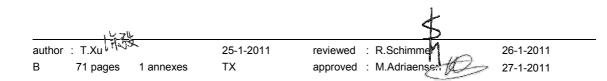![KEMA logo]

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Conformance Test Report for Client System with
IEC 61850-8-1 interface IPCOMM ipConv Gateway
IEC61850 Client Protocol Stack

Arnhem, January 25, 2011

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By order of IPCOMM,Germany

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| B 71 pages 1 annexes TX | | approved : M.Adriaensen | 27-1-2011 |

CONTENTS

1   INTRODUCTION

1.1   Identifications

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

SUT	IPCOMM ipConv Gateway IEC61850 Client Protocol Stack PS_IEC61850CLIENT_1 21.01.2011
MANUFACTURER	IPCOMM GmbH, Grundstrasse 15, 91056 ERLANGEN GERMANY
PICS	Conformance Test Procedures for Client System with IEC 61850-8-1 interface, version 1.1
MICS	Conformance Test Procedures for Client System with IEC 61850-8-1 interface, version 1.1
TICS	Conformance Test Procedures for Client System with IEC 61850-8-1 interface, version 1.1
PIXIT	Conformance Test Procedures for Client System with IEC 61850-8-1 interface, version 1.1
SCD	KEMA.SCD
TEST INITIATOR	*MANUFACTURER*
TEST FACILITY	KEMA Protocol Competence & Test Center
TEST ENGINEER	Tao Xu; Tao.Xu@kema.com
TEST SESSION	January 2011; Arnhem, the Netherlands
SERVER SIMULATOR	UniCA Multi IED simulator v1.21.0.5
ANALYSER	UniCA 61850 analyzer v4.21.03
HMI	Included in the SUT
TIME SERVER	Meinberg SNTP server

1.2 Background

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

"Does the protocol implementation of the SUT, conform to the IEC 61850 standard and the PICS, MICS, TICS, PIXITdocuments as configured with SCD?"

To answer this question, *TEST FACILITY* has performed a **conformance test** of the IEC 61850 implementation in the *SUT*. This test has been performed according procedures and conditions set forth in IEC 61850 part 10 and UCA IUG Quality Assurance Program. *TEST FACILITY* is accredited/recognized by the UCA IUG to perform formal IEC 61850 conformance tests and issue the Level A/B 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 *SUT*.

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

The test results are the basis of the conformance statement.

1.4 Contents of this document

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

Chapter 3 describes the various relevant components for the conformance test and their configuration as used in the conformance test, including the SUT. 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.

1.5 Glossary

SUT	System 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
UCA IUG	UCA International Users Group

2 REFERENCES

2.1 Normative

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

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

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

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

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

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

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

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

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

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

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

IEC 61850-8-1, *Communication networks and systems in substations – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO/IEC 9506-1 and ISO/IEC 9506-2) and to ISO/IEC 8802-3; First edition 2004-05*

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

2.2   **Other**

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

UCA IUG: Quality Assurance Program for IEC Device Implementation Testing and Test System Accreditation and Recognition, Version 2.6, March 8, 2007

UCA IUG: Quality Assurance Program Addendum for IEC 61850 Specific Product Testing, Version 1.0, March 8, 2007

UCA IUG: Test Center Accreditation and Recognition Procedure
For IEC 61850 Device Testing, V1.1, August, 2006

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

Test Procedures Change List (TPCL) for IEC 61850 client test procedures revision 1.1 Version 1.0 (when available)

3   THE CONFORMANCE TEST

3.1   Components in the test environment

The test environment consists of the following components:

