to send a report for the BRCB.		
<u>Comment</u> 		

cBr10	Reports with basic data	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 *PIXIT Rp8*		
<u>Expected result</u> 1. DUT successfully configures and enables the report control block 2. The DUT processes the report as normal		
<u>Test description</u> 1. Force the DUT to configure and enable a BRCB which contains basic (unstructured) data (for example stVal and quality). 2. Force the SERVER SIMULATOR to send a report for the BRCB.		
<u>Comment</u> In the situation where the DUT receives a report with status/measurement or quality changes but "t" attribute is not included, the timestamp is updated with TimeOfEntry.		

cBr11	BRCB, RptID and DatSet with maximum name length	Passed

IEC 61850-7-2 clause 17.2, 22.2
IEC 61850-8-1 clause 17.1, 17.2

Expected result
1. DUT successfully configures and enables the report control block
2. The DUT processes the report as normal

Test description
1. Force the DUT to configure and enable an BRCB which has:
   − Maximum possible LD, LN and brcb name length
   − Maximum possible LD, LN and DataSet name length
   − Maximum RptID length
   − Maximum possible DatSet ObjectReference length
   − Maximum possible DataRef length
2. Force the SERVER SIMULATOR to send a report for the BRCB.

Comment
The maximum length for RCB is   117 (64 / 16 $ BR $ 32)
The maximum length for DataSets is   114 (64 / 16 $ 32)
The maximum length for RptID is   129 (VisString129)
The maximum length for DataSet ObjectReference is 114 (64 / 16 $ 32)
The maximum length for Data Reference is   123 (64 / 16 $ 2 $ 12 $ 12 $12)

Only standardized DA names can be processed by the DUT.
E.g.
DUT supports:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXA1234
5678901$phsA$cValmagf
DUT does not support:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01MXAvPPV
Phs0102$mag**010203045**$f**01020304056**

cBr12	DataSet update	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp13

Expected result
1. DUT creates the DataSet and updates the datSet object reference
5. DUT deletes the old DataSet and creates the new DataSet
6. DUT creates the DataSet and updates the datSet object reference
8. DUT processes the report as normal

Test description
If the DUT supports dynamic DataSets:
1. Start the DUT and force it to create a DataSet in the SERVER SIMULATOR
2. Force the DUT to enable a ReportControlBlock with this DataSet
3. Force the DUT to disable the ReportControlBlock
4. The DUT may restart the association
5. Force the DUT to delete the DataSet in the ReportControlBlock and the DataSet
6. Force the DUT to create a changed DataSet in the SERVER SIMULATOR
7. Force DUT to enable the reconfigured ReportControlBlock with the changed DataSet
8. Force the SERVER SIMULATOR to send a report for the BRCB.

Comment

cBr13	Indexed BRCB usage	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp3, Rp9

Expected result
1. DUT enables the BRCB
3. DUT behaves as specified in PIXIT Rp9
4. DUT enables the BRCB
6. DUT behaves as specified in PIXIT Rp9
7. DUT enables the BRCB
9. DUT behaves as specified in PIXIT Rp9

Test description
a1) Static reporting with max>1
1. Start the DUT and force it to enable an indexed BRCB
2. Stop the DUT and force another client to enable this BRCB
3. Start the DUT
a2) Static reporting with max=1
4. Start the DUT and force it to enable an BRCB with max=1
5. Stop the DUT and force another client to enable this BRCB
6. Start the DUT
7. Dynamic reporting
8. Start the DUT and force it to enable an BRCB not configured in SCL
9. Stop the DUT and force another client to enable this BRCB
10. Start the DUT

Comment

cBr14	Non Indexed BRCB usage	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp3

Expected result
3. DUT enables the non-indexed BRCB
4. DUT processes the report as normal

Test description
1. Configure a non-indexed BRCB in SERVER SIMULATOR
2. Load the SCL file with the non-indexed BRCB into the DUT configuration tool
3. Start the DUT and force it to enable the non-indexed BRCB
4. Force the SERVER SIMULATOR to send a report

