

VERIFICATION REPORT

IEC 61850 Edition 2 client conformance test in SICAM AK3

Siemens AG

Report no.: 16-2309

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| Report title: | Verification Report IEC 61850 Edition 2 client conformance test in SICAM AK3 | DNV GL - Energy KEMA Nederland B.V. Utrechtseweg 310-B50 6812 AR ARNHEM The Netherlands |
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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 |
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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.

| | |
|-------------------------|--|
| <i>DUT</i> | SICAM AK 3 Automation Component with modules CP-2016, CP-2019 and SM-2558 Software version: ETA5 Rev. 03.04 Module: CP-2016 CP-2019 SM-2558 HW version: BC2-016--.03 BC2-019--.03 BC2-558--.03 S/N: BF1512032572 BF1601022478 BF1512033766 |
| <i>MANUFACTURER</i> | Siemens AG Humboldstr. 59 90459 Nuremberg Germany |
| <i>PICS</i> | "Protocol Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in Siemens SICAM AK 3, 2016-09-16" |
| <i>MICS</i> | "Model Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in Siemens SICAM AK 3, 2016-09-16" |
| <i>TICS</i> | "TISSUES Implementation Conformance Statement for the IEC 61850 Ed.2 Client Interface in Siemens SICAM AK 3, 2016-09-16" |
| <i>PIXIT</i> | "Protocol Implementation extra Information for Testing (PIXIT) the IEC 61850 Ed.2 Client Interface in Siemens SICAM AK 3, 2016-09-16" |
| <i>SCD</i> | Ed2_REFIED_REPORT_CONTROL_Rev4.scd |
| <i>TEST INITIATOR</i> | <i>MANUFACTURER</i> , Johann Hahn |
| <i>TEST FACILITY</i> | KEMA Nederland B.V. Protocol Competence & Test Center Utrechtseweg 310-B50, Arnhem, The Netherlands Accredited as independent Level A test lab by the UCAIug |
| <i>TEST ENGINEER</i> | Patricia del Río, patricia.rio@dnvgl.com |
| <i>TEST SESSION</i> | September 2016, Vienna, Austria |
| <i>SERVER SIMULATOR</i> | UniCA 61850 IED simulator 5.31.00 and 5.29.06 |
| <i>ANALYSER</i> | UniCA 61850 Analyzer 5.31.00 |
| <i>HMI</i> | To monitor processed data: Client WEB browser To configure DUT and force commands: SICAM TOOLBOX II V6.00 |
| <i>TIME SERVER</i> | KemaSNTP.exe, DNV KEMA SNTP Master |

1.2 Background

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

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

"Does the protocol implementation of the DUT, conform to the 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