- SUT
- SERVER SIMULATOR 1..N
- ANALYSER
- Ethernet HUB
- TIME SERVER

```
┌─────────────────────────────┐
│  HMI (integrated in SUT or   │
│       protocol simulator)    │
└─────────────────────────────┘
              │
┌─────────────────────────────┐    ┌──────────────────┐
│  Client System Under Test    │    │   TIME SERVER    │
│          (SUT)               │    │                  │
└─────────────────────────────┘    └──────────────────┘
              │                              │
┌────────────────────────────────────────────────────┐
│                    Ethernet Hub                     │
└────────────────────────────────────────────────────┘
        │                 │                 │
┌───────────────┐ ┌───────────────┐ ┌───────────────┐
│    SERVER     │ │    SERVER     │ │   ANALYZER    │
│  SIMULATOR 1  │ │  SIMULATOR N  │ │               │
└───────────────┘ └───────────────┘ └───────────────┘
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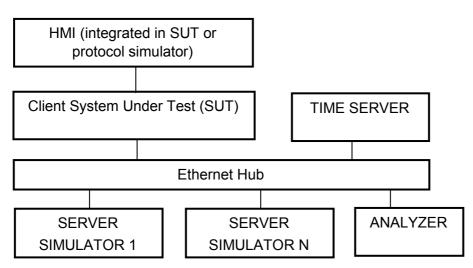
Figure 3.1 The test environment

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

The server [simulator] requirements are:
- Modeling:
  o contain all common data classes supported by the SUT
  o contain several new data objects within a standard logical node
  o contain several new data attributes within a standard data object (common data class)
  o contain several new enum types and enum values
- Configuration:
  o one or more servers with preconfigured datasets with data objects
  o one or more servers with dynamic datasets (when supported by SUT)
  o one or more servers with report control block indexing
  o one or more servers without report control block indexing
- Communication:
  o support all conformance blocks supported by the SUT in one or more servers
  o support all ASCI services supported by the SUT
  o one or more servers with all supported control models

3.2 Overview of the test suite

The abstract test cases and detailed test procedures are structured as follows:
- Documentation and version control (IEC 61850-4)
- Configuration file (IEC 61850-6)
- Data model (IEC 61850-7-3 and IEC 61850-7-4)
- Mapping of ACSI models and services (IEC 61850-7-2 and IEC 61850-8-1)
  o Application Association
  o Server & Logical Device & Logical Node & Data
  o Data Set
  o Substitution
  o Setting Group Control
  o Unbuffered and Buffered Reporting
  o Logging
  o Generic Substation Events
  o Control
  o Time Synchronization
  o File Transfer

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 in this Chapter describes the summary 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 with test result passed and the **Conditional** column indicates the conditional test cases with test result passed. For details refer to the applicable test procedure in annex A.

When all mandatory testcases within a conformance block are Passed or Inconclusive the SUT has passed the test for that conformance block.

Table 4.1   Summary of passed test cases for *SUT*

	Conformance Block	Mandatory	Conditional
1:	Basic Exchange	cAss1, cAss2, cAss3, cAss4, cAssN1, cAssN4, cAssN5, cAssN6	cAssN7 cSrvN5, cSrvN6
5:	Unbuffered Reporting	cRp2, cRp3, cRp4, cRp5, cRp8, cRp9, cRp10, cRpN2, cRpN3, cRpN7, cRpN8	cRp6, cRp7, cRpN1, cRpN4
6:	Buffered Reporting	cBr2, cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	cBrN1 cBr6, cBr7, cBrN4
12a:	Direct control	cCtl4, cCtlN1 cDOns1, cDOns2	
12b:	SBO control	cCtl4, cCtlN1 cSBOns1, cSBOns2, cSBOns3	cSBOns4
12c:	Enhanced Direct Control	cCtl4, cCtlN1 cDOes1, cDOes2	
12d:	Enhanced SBO control	cCtl4, cCtlN1, cSBOes1, cSBOes2, cSBOes3	cSBOes4
13:	Time sync	cTm1	cTm2, cTmN1

5 CONCLUSION AND RECOMMENDATIONS

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

Based on the test results described in this report, *TEST FACILITY* declares the tested IEC 61850 implementation in the *SUT* 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 *SUT*:

- None.

ANNEX A   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 SUT do match (IEC61850-4)	PASSED