Comment

cBr15	Extended DataSet Elements	Passed

IEC 61850-7-4 clause 5.3.10, 5.10.4
IEC 61850-8-1 clause 17.1, 17.2

Expected result
2.   DUT enables the BRCB
3.   DUT processes the report and supported CDC as normal

Test description
1.   Configure the SERVER SIMULATOR with a DataSet containing supported CDC classes
      as well as CDCs which may not be supported:
      −   Tracking (all tracking DO CDCs within logical node LTRK:
           SpcTrk (CTS), UrcbTrk (UTS), BrcbTrk (BTS), LocbTrk (LTS), GocbTrk (GTS),
           MsvcbTrk (MTS), UsvcbTrk (NTS), SgcbTrk (STS)
      −   Complete arrays (harmonic values with CDC "HDEL")") with FC="MX
2.   Configure and start the DUT with a report control using this DataSet
3.   Force the SERVER SIMULATOR to send a GI or integrity report

Comment

cBr16	Pre-assigned BRCBs	Passed

IEC 61850-6 clause 9.3.8
IEC 61850-7-2 clause 17.2, TISSUE #1276
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp7

Expected result
3.   DUT does use the BRCBs assigned to DUT and does not use the BRCBs assigned to
      another client(s)

Test description
1.   Configure firstBRCB01 assigned to DUT and firstBRCB02 to another client, and secondBRCB01 to
      another client and secondBRCB02 to DUT and start the SERVER SIMULATOR
2.   Load the SCD in the DUT
3.   Start the DUT

Comment

cBr18	BRCB in logical device with ldName	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2

Expected result
1.   DUT enables the BRCB
2.   DUT processes the report as normal

Test description
1.   Start the DUT and force it to enable a BRCB in a logical device with ldName
2.   Force the SERVER SIMULATOR to send a report

Comment

cBr30	Process buffered reports with and without buffer overflow	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp20

Expected result
5. The DUT resync's to the last received EntryID and handles the buffered reports or purges the buffer
8. The DUT tries to resync to the last received EntryID and handles the buffer overflow and buffered reports as specified in PIXIT or purges the buffer

Test description
1. Configure and enable a BRCB with trigger conditions data change and all supported optional fields.
2. Force data changes in a server to force reports
3. Disconnect the Ethernet cable between the server and switch or disable a port in the switch
4. Force data changes in the server to force report buffering
5. Restore the Ethernet connection
6. Disconnect the Ethernet cable between the server and switch or disable a port in the switch
7. Force many data changes in the server to force buffer overflow
8. Restore the Ethernet connection

Comment
The client always executes a GI after enabling a BRCB to avoid losing information in case of Buffer-overflow. Because the client always performs SetBRCBValues of GI=TRUE, even if TrgOps.GI = FALSE, the user is responsible of setting TrgOps.GI = TRUE prior GI during the client configuration.

cBr31	Set EntryID of buffered reports	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp21

Expected result
6. The DUT sends a correct SetBRCBValues request with the last received EntryID
7. The DUT is able to process the buffered reports

Test description
1. Configure and enable a BRCB with trigger conditions data change and/or quality change, and all supported optional fields.
2. Force data/quality changes in a server to force reports
3. Disconnect the Ethernet cable between switch and the server or disable a port in the switch
4. Force data/quality changes in the server to force buffered reports
5. Restore the Ethernet connection
6. Force DUT to send a correct SetBRCBValues request with an EntryID that was received before the disconnect
7. DUT enables the reporting

Comment

cBr32	Purge buffered reports	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp21

Expected result
6. The DUT requests purge buffer

Test description
1. Configure and enable a BRCB with trigger conditions data change and/or quality change, and all supported optional fields.
2. Force data/quality changes in a server to force reports
3. Disconnect the Ethernet cable between switch and the server or disable a port in the switch
4. Force data/quality changes in the server to force buffered reports
5. Restore the Ethernet connection
6. Force DUT to purge buffered reports (PIXIT)

Comment

cBr33	Verify the client first sets the ResvTms attribute if this attribute is available and if it is 0	Passed

IEC 61850-7-2 clause 17.2.2.17
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp22

Expected result
3. The DUT sends a write request for the ResvTms attribute before enabling the BRCB

Test description
1. Configure a BRCB which has a ResvTms attribute.
2. The attribute shall have the value 0 in the SERVER SIMULATOR
3. Start the DUT and force it to enable the BRCB.