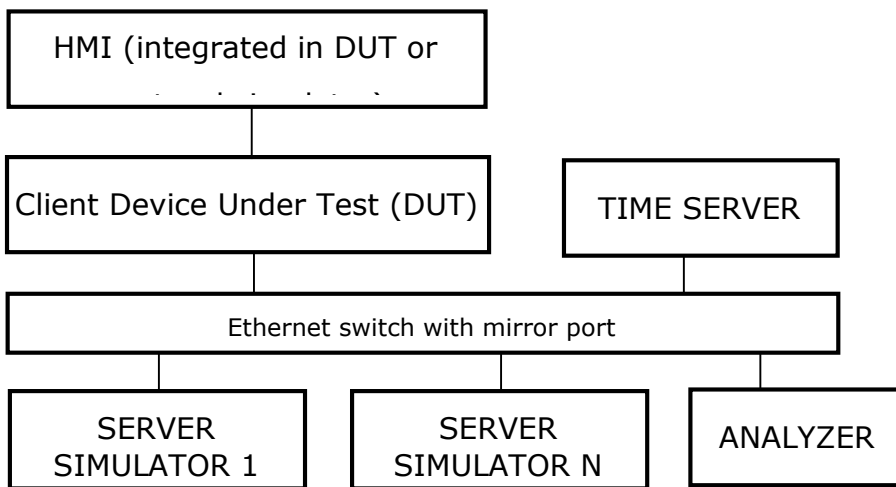


Figure 3.1 The test environment

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:
 - contain all common data classes supported by the DUT
 - contain several new data objects within a standard logical node
 - contain several new enum types and enum values
- configuration:
 - one or more servers with preconfigured datasets with data objects
 - one or more servers with dynamic datasets (when supported by DUT)
 - one or more servers with report control block indexing
 - one or more servers without report control block indexing
- communication:
 - support all conformance blocks supported by the DUT in one or more servers
 - support all ACSI services supported by the DUT
 - 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, 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 |
| 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_PrefixMMX
U01\$MX\$A12345678901\$phsA\$cVal\$mag\$f
DUT does not support:
ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMX
U01\$MX\$AvPPVPhs0102\$mag**010203045**\$f**01020304056**
- (6) According to the DUT implementation when "t" attribute is not reported and changes are detected in the signal value or quality, 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.

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.NamPit.configRev as described in <i>PIXIT Cf1</i> . 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 (<i>PIXIT Sr1</i>) | 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 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cMdl3 - measurements | Support of CDC: measurement information | Passed |
|--|--|---------------|
| MICS | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| | | |
|--|--------------------------------|---------------|
| cMdl3 - control | Support of CDC: control | Passed |
| MICS | | |
| <u>Expected result</u> | | |
| 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 | | |
| <u>Test description</u> | | |
| <ol style="list-style-type: none"> 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 | | |
| <u>Comment</u> | | |

| | | |
|--|---------------------------------|---------------|
| cMdl3 - settings | Support of CDC: settings | Passed |
| MICS | | |
| <u>Expected result</u> | | |
| <ol style="list-style-type: none"> 4. DUT sends correct SelectEditSGValues requests for the supported CDC's (MICS) 5. DUT sends correct SetDataValue requests for the supported CDC's (MICS) | | |
| <u>Test description</u> | | |
| <ol style="list-style-type: none"> 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 | | |
| <u>Comment</u> | | |
| 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 <i>PIXIT As1</i> | | |
| <u>Expected result</u> 1. DUT accepts Associate response+ from all servers 2. DUT returns to "state" where it is able to start new TPAA's with the same servers | | |
| <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> Tested with 20 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 <i>PIXIT As5</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 TPAA's | | |
| <u>Comment</u> Tested with 2 servers | | |

| cAssN1 | Access point mismatch | Passed |
|---|------------------------------|---------------|
| IEC 61850-8-1 clause 10.2, 25.3.1 and table 132 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT As3</i> | | |
| <u>Expected result</u> 1. DUT accepts Associate response+ from server 2. DUT receives and responds correctly to the abort request from the server 3. | | |
| <u>Test description</u> 1. Set-up a TPAA with one server 2. Force SERVER SIMULATOR to abort TPAA 3. Repeat step 1 and 2, 10 times | | |
| <u>Comment</u> | | |

| cAssN5 | Server deny | Passed |
|---|--------------------|---------------|
| IEC 61850-7-2 clause 8.3 IEC 61850-8-1 clause 10.2 <i>PIXIT As3</i> | | |
| <u>Expected result</u> 2. DUT detects the Association failure and behaves as specified in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT As2, As3</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 IdName |