cDoc2	Check if the major/minor software version manufacturer PIXIT documentation and software version of the SUT does match (IEC61850-4). PIXIT shall indicate the required information as requested in the test cases in this document	PASSED
cDoc3	Check if the major/minor software version in manufacturer TICS documentation and software version of the SUT does match (IEC65180-4). TICS shall indicate if the SUT supports servers that implemented or not implemented the TISSUE	PASSED
cDoc4	Check if the major/minor software version manufacturer MICS documentation and software version of the SUT does match (IEC61850-4). MICS shall indicate which CDC's and/or CDC parts are supported by the SUT, for example arrays	PASSED

A2   Configuration file (IEC 61850-6)

Id	Test procedure	Verdict
cCnf1	Check if the SUT process the data names, data types as configured in the SCL configuration file.	PASSED
cCnf2	Change at least 5 end-user configurable parameters that are displayed by the SUT in the SCL configuration file, configure the SUT using the SCL configuration file (using the supplied configuration tool) and check the updated configuration. Restore the original SCL file and re-configure the SUT to its original state.	PASSED

cCnf3	Verify that client can handle the ConfigRev management in SCL and exposed by the server in LLN0.NamPlt.configRev as described in the PIXIT. On a mismatch the SUT shall behave as described In the PIXIT (note that, if the PIXIT describes that the SUT does not check such a mismatch, no action is required by the SUT)	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 and expands objects like SDOs correctly (PIXIT)	PASSED
cMdl2	Verify that SUT 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 blocks d) setting group control block e) GOOSE control block f) Log control block	PASSED
cMdl3	Verify that SUT can read and process the mandatory & optional attributes from the CDCs in part 7-3 unless stated otherwise in the MICS	PASSED

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 GetDataValues	GetAllDataValues SetDataValues GetServerDirectory GetLogicalDeviceDirectory GetLogicalNodeDirectory (DATA) GetDataDirectory GetDataDefinition
2: Data Set	GetLogicalNodeDirectory (DATA-SET) GetDataSetDirectory	GetDataSetValues SetDataSetValues
2+: Data Set Definition	CreateDataSet DeleteDataSet	
3: Substitution	SetDataValues	GetLogicalNodeDirectory (SGCB)
4: Setting Group Selection	SelectActiveSG GetSGCBValues	
4+: Setting Group Definition	SelectEditSG, GetSGValues SetSGValues ConfirmEditSGValues	
5: Unbuffered Reporting	**Receive** Report GetURCBValues SetURCBValues	GetLogicalNodeDirectory (URCB)
6: Buffered Reporting	**Receive** Report GetBRCBValues SetBRCBValues	GetLogicalNodeDirectory (BRCB)
7: Logging	GetLCBValues GetLogicalNodeDirectory (LOG) QueryLogByTime or QueryLogAfter GetLogStatusValues	GetLogicalNodeDirectory (LCB) SetLCBValues
12a: Direct control	Operate	TimeActivatedOperate
12b: SBO control	Select, Operate	Cancel, TimeActivatedOperate

Conformance Block	Mandatory	Conditional
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) GetFileAttributeValues GetFile	SetFile DeleteFile

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, cSrv5, cSrvN3	Automatic startup: cAssN7 GetXxxDirectory[1]: cSrv1, cSrv2, cSrv3, cSrv4, cSrvN1 SetDataValues: cSrv6, cSrvN4 GetAllDataValues: cSrv7, cSrvN2 Quality: cSrvN5 TimeQuality: cSrvN6
2: Data Sets	cDs1, cDs2, cDs5, cDsN1	GetDataSetValues: cDs3, cDsN2 SetDataSetValues: cDs4, cDsN3
2+: Data Set Definition	cDs6, cDsN4	DeleteDataSet: cDs7, cDsN5
3: Substitution	cSub1	cSub2, cSub3
4: Setting Group Selection	cSg2, cSgN1	GetLogicalNodeDirectory(SGCB): cSg1 GetSettingGroupValues: Sg3
4+: Setting Group Definition	cSg3, cSg4	
5: Unbuffered Reporting	cRp2, cRp3, cRp4, cRp5, cRp8, cRp9, cRp10 cRpN2, cRpN3, cRpN7, cRpN8	GetLogicalNodeDirectory(URCB): cRp1, cRpN1 Buffer time: cRp6 General interrogation: cRp7 Reserved: cRpN4 Unsupported optflds: cRpN5 Unsupported trigger: cRpN6

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[1] GetXxxDirectory = GetServerDirectory, GetLogicalDeviceDirectory, GetLogicalNodeDirectory(DATA), GetDataDirectory and GetDataDefinition

Conformance Block	Mandatory	Conditional