Comment

cBrN1	Renamed BRCB	Passed

IEC 61850-7-2 clause 10.2.2, 17.2
IEC 61850-8-1 clause 12.3.1, 17.1, 17.2
PIXIT Rp18

Expected result
4. DUT does send the GetLogicalNodeDirectory(BRCB) request and it process the respond as specified in the PIXIT
5. DUT does not send the GetBRCBValues request (prevent) OR when it sends the request it behaves as specified in the PIXIT

Test description
1. Stop a SERVER SIMULATOR
2. Reconfigure a BRCB in the SERVER SIMULATOR SCL with a new valid name that was used by the client
3. Start SERVER SIMULATOR
4. Either force the DUT to perform a GetLogicalNodeDirectory(BRCB) request for the LD which contains the BRCB
5. Or force the DUT to do a Read request on the missing URCB

Comment

cBrN2	SetBRCBValues response-	Passed

IEC 61850-7-2 clause 10.2.2, 17.2
IEC 61850-8-1 clause 12.3.1, 17.1, 17.2
PIXIT Rp19

Expected result
3. The DUT processes the SetBRCBValues response- as specified in the PIXIT

Test description
1. Stop a SERVER SIMULATOR
2. Change the SERVER SIMULATOR configuration so that one or more of the following BRCB elements which were previously writable become read-only: datSet, rptID, optFlds, bufTm, trgOps, intgPd
3. Start SERVER SIMULATOR and force the DUT to perform a SetBRCBValues request for one or more of the read-only BRCB elements

Comment

cBrN5	DUT is able to handle report control blocks with a mismatching configuration	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp12

Expected result
4. The DUT behaves as described in the PIXIT.

Test description
1. Stop a SERVER SIMULATOR
2. Configure several BRCBs in the SERVER SIMULATOR SCL file in the following way (one change per BRCB) and keep the ConfRev value the same:
    a   Change the referenced dataset into a new valid dataset
    b   Change the RptID
    c   Configure the dataset linked to a BRCB in the SERVER SIMULATOR SCL file in the following way:
        −   change the order of dataset members, without changing the order of the data types
        −   change the order of dataset members, hereby changing the order of the data types
        −   remove a dataset element from the middle of the dataset
        −   add a dataset element in the middle of a dataset
3. Set datSet and rptID in the ReportSettings (for the SERVER SIMULATOR containing the BRCB) to "Conf".
4. Start the SERVER SIMULATOR and force the DUT to enable the BRCB

Comment

cBrN6	DUT is able to detect a change in ConfRev	☐ Passed ☐ Failed ☐ Inconclusive

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp13

Expected result
3. The DUT behaves as described in the PIXIT.

Test description
1. Stop a SERVER SIMULATOR
2. Increment the value for confRev of a BRCB in the SERVER SIMULATOR SCL and remove a member from the referenced dataset
3. Start the SERVER SIMULATOR and force DUT to enable the BRCB
4. Repeat step 1 to 3, this time without changing the referenced dataset in step 2

Comment

cBrN20	Set EntryID fails	Passed

IEC 61850-7-2 clause 17.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT Rp11

Expected result
5. The DUT behaves as specified in PIXIT

Test description
1. Force data changes in a SERVER SIMULATOR to force reports
2. Disconnect the Ethernet cable between the Ethernet switch and the SERVER SIMULATOR or disable a port in the switch
3. Force many data changes in a SERVER SIMULATOR to force a buffer overflow
4. Restore the Ethernet connection
5. Force DUT to perform a SetBRCBValues request with an EntryID that is not in the buffer anymore

Comment

A4.12   Block 12: Control

Test case	Test case description
cCtl1	Check if the DUT is able to set the TEST field in the SelectWithValue and Operate requests (PIXIT).
cCtl2	Check if the DUT is able to set the CHECK (synchrocheck or interlock-check bits) in the SelectWithValue and Operate requests (PIXIT) for the supported control models.
cCtl3	Check if the DUT is able to change control model using online services (PIXIT).
cCtl4	Verify the values of originator category, origin identification and the control number (PIXIT)
cCtl5	Check if the DUT reacts as described in the PIXIT when it detects a control model mismatch: a Server status-only, DUT expects controllable b Server SBO, DUT expects direct operate c Server direct operate, DUT expects SBO d Server SBO enhanced DUT expects SBO normal
cCtl6	Check if the DUT reacts as described in the PIXIT when it detects a control model that is not initialized in the SCL file

The testing of the control model has been divided in the four possible control models that can be implemented:

– direct control with normal security
– SBO control with normal security
– direct control with enhanced security
– SBO control with enhanced security.