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 | | |
| <u>Expected result</u> 2. DUT accepts a GetServerDirectory response+ from the server | | |
| <u>Test description</u> 1. Set-up a TPAA with at least two servers 2. DUT request for each server a GetServerDirectory(LOGICAL-DEVICE) 3. Continue with cSrv2 | | |
| <u>Comment</u> Tested with 2 servers | | |

| cSrv2 | GetLogicalDeviceDirectory | Passed |
|--|---------------------------|--------|
| IEC 61850-7-2 Subclause 9.2.1 IEC 61850-8-1 Subclause 11 | | |
| <u>Expected result</u> 1. DUT accepts a GetLogicalDeviceDirectory response+ from the server | | |
| <u>Test description</u> 1. DUT request for each responded LogicalDevice a GetLogicalDeviceDirectory 2. Continue with cSrv3 | | |
| <u>Comment</u> Tested with 2 servers | | |

| cSrv3 | GetLogicalNodeDirectory | Passed |
|--|-------------------------|--------|
| IEC 61850-7-2 Subclause 10.2.2 IEC 61850-8-1 Subclause 12.3.1 | | |
| <u>Expected result</u> 1. DUT accepts a GetLogicalNodeDirectory(DATA) response+ from the server | | |
| <u>Test description</u> 1. DUT request for each responded LogicalNode a GetLogicalNodeDirectory(DATA) 2. Continue with cSrv4 | | |
| <u>Comment</u> 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 | | |
| <u>Expected result</u> 1. DUT accepts a GetDataDirectory/GetDataDefinition response+ from the server | | |
| <u>Test description</u> 1. DUT request for responded dataobjects a GetDataDirectory/GetDataDefinition 2. Release the TPAA with all servers | | |
| <u>Comment</u> 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 <i>PIXIT Sr3</i> | | |
| <u>Expected result</u> 2-3. DUT receives the object model either by Reporting or by GetDataValues+ response and handles the values as stated in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cSrv6 | SetDataValues | Passed |
|---|----------------------|---------------|
| IEC 61850-7-2 clause 11.4.3 IEC 61850-8-1 clause 13.4.2 <i>PIXIT Sr7</i> | | |
| <u>Expected result</u> 2. DUT accepts a SetDataValues response+ from server | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> 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 <i>PIXIT Sr8</i> | | |
| <u>Expected result</u> 2-3. DUT accepts a GetDataValues response+ from server | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> During startup, the DUT requests multiple DOs in one GetDataValues request. No GetDataValues requests of DAs are used. | | |

| cSrv10 | IdName | Passed |
|--|---------------|---------------|
| IEC 61850-6 clause 8.5.3 | | |
| <u>Expected result</u> 2. DUT request services with data object references with the IdName value | | |
| <u>Test description</u> 1. Set-up a TPAA with one server 2. DUT request ACSI services on data objects identified by IdName | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Sr2, Sr11</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Sr2, Sr11</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cSrvN5 | Quality values | Passed |
|---|----------------|--------|
| IEC 61850-7-2 clause 11.4.2 IEC 61850-8-1 clause 13.4.1 <i>PIXIT Sr4, Sr5, Sr6</i> | | |
| <u>Expected result</u> 1. DUT processes the quality as specified in the PIXIT | | |
| <u>Test description</u> 1. Change the value of attribute q of a data object of one server to: <ul style="list-style-type: none"> - Validity: Invalid - Validity: Questionable - Failure = true - Validity: Questionable - OldData = true - Source = Substituted (by another client) - Test = true - OperatorBlocked = true | | |
| <u>Comment</u> | | |

| cSrvN6 | Time Quality values | Passed |
|--|---------------------|--------|
| IEC 61850-7-2 clause 11.4.2 IEC 61850-8-1 clause 13.4.1 <i>PIXIT Sr12, Sr13</i> | | |
| <u>Expected result</u> 1-3. DUT processes the time quality as specified in the PIXIT | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