6: Buffered Reporting	cBr2, cBr3, cBr4, cBr5, cBr8, cBr9, cBr10, cBr11, cBr12, cBrN2, cBrN3, cBrN7, cBrN8, cBrN9	GetLogicalNodeDirectory(BRCB): cBr1, cBrN1 Buffer time: cBr6 General interrogation: cBr7 Purge buffer: cBr13 Reserved: cBrN4 Unsupported optflds: cBrN5 Unsupported trigger: cBrN6
12a: Direct control	cCtl4, cCtlN1, cDOns1, cDOns2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3
12b: SBO control	cCtl4, cCtlN1, cSBOns1, cSBOns2, cSBOns3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOns4
12c: Enhanced Direct Control	cCtl4, cCtlN1, cDOes1, cDOes2	Test: cCtl1 Check: cCtl2 Change control model: cCtl3
12d: Enhanced SBO control	cCtl4, cCtlN1,cSBOes1, cSBOes2, cSBOes3	Test: cCtl1 Check: cCtl2 Change control model: cCtl3 Cancel: cSBOes4
13: Time sync	cTm1	Optional: cTm2 TimeQuality: cTmN2 ClockNotsynchronized: cTmN1
14: File transfer	cFt1, cFt2, cFt3, cFtN1, cFtN2	SetFile: cFt4, cFtN3 DeleteFile: cFt5

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

Note2: Time activated control and logging test procedures are not available yet

Note3: cCtlN2 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 procedure.

A4.1   Block 1: Basic services

Abstract test cases for Application Association

Test case	Test case description
cAss1	Associate and force client to release a TPAA (IEC 61850-7-2 7.4, 8-1 10.2)
cAss2	Force the client to associate with maximum number of servers simultaneously (PIXIT).
cAss3	Verify that losing and restoring the TPAA between SUT and server has no effect on existing TPAA between SUT and other servers.
cAss4	Verify the client can handle servers with small (4k) and large (64k) MMS PDU size, the client should keep on proposing it's 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 AccessPoint mismatch.
cAssN2	Associate and server responds with negative response due to AuthenticationParameter mismatch.
cAssN3	Associate and server releases TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN4	Associate and server-abort TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN5	Associate and server denies TPAA (IEC 61850-7-2 7.4). SUT should try to re-establish the association after the configured period (PIXIT).
cAssN6	Disconnect the communication interface, the SUT should detect link lost within a specified period.
cAssN7	Interrupt and restore the power supply, the SUT shall automatically establish the configured associations when ready (PIXIT).

Detailed test procedures for Application Association

cAss1	Associate and force client to release a TPAA (IEC 61850-7-2, 7.4)	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
<u>Expected result</u> 1. SUT accepts Associate.response+ from server 2. SUT 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 SUT to release or abort TPAA 3. Repeat step 1 and 2, 10 times		
<u>Comment</u> 		

cAss2	Associate to maximum servers	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
<u>Expected result</u> 1. SUT accepts Associate.response+ from all servers 2. SUT returns to "state" where it is able to start new TPAAs with the same servers		
<u>Test description</u> 1. Set-up a TPAA with the maximum number of servers as specified in the PIXIT 2. Force SUT to release or abort all open TPAAs 3. Repeat step 1 and 2, 10 times		
<u>Comment</u> Tested with 50 servers		

cAss3	Restore lost association	PASSED

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

Expected result

1. SUT accepts Associate.response+ from all servers
2. SUT detects connection loss and tries to reconnect to the server. All other TPAAs shall remain active.
3. SUT successfully restores the connection to the server
4. SUT receives and accepts the Release.response+ from all servers or receives and accepts the abort response+ from all servers

Test description

1. Set-up a TPAA with at least two servers
2. Force a TPAA disconnect for one server
3. Restore the situation where the disconnected server is able to accept a new TPAA
4. Force SUT to release or abort all TPAAs

Comment

cAss4	Verify that the client can handle servers with small and large MMS PDU size	PASSED

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

Expected result

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