Detailed test procedures for Control

cCtl1	Control with Test flag	Passed
IEC 61850-7-2 clause 20.5.2.6 IEC 61850-8-1 clause 20 *PIXIT Ctl1, Ctl4*		
<u>Expected result</u> DO normal/enhanced security: – The DUT sends the Operate request with Test flag = true SBO normal security: – The DUT sends the Operate requests with Test flag = true SBO enhanced security: – The DUT sends the SelectWithValue and Operate requests both with Test flag = true		
<u>Test description</u> DO normal/enhanced security: – Force the DUT to perform an Operate request with the Test flag set SBO normal security: – Force the DUT to perform a Select request followed by an Operate request with the Test flag set SBO enhanced security: – Force the DUT to perform a SelectWithValue request followed by an Operate request, both with the Test flag set		
<u>Comment</u> Step related to "SBO normal security" is not applicable since the DUT does not support SBOns.		

cCtl2	Synchro and/or interlock check	Passed

IEC 61850-7-2 clause 20.5.2.7
IEC 61850-8-1 clause 20
PIXIT Ctl1, Ctl5

<u>Expected result</u>
The DUT sends the request(s) with the Check bits as specified in PIXIT.

<u>Test description</u>
DO normal/enhanced security:
1. Force the DUT to send an Operate request with the synchrocheck bit set
2. Force the DUT to send an Operate request with the interlock-check bit set
3. Force the DUT to send an Operate request with the interlock- and synchrocheck bit set
SBO normal security:
1. Force the DUT to perform a Select and Operate request with the synchrocheck bit set
2. Force the DUT to perform a Select and Operate request with the interlock-check bit set
3. Force the DUT to perform a Select and Operate request with the interlock- and synchrocheck bit set
SBO enhanced security:
1. Force the DUT to perform a SelectWithValue and Operate request, both with the synchrocheck bit set
2. Force the DUT to perform a SelectWithValue and Operate request, both with the interlock-check bit set
3. Force the DUT to perform a SelectWithValue and Operate request, both with the interlock- and the synchrocheck bit set

<u>Comment</u>
Step related to "SBO normal security" is not applicable since the DUT does not support SBOns.

cCtl4	Verify control number and originator	Passed

IEC 61850-7-2 clause 20.2, 20.3
IEC 61850-8-1 clause 20
PIXIT Ctl6, Ctl7

<u>Expected result</u>
The DUT sets the control number and the originator as specified in PIXIT

<u>Test description</u>
Execute the applicable control model specific test cases

<u>Comment</u>

cCtl5	Control model mismatch	Passed

IEC 61850-7-2 clause 20.2, 20.3
IEC 61850-8-1 clause 20
PIXIT Ctl12

Expected result
3.   The DUT behaves as specified in the PIXIT

Test description
1.   Stop one SERVER SIMULATOR the DUT
2.   Configure the server SCL file for the DUT and the SERVER SIMULATOR differently to get a control model mismatch:
    a   DUT expects DOns;   SERVER SIMULATOR is SBOns, repeat for DOes, SBOes and status-only
    b   DUT expects SBOns;   SERVER SIMULATOR is DOns, repeat for DOes, SBOes and status-only
    c   DUT expects DOes;   SERVER SIMULATOR is DOns, repeat for SBOns, SBOes and status-only
    d   DUT expects SBOes;   SERVER SIMULATOR is DOns, repeat for SBOns, DOes and status-only
3.   Start the DUT and force the DUT to request a Select/SelectWithValue/Operate request for the control object(s) with mismatching control model

Comment
Step b) is not applicable since the DUT does not support SBOns.