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 | | |
| <u>Expected result</u> 1. DUT accepts the response | | |
| <u>Test description</u> 1. Force DUT to perform a GetLogicalNodeDirectory(DATA-SET) request for each server and logical device | | |
| <u>Comment</u> | | |

| cDs2 | GetDataSetDirectory | Passed |
|--|---------------------|--------|
| IEC 61850-7-2 clause 13.3.6 IEC 61850-8-1 clause 14.3.5 | | |
| <u>Expected result</u> 1. DUT accepts the response | | |
| <u>Test description</u> 1. Force DUT to perform a GetDataSetDirectory request for the data sets used by the DUT | | |
| <u>Comment</u> 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 <i>PIXIT Ds4</i> | | |
| <u>Expected result</u> 3. DUT responds as specified in PIXIT on the reconfigured datasets | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cDs6 | Pre-configured dataset name length | Passed |
|---|------------------------------------|--------|
| IEC 61850-7-2 clause 13.3 IEC 61850-8-1 clause 14.3 <i>PIXIT Ds7</i> | | |
| <u>Expected result</u> 2. DUT can handle the response and updates the dataset member with the maximum name length correctly | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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\$f01020304056 | | |

| 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 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Ds11</i> | | |
| <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 <i>PIXIT Ds12</i> | | |
| <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 <i>PIXIT Ds6</i> | | |
| <u>Expected result</u> 2. DUT can handle the response and updates the dataset member with the maximum name length correctly. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Ds11, Ds12</i> | | |
| <u>Expected result</u> 1. DUT behaves as specified in the PIXIT | | |
| <u>Test description</u> 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- | | |
| <u>Comment</u> Note: The dataset can't be created when another client created a dataset with the same name just before | | |

| cDsN11 | DeleteDataSet response- | Passed |
|--|--------------------------------|---------------|
| IEC 61850-7-2 clause 13.3.5 IEC 61850-8-1 clause 14.3.4 <i>PIXIT Ds13</i> | | |
| <u>Expected result</u> 1. DUT behaves as specified in the PIXIT | | |
| <u>Test description</u> 1. Force DUT to send a DeleteDataSet request and force the SERVER SIMULATOR to return a DeleteDataSet response- | | |
| <u>Comment</u> Note: The dataset can't be deleted when it is referenced by another client in a report control block | | |

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). <ul style="list-style-type: none"> - 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: <ul style="list-style-type: none"> - 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 <i>PIXIT Sg1</i> | | |
| <u>Expected result</u> 1. The DUT sends a correct GetLogicalNodeDirectory(SGCB) request | | |
| <u>Test description</u> 1. Force the DUT to send a GetLogicalNodeDirectory(SGCB) request for each logical device in each server | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Sg2, Sg3</i> | | |
| <u>Expected result</u> 1. The DUT sends a correct SelectActiveSG request 2. The DUT sends a correct GetSGCBValues request | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Sg5</i> | | |
| <u>Expected result</u> 1. DUT uses autodescription to prevent sending the request or DUT responds as specified in PIXIT to the negative responses from the server | | |
| <u>Test description</u> 1. Force the DUT to send the following request and the SERVER SIMULATOR to return a negative respond for: <ul style="list-style-type: none"> - SelectActiveSG - GetSGCBValues | | |
| <u>Comment</u> | | |

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 DataSet 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 IdName |

| 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 <i>PIXIT Rp1</i> | | |
| <u>Expected result</u> 1. DUT correctly requests GetLogicalNodeDirectory(URCB) | | |
| <u>Test description</u> 1. Force the DUT to perform a GetLogicalNodeDirectory(URCB) | | |
| <u>Comment</u> | | |

| cRp2 | GetURCBValues and SetURCBValues | Passed |
|--|---------------------------------|--------|
| IEC 61850-7-2 clause 17.2.5.4 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp2</i> | | |
| <u>Expected result</u> 4. The DUT sends a correct request 5. The DUT changes the trigger options, optional fields and integrity period and enables the reporting | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> The DUT performs GetURCBValues request to read: RptEna, DataSet 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 | | |
| <u>Expected result</u> 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. | | |
| <u>Test description</u> 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" | | |
| <u>Comment</u> | | |

| | | |
|--|--|---------------|
| 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 | | |
| <u>Expected result</u> 4. DUT is able to process the reports send by the server. | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> | | |