Test description

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

Comment

Tested with 2 servers

cAssN1	Access point mismatch	PASSED
IEC 61850-8-1 clause 10.2, 25 and table 111 PIXIT		
Expected result 2. The TPAA fails 4. The TPAA fails 6. The TPAA fails		
Test description 1. Set-up the SUT and one server to have a mismatching Transport Selector 2. Set-up a TPAA between the SUT and the server 3. Set-up the SUT and one server to have a mismatching Presentation Selector 4. Set-up a TPAA between the SUT and the server 5. Set-up the SUT and one server to have a mismatching Session Selector 6. Set-up a TPAA between the SUT and the server		
Comment		

cAssN4	Server abort	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 1. SUT accepts Associate.response+ from server 2. SUT receives and responds correctly to the abort request from the server		
Test description 1. Set-up a TPAA with one server 2. Force server to abort TPAA 3. Repeat step 1 and 2, 10 times		
Comment		

cAssN5	Server deny	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result		
2. SUT detects the Association failure and responds as specified in the PIXIT.		
Test description		
1. Set-up test configuration with at least two servers 2. Force the SUT to perform an Associate request for all servers which is denied (response-) by one server caused by a mismatching session or presentation selector 3. Repeat step 1 and 2, 10 times		
Comment		

cAssN6	Detection of lost link	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result		
3. SUT shall detect the lost link and shall try to reconnect to the server 4. SUT shall set-up a TPAA with the server		
Test description		
1. Connect the SUT and one server to a hub 2. Set-up a TPAA with the server 3. Disconnect the physical link, between the hub and the server, some seconds longer than the timeout specified in the PIXIT 4. Reconnect the Ethernet cable		
Comment		

cAssN7	Power supply interrupt	PASSED
IEC 61850-7-2 clause 7.4 IEC 61850-8-1 clause 10.2 PIXIT		
Expected result 3. SUT behaves as specified in the PIXIT.		
Test description 1. Set-up a TPAA between SUT and all servers as configured in SCL 2. Interrupt the power supply to SUT 3. Restore the power supply to SUT		
Comment		

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

Test case	Test case description
cSrv1	Check the SUT is able to request a GetServerDirectory(LOGICAL-DEVICE) for all the logical devices of the configured servers (See Note 2).
cSrv2	For each GetServerDirectory(LOGICAL-DEVICE) response check the client issues a GetLogicalDeviceDirectory request.
cSrv3	Force SUT to send a GetLogicalNodeDirectory(DATA) request for each responded Logical Node from cSrv2.
cSrv4	Force SUT to send the following requests for a subset of the GetLogicalNodeDirectory(DATA): a) GetDataDirectory request and check response (IEC 61850-7-2, 10.4.4) b) GetDataDefinition request and check response (IEC 61850-7-2, 10.4.5)
cSrv5	Verify that after start-up the client 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.
cSrv7	Request GetAllDataValues for the required functional constraints and check if the SUT updates its model (IEC 61850-7-2, 9.2.3)

NOTE 1   Configured servers means the servers the client is configured to communicated with. The client at least needs to know the parameters to establish an association with them.

Test case	Test case description
cSrvN1	Check that the SUT 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 SUT 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 SUT is able to communicate with other connected servers after a request for GetDataValues fails in the following circuimstances: 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 SUT is able to communicate with other connected servers after a request for SetDataValues fails in the following circumstances: a) The response is negative. b) One of the data values is read-only

Test case	Test case description
cSrvN5	If SUT detects/notify changes in the "Quality" attribute, force a server to change the values in the Quality of the measured/status values monitored by the SUT and check the behaviour described in the PIXIT.