A4.12a   Block 12a: Direct Control

Test case	Test case description
cDOns1	Operate Request[test ok] resp+ Perform a correct Operate request. Check that the DUT does not generate an error.
cDOns2	Operate Request[test not ok] resp- Client requests Operate resulting in Test not ok. Check that the DUT realizes the operation failed.
cDOns3	TimeActivatedOperate [test not ok] resp- Verify the WaitForActivationTime results in a timer expired 'Test not ok' and that the DUT realizes the operation succeeded.
cDOns4	TimeActivatedOperate [test ok] resp+ Send a TimeActivatedOperate request. Verify the WaitForActivationTime results in a timer expired 'Test ok' and that the DUT realizes the operation succeeded.

Detailed test procedures for Direct Control with normal security (DOns).

cDOns1	Successful Operate	Passed
IEC 61850-7-2 clause 20.2.1 IEC 61850-8-1 clause 20.8		
<u>Expected result</u> 1. The DUT sends correct Operate request and processes the response+		
<u>Test description</u> 1. Force the DUT to perform an Operate request on a DOns control object		
<u>Comment</u>		

cDOns2	Failed Operate	Passed
IEC 61850-7-2 clause 20.2.1 IEC 61850-8-1 clause 20.8 *PIXIT Ctl8, Ctl9*		
<u>Expected result</u> 1. The DUT processes the response- as specified in the PIXIT.		
<u>Test description</u> 1. Force the DUT to perform an Operate request on a DOns control object that results in a Operate response- with an optional Last Application Error		
<u>Comment</u> The DUT is able to process Operate response- with LastAppError for DOns.		

A4.12c   Block 12c: Enhanced Direct Control

Test case	Test case description
cDOes1	Operate[test ok] resp+: Send a correct Operate request. a Check that the DUT notices the operation ended positively when it receives the CommandTermination+. b Check that the DUT notices the operation ended negatively when it receives the CommandTermination- (PIXIT)
cDOes2	Operate[test not ok] resp-: Send an Operate request, thereby making sure the device will generate a 'test not ok'. Check that the DUT behaves as specified in the PIXIT.
cDOes3	TimeActivatedOperate[test not ok] resp-: Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test not ok'. Check that the DUT realizes the operation failed.
cDOes4	TimeActivatedOperate [test ok] resp+: Send a correct TimeActivatedOperate request. a Check that the DUT realizes the operation request succeeded. b Check that the DUT notice the operation ended positively when it receives the CommandTermination+. c Check that the DUT notice the operation ended negatively when it receives the CommandTermination-.

Detailed test procedures for Direct Control with enhanced security (DOes).

cDOes1	Successful Operate with command termination	Passed
IEC 61850-7-2 clause 20.3.2, 20.5.3.5 IEC 61850-8-1 clause 20.8 and 20.9 *PIXIT Ctl13*		
Expected result 1. Check that the DUT processes the CommandTermination+ as specified in the PIXIT 2. Check that the DUT processes the CommandTermination- as specified in the PIXIT		
Test description 1. Force the DUT to send a correct Operate request that causes the server to send an Operate response+ and a CommandTermination.request+ 2. Force the DUT to send a correct Operate request that causes the server to send an Operate response+ and a CommandTermination.request-		
Comment		

cDOes2	Operate failure	Passed
IEC 61850-7-2 clause 20.3.2, 20.5.3.5 IEC 61850-8-1 clause 20.8 and 20.9 *PIXIT Ctl8, Ctl9*		
Expected result 1. The DUT processes the Operate response- as specified in the PIXIT		
Test description 1. Force the DUT to perform an Operate and the SERVER SIMULATOR to send Operate response- with LastApplicationError		
Comment		