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

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

| | | |
|---|--|---------------|
| 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 <i>PIXIT Rp16</i> | | |
| <u>Expected result</u> 1. DUT successfully performs a general interrogation request | | |
| <u>Test description</u> 1. Force the DUT to perform a general interrogation request on an URCB | | |
| <u>Comment</u> 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 <i>PIXIT Rp17</i> | | |
| <u>Expected result</u> 1. The DUT only may write to the "Dyn" URCB fields in the SCL. | | |
| <u>Test description</u> 1. Force DUT to enable multiple URCBs that are configured in the SCL for the DUT | | |
| <u>Comment</u> | | |

| cRp9 | Reports with complex structured data | Passed |
|--|---|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp8</i> | | |
| <u>Expected result</u> 1. DUT successfully configures and enables the report control block 2. DUT processes the report as normal 3. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cRp10 | Reports with basic data | Passed |
|--|--------------------------------|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp8</i> | | |
| <u>Expected result</u> 1. DUT successfully configures and enables the report control block 2. The DUT processes the report as normal 3. | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> According to the DUT implementation when "t" attribute is not reported and changes are detected in the signal value or quality, the timestamp is updated with TimeOfEntry. | | |

| cRp11 | URCB, RptID and DataSet with maximum name length | Passed |
|---|--|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 | | |
| <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 an URCB which has: <ul style="list-style-type: none"> • Maximum possible LD, LN and URCB name length • Maximum possible LD, LN and DataSet name length • Maximum RptID length • Maximum available DataSet ObjectReference length • Maximum available DataRef length 2. Force the SERVER SIMULATOR to send a report for the URCB. | | |
| <u>Comment</u> 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_PrefixMMXU01\$MX\$A1234 5678901\$phsA\$cVal\$mag\$f DUT does not support: ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01\$MX\$AvPPV Phs0102\$mag 010203045\$01020304056 | | |

| cRp12 | DataSet update | Passed |
|--|----------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp13</i> | | |
| <u>Expected result</u> 1. DUT creates the DataSet and updates the DataSet object reference 5. DUT deletes the old DataSet and creates the new DataSet 6. DUT creates the DataSet and updates the DataSet object reference 8. DUT processes the report as normal | | |
| <u>Test description</u> If the DUT supports dynamic DataSets: <ol style="list-style-type: none"> 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. | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cRp14 | Non Indexed URCB usage | Passed |
|--|------------------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT Rp3 | | |
| <u>Expected result</u> 3. DUT enables the non-indexed URCB 4. DUT processes the report as normal | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> 2. DUT enables the URCB 3. DUT processes the report and supported CDC as normal | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp7</i> | | |
| <u>Expected result</u> 3. DUT does use the URCBs assigned to DUT and does not use the URCBs assigned to another client(s) | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cRp18 | URCB in logical device with IdName | Passed |
|--|---|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 | | |
| <u>Expected result</u> 1. DUT enables the URCB 2. DUT processes the report as normal | | |
| <u>Test description</u> 1. Start the DUT and force it to enable an URCB in a logical device with IdName 2. Force the SERVER SIMULATOR to send a report | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp18</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cRpN2 | SetURCBValues Response- | Passed |
|--|-------------------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp19</i> | | |
| <u>Expected result</u> 3. The DUT processes the SetURCBValues response- as specified in the PIXIT | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp12</i> | | |
| <u>Expected result</u> 4. The DUT behaves as described in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp13</i> | | |
| <u>Expected result</u> 3. The DUT behaves as described in the PIXIT. 4. The DUT behaves as described in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

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 DataSet 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 IdName |
| 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 <i>PIXIT Rp1</i> | | |
| <u>Expected result</u> 1. DUT correctly requests GetLogicalNodeDirectory(BRCB) | | |
| <u>Test description</u> 1. Force the DUT to perform a GetLogicalNodeDirectory(BRCB) | | |
| <u>Comment</u> | | |

| cBr2 | SetBRCBValues and SetBRCBValues | Passed |
|--|---------------------------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp2</i> | | |
| <u>Expected result</u> 4. The DUT sends a correct request 5. The DUT changes the trigger options, optional fields and integrity period and enables the reporting | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> The DUT performs GetBRCBValues request to read: RptEna, DataSet, 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 <i>PIXIT Rp5</i> | | |
| <u>Expected result</u> 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. | | |
| <u>Test description</u> 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" | | |
| <u>Comment</u> | | |

| | | |
|---|--|---------------|
| 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 <i>PIXIT Rp4</i> | | |
| <u>Expected result</u> 4. DUT is able to process the reports sent by the server. | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> | | |

| cBr5 | DUT can process segmented buffered reports | Passed |
|--|---|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp6</i> | | |
| <u>Expected result</u> 1. DUT can process the reported value change(s) | | |
| <u>Test description</u> 1. Force to send a GI and the SERVER SIMULATOR to send a segmented report with new values | | |
| <u>Comment</u> | | |

| cBr6 | Change buffer time | Passed |
|--|---------------------------|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT 14</i> | | |
| <u>Expected result</u> 1. DUT successfully sends the SetBRCBValues request. | | |
| <u>Test description</u> 1. Force the DUT to perform a SetBRCBValues request to change the bufTm of a BRCB | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp16</i> | | |
| <u>Expected result</u> 1. DUT successfully performs a general interrogation request | | |
| <u>Test description</u> 1. Force the DUT to perform a general interrogation request on a BRCB | | |
| <u>Comment</u> 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 <i>PIXIT Rp17</i> | | |
| <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 <i>PIXIT Rp8</i> | | |
| <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 | <input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive |
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp8</i> | | |
| <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> According to the DUT implementation when "t" attribute is not reported and changes are detected in the signal value or quality, the timestamp is updated with TimeOfEntry. | | |

| cBr11 | BRCB, RptID and DataSet with maximum name length | Passed |
|---|--|--------|
| IEC 61850-7-2 clause 17.2, 22.2 IEC 61850-8-1 clause 17.1, 17.2 | | |
| <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 an BRCB which has: <ul style="list-style-type: none"> - Maximum possible LD, LN and brcb name length - Maximum possible LD, LN and DataSet name length - Maximum RptID length - Maximum possible DataSet ObjectReference length - Maximum possible DataRef length 2. Force the SERVER SIMULATOR to send a report for the BRCB. | | |
| <u>Comment</u> 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) 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\$A1234 5678901\$phsA\$cVal\$mag\$f DUT does not support: ED2_REF_IEDMAXLD_Padding_Padding_Padding_Padding_Padding_Padding/MAX_PrefixMMXU01\$MX\$AvPPV 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 <i>PIXIT Rp13</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> If the DUT supports dynamic DataSets: <ol style="list-style-type: none"> 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. | | |
| <u>Comment</u> | | |

| cBr13 | Indexed BRCB usage | Passed |
|--|--------------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT Rp3, Rp9 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> The recommended respond is specified in the "Reporting guideline for Client systems", TISSUE #1276 | | |

| cBr14 | Non Indexed BRCB usage | Passed |
|--|------------------------|--------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT Rp3 | | |
| <u>Expected result</u> 3. DUT enables the non-indexed BRCB 4. DUT processes the report as normal | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> 2. DUT enables the BRCB 3. DUT processes the report and supported CDC as normal | | |
| <u>Test description</u> 1. Configure the SERVER SIMULATOR with a DataSet containing supported CDC classes as well as CDCs which may not be supported: <ul style="list-style-type: none"> - 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp7</i> | | |
| <u>Expected result</u> 3. DUT does use the BRCBs assigned to DUT and does not use the BRCBs assigned to another client(s) | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> Note: The assignment is based on the RptEnable ClientLN. The DUT can use its own IP-address and the IP-address in the SCD to determine which RCB are assigned. | | |