A4.12d   Block 12d: Enhanced SBO Control

Test case	Test case description
cSBOes1	SelectWithValue [test not ok] resp-: Select device using SelectWithValue resulting in test not ok. Check the DUT indicates an error.
cSBOes2	SelectWithValue [test ok] resp+ and Operate[test ok] resp+ Select device using correct SelectWithValue. Perform a correct Operate request. Check the DUT indicates no error after receiving the command termination+ and an error after receiving command termination – (PIXIT)
cSBOes3	SelectWithValue [test ok] resp+ and Operate[test not ok] resp- Perform a SelectWithValue and Operate request. The Operate results in test not ok. Check that the DUT realizes the operation failed.
cSBOes4	SelectWithValue [test ok] resp+ and Cancel Perform a correct Cancel request. Check the DUT indicates no error.
cSBOes5	SelectWithValue [test ok] resp+ and TimeActivatedOperate [test ok] resp Perform a correct TimeActivatedOperate request. Check that the DUT realizes the operation succeeded after the WaitForActivationTime and detects the CommandTermination with the result of the order.
cSBOes6	SelectWithValue [test ok] resp+ and TimeActivatedOperate [test not ok] resp- Perform a SelectWithValue and TimeActivatedOperate request. The TimeActivatedOperate results in test not ok. Check that the DUT realizes the operation failed.

Detailed test procedures for SBO Control with enhanced security (SBOes).

cSBOes1	SelectWithValue [test not ok]	Passed
IEC 61850-7-2 clause 20.3.3, 20.5.3.3 IEC 61850-8-1 clause 20.6, 20.9 PIXIT Ctl9		
Expected result 1. DUT indicates SelectWithValue failure and shall not send an Operate request		
Test description 1. Force the DUT to perform a SelectWithValue request and force the SERVER SIMULATOR to send a SelectWithValue response- with LastApplicationError		
Comment		

cSBOes2	SelectWithValue and successful Operate with command termination	Passed

IEC 61850-7-2 clause 20.3.3, 20.5.3.5
IEC 61850-8-1 clause 20.6, 20.8, 20.9

Expected result
1. The DUT performs a correct SelectWithValue request
2. The DUT performs a correct Operate request
3. The DUT performs a correct SelectWithValue request
4. The DUT performs a correct Operate request and handles the CommandTermination- as specified in the PIXIT

Test description
1. Force the DUT to perform a SelectWithValue request for an SBOes object
2. Force the DUT to perform an Operate request for the selected object and server simulator to send Operate response+ and CommandTermination+
3. Force the DUT to perform a SelectWithValue request for an SBOes object
4. Force the DUT to perform an Operate request for the selected object and server simulator to send Operate response+ and CommandTermination-

Comment

cSBOes3	SelectWithValue and failed Operate	Passed

IEC 61850-7-2 clause 20.3.3, 20.5.3.5
IEC 61850-8-1 clause 20.6, 20.8, 20.9
PIXIT Ctl9

Expected result
1. The DUT performs a correct SelectWithValue request
2. The DUT performs a correct Operate request and indicates the failed operate as described in PIXIT.

Test description
1. Force the DUT to perform a SelectWithValue request
2. Force the DUT to perform an Operate request force the SERVER SIMULATOR to send an Operate response- with LastApplicationError

Comment

cSBOes4	Cancel	Passed

IEC 61850-7-2 clause 20.3.3, 20.5.3.4
IEC 61850-8-1 clause 20.7, 20.9

Expected result
1. The DUT performs a correct SelectWithValue request
2. The DUT performs a correct Cancel request

Test description
1. Force the DUT to perform a SelectWithValue request
2. Force the DUT to perform a Cancel request

Comment

A4.13 Block 13: Time Synchronization

cTm1	Verify that the DUT supports the SCSM time synchronisation, Change the time in the time server and verify the DUT uses the new time
cTm2	Check that the timestamp accuracy of the DUT matches the documented timestamp quality.

cTmN1	Verify that a lost time synchronisation is detected after a specified period and the timestamp quality invalid is set
cTmN2	Verify the DUT can set the time stamp quality "ClockFailure" (PIXIT)