| cBr18 | BRCB in logical device with IdName | Passed |
|---|---|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 | | |
| <u>Expected result</u> 1. DUT enables the BRCB 2. DUT processes the report as normal | | |
| <u>Test description</u> 1. Start the DUT and force it to enable a BRCB in a logical device with IdName 2. Force the SERVER SIMULATOR to send a report | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 | | |
| <u>Expected result</u> 6. The DUT sends a correct SetBRCBValues request with the last received EntryID 7. The DUT is able to process the buffered reports | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cBr32 | Purge buffered reports | Passed |
|--|-------------------------------|---------------|
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp21</i> | | |
| <u>Expected result</u> 6. The DUT requests purge buffer | | |
| <u>Test description</u> 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) | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp22</i> | | |
| <u>Expected result</u> 3. The DUT sends a write request for the ResvTms attribute before enabling the BRCB | | |
| <u>Test description</u> 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. | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp18</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp19</i> | | |
| <u>Expected result</u> 3. The DUT processes the SetBRCBValues response- as specified in the PIXIT | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Rp12</i> | | |
| <u>Expected result</u> 4. The DUT behaves as described in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| | | |
|---|--|---|
| cBrN6 | DUT is able to detect a change in ConfRev | <input type="checkbox"/> Passed <input type="checkbox"/> Failed <input type="checkbox"/> Inconclusive |
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp13</i> | | |
| <u>Expected result</u> 3. The DUT behaves as described in the PIXIT. | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| | | |
|--|--------------------------|---------------|
| cBrN20 | Set EntryID fails | Passed |
| IEC 61850-7-2 clause 17.2 IEC 61850-8-1 clause 17.1, 17.2 <i>PIXIT Rp11</i> | | |
| <u>Expected result</u> 5. The DUT behaves as specified in PIXIT | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

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: <ul style="list-style-type: none"> 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 <i>PIXIT Ctl1, Ctl4</i> | | |
| <u>Expected result</u> DO normal/enhanced security: <ul style="list-style-type: none"> - The DUT sends the Operate request with Test flag = true SBO normal security: <ul style="list-style-type: none"> - The DUT sends the Operate requests with Test flag = true SBO enhanced security: <ul style="list-style-type: none"> - The DUT sends the SelectWithValue and Operate requests both with Test flag = true | | |
| <u>Test description</u> DO normal/enhanced security: <ul style="list-style-type: none"> - Force the DUT to perform an Operate request with the Test flag set SBO normal security: <ul style="list-style-type: none"> - Force the DUT to perform a Select request followed by an Operate request with the Test flag set SBO enhanced security: <ul style="list-style-type: none"> - Force the DUT to perform a SelectWithValue request followed by an Operate request, both with the Test flag set | | |
| <u>Comment</u> | | |

| cCtl2 | Synchro and/or interlock check | Passed |
|---|--------------------------------|--------|
| IEC 61850-7-2 clause 20.5.2.7 IEC 61850-8-1 clause 20 <i>PIXIT Ctl1, Ctl5</i> | | |
| <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> | | |

| cCtl4 | Verify control number and originator | Passed |
|--|--------------------------------------|--------|
| IEC 61850-7-2 clause 20.2, 20.3 IEC 61850-8-1 clause 20 <i>PIXIT Ctl6, Ctl7</i> | | |
| <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 | | |
| <u>Expected result</u> 3. The DUT behaves as specified in the PIXIT | | |
| <u>Test description</u> 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 SBOs, repeat for DOes, SBOes and status-only b DUT expects SBOs; SERVER SIMULATOR is DOns, repeat for DOes, SBOes and status-only c DUT expects DOes; SERVER SIMULATOR is SBOs, repeat for SBOs, SBOes and status-only d DUT expects SBOes; SERVER SIMULATOR is DOns, repeat for SBOs, 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 | | |
| <u>Comment</u> | | |

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 <i>PIXIT Ct18, Ct19</i> | | |
| <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> | | |

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 <i>PIXIT Ct13</i> | | |
| <u>Expected result</u> 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 | | |
| <u>Test description</u> 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- | | |
| <u>Comment</u> | | |

| 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 <i>PIXIT Ct18, Ct19</i> | | |
| <u>Expected result</u> 1. The DUT processes the Operate response- as specified in the PIXIT | | |
| <u>Test description</u> 1. Force the DUT to perform an Operate and the SERVER SIMULATOR to send Operate response- with LastApplicationError | | |
| <u>Comment</u> | | |

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 Ct19 | | |
| <u>Expected result</u> 1. DUT indicates SelectWithValue failure and shall not send an Operate request | | |
| <u>Test description</u> 1. Force the DUT to perform a SelectWithValue request and force the SERVER SIMULATOR to send a SelectWithValue response- with LastApplicationError | | |
| <u>Comment</u> | | |

| 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 | | |
| <u>Expected result</u> | | |
| <ol style="list-style-type: none"> 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 | | |
| <u>Test description</u> | | |
| <ol style="list-style-type: none"> 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- | | |
| <u>Comment</u> | | |

| 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 Ct19 | | |
| <u>Expected result</u> | | |
| <ol style="list-style-type: none"> 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. | | |
| <u>Test description</u> | | |
| <ol style="list-style-type: none"> 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 | | |
| <u>Comment</u> | | |

| cSBOes4 | Cancel | Passed |
|---|---------------|---------------|
| IEC 61850-7-2 clause 20.3.3, 20.5.3.4 IEC 61850-8-1 clause 20.7, 20.9 | | |
| <u>Expected result</u> | | |
| <ol style="list-style-type: none"> 1. The DUT performs a correct SelectWithValue request 2. The DUT performs a correct Cancel request | | |
| <u>Test description</u> | | |
| <ol style="list-style-type: none"> 1. Force the DUT to perform a SelectWithValue request 2. Force the DUT to perform a Cancel request | | |
| <u>Comment</u> | | |

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 <i>PIXIT Tm1</i> | | |
| <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 <i>PIXIT Tm1</i> | | |
| <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, <i>PIXIT Tm1, Tm5</i> | | |
| <u>Expected result</u> 1. DUT uses the correct timestamp 3. DUT uses the timestamp with "ClockNotSynchronized" 5. DUT uses the correct timestamp | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> 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 <i>PIXIT Ft3</i> | | |
| <u>Expected result</u> 1. The DUT sends the GetServerDirectory(FILE) request without a file name specification or with wildcard and processes the GetServerDirectory response | | |
| <u>Test description</u> 1. Force the DUT to perform a GetServerDirectory(FILE) request | | |
| <u>Comment</u> GetServerDirectory(FILE) and GetFileAttributeValues are mapped on the same MMS service | | |

| cFt3 | GetFile | Passed |
|--|----------------|---------------|
| IEC 61850-7-2 clause 23.2.1 IEC 61850-8-1 clause 23.2.1 <i>PIXIT Ft6, Ft8</i> | | |
| <u>Expected result</u> 1. The DUT processes the file 2. The DUT processes the file 3. The DUT processes the file | | |
| <u>Test description</u> 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 | | |
| <u>Comment</u> | | |

| cFtN1 | GetFile response- | Passed |
|---|-------------------|--------|
| IEC 61850-7-2 clause 23.2.1 IEC 61850-8-1 clause 23.2.1 PIXIT Ft9 | | |
| <u>Expected result</u> 1. The DUT processes the GetFile response- | | |
| <u>Test description</u> 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) | | |
| <u>Comment</u> | | |



ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.