Detailed test procedures for Time and time synchronization

cTm1	Time synchronisation	Passed
IEC 61850-7-2 clause 21 and 6.1.2.9.3.3 IEC 61850-8-1 clause 21 *PIXIT Tm1*		
<u>Expected result</u> 3. The DUT uses the new timestamp		
<u>Test description</u> 1. DUT exposes the time and time quality as specified in the PIXIT 2. Test engineer changes the time of the time server and waits till DUT has received the new time synch message 3. DUT exposes the time and time quality as specified in the PIXIT		
<u>Comment</u>		

cTm2	Time accuracy	Passed
IEC 61850-7-2 clause 21 and 6.1.2.9.3.3 IEC 61850-8-1 clause 21 *PIXIT Tm1*		
<u>Expected result</u> 1. DUT timestamp accuracy matches with the documented accuracy 3. DUT uses the new timestamp		
<u>Test description</u> 1. DUT displays the time and time quality (PIXIT) or requests a service including the timestamp 2. Test engineer changes the time of the time server and waits till DUT has received the new time synch message 3. DUT displays the time and time quality (PIXIT) or requests a service including the timestamp		
<u>Comment</u>		

cTmN1	Time synchronisation lost	Passed

IEC 61850-7-2 clause 21 and 6.1.2.9.3.3
IEC 61850-8-1 clause 21,
PIXIT Tm1, Tm5

Expected result
1. DUT uses the correct timestamp
3. DUT uses the timestamp with "ClockNotSynchronized"
5. DUT uses the correct timestamp

Test description
1. DUT displays the time and time quality (PIXIT) or requests a service including the timestamp
2. Test engineer stops or disconnects the time server and waits for the DUT to detect the time server is lost
3. DUT displays the time and time quality (PIXIT) or requests a service including the timestamp
4. Test engineer restarts or reconnects the time server and waits till DUT has received the time synch message
5. DUT displays the time and time quality (PIXIT) or requests a service including the timestamp

Comment
Time to detect the time server is lost ~ 4 min

A4.14   Block 14: File Transfer

cFt1	Verify that the DUT can send a GetServerDirectory(FILE) request with correct parameters and that the DUT is able to process the response (IEC 61850-7-2 clause 7.2.2)
cFt2	Verify that the DUT can send a GetFileAttributeValues request with correct parameters and verify that the DUT is able to process the response (IEC 61850-7-2 clause 23.2.4)
cFt3	Verify that the DUT can send a GetFile request with correct parameters and verify the DUT handles the response (IEC 61850-7-2 clause 23.2.1)
cFt4	The DUT requests a SetFile service with a small and large file and verify the DUT sends the resulting file(s).
cFt5	Verify that the DUT can send a DeleteFile request with correct parameters and verify that the DUT can handle the response

cFtN1	Force SERVER SIMULATOR to respond– on GetFile request, and verify the DUT reports an error.
cFtN2	Force SERVER SIMULATOR to respond– on GetFileAttributeValues request, and verify the DUT reports an error
cFtN3	Force SERVER SIMULATOR to respond– on SetFile request, and verify the DUT reports an error.

Detailed test procedures for File transfer

cFt1	GetServerDirectory(FILE)	Passed
IEC 61850-7-2 clause 7.2.2 IEC 61850-8-1 clause 9.3, 23.2 *PIXIT Ft3*		
Expected result 1. The DUT sends the GetServerDirectory(FILE) request without a file name specification or with wildcard and processes the GetServerDirectory response		
Test description 1. Force the DUT to perform a GetServerDirectory(FILE) request		
Comment		

cFt3	GetFile	Passed
IEC 61850-7-2 clause 23.2.1 IEC 61850-8-1 clause 23.2.1 *PIXIT Ft6, Ft8*		
Expected result 1. The DUT processes the file 2. The DUT processes the file 3. The DUT processes the file		
Test description 1. Force the DUT to perform a GetFile request for a small file of about 1kB 2. Force the DUT to perform a GetFile request for a file with file size 0 (unknown) 3. Force the DUT to perform a GetFile request for a large file of about 1MB		
Comment		

cFtN1	GetFile response-		Passed
IEC 61850-7-2 clause 23.2.1 IEC 61850-8-1 clause 23.2.1 *PIXIT Ft9*			
<ins>Expected result</ins> 1. The DUT processes the GetFile response-			
<ins>Test description</ins> 1. Force the DUT to perform a GetFile request and the SERVER SIMULATOR to send a GetFile response- (e.g. by limiting the file access rights)			
<ins>Comment</ins> 			

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