cSrvN6	If SUT 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 SUT and check the behaviour described in the PIXIT.

NOTE 2   "Client reports an error" can be anything to notify the end-user some error has happened

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

cSrvN5	Quality values	PASSED
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1 PIXIT		
Expected result 1. SUT processes the quality as specified in the PIXIT.		
Test description 1. Change the value of attribute q of a data object of one server to: - Validity: Invalid - Validity: Questionable – Failure = true - Validity: Questionable – OldData = true - Source = Substituted (by another client) - Test = true - OperatorBlocked = true		
Comment		

cSrvN6	Time Quality values	PASSED
IEC 61850-7-2 clause 10.4.2 IEC 61850-8-1 clause 13.2.1 PIXIT		
Expected result 1-3. SUT processes the time quality as specified in the PIXIT.		
Test description 1. Force server to respond with data object with time quality "clock failure" 2. Force server to respond with data object with time quality "clock not synchronised" 3. Force server to respond with data object with time quality "leap seconds known"		
Comment		

A4.2 Block 5: Unbuffered Reporting

Test case	Test case description
cRp1	Force the SUT to perform a GetLogicalNodeDirectory(URCB) request for the logical nodes declared in the PIXIT.
cRp2	SetURCBValues for RptID and DatSet.Check that the SUT overwrites mismatching RptID and DatSet values in URCBs.
cRp3	Verify the client is able to process the reports with different optional fields.
cRp4	Verify the client is able to process unbuffered reports with the following supported trigger conditions: a) on integrity b) on update (dupd) c) on update with integrity (dupd+integrity) d) on data change (dchg) e) on data and quality change (dchg+qch) f) On data and quality change with integrity period (dchg+qchg)
cRp5	Verify the client is able to process segmented reports
cRp6	Verify client can change the (pre-)configured Buffer Time (IEC 61850-7-2 clause 14.2.2.9)
cRp7	Verify client can force a General interrogation
cRp8	Verify that the SUT configures and enables the URCB's as specified in the SCD file. The SUT is only allowed to write to the "dyn" URCB fields in the SCL.
cRp9	Verify that the SUT can process reports with complex structured data (for example WYE and DEL data objects)
cRp10	Verify that the SUT can handle reports with basic data (for example stVal and quality)

Test case	Test case description
cRpN1	Check that the SUT still communicates with other servers when it performs a GetLogicalNodeDirectory(URCB) request which returns a negative response.
cRpN2	Check that the SUT still works properly when it performs a GetURCBValues request which returns a negative response.
cRpN3	Check that the SUT still works properly when it performs a SetURCBValues request which returns a negative response.
cRpN4	Check that the SUT still works properly when it performs a SetURCBValues request while the URCB is reserved by another client (Resv=TRUE, PIXIT)
cRpN5	Check that the SUT keeps functioning normally if it receives a report that contains OptFlds that the SUT does not support.
cRpN6	Check that the SUT keeps functioning normally if it receives a report that contains Trigger options that the SUT does not support.
cRpN7	Check that the SUT behaves as described in the PIXIT when a URCB in the server has a different configuration then expected.
cRpN8	Verify that the SUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 14.2.2.7) of the Report Control Block. When the SUT does not perform the ConfRev check it should check the dataset members. The means of detection need to be specified in the PIXIT.

Detailed test procedures for Unbuffered Reporting

cRp2	SetURCBValues for RptID and DatSet	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT configures the new values.		
Test description 1. Stop SUT 2. Configure the "RptID" and the "DatSet" fields for a report control block in the SUT SCL file for one server to be different from the values in the server. 3. Configure RptID and DatSet in the ReportSettings for the server to be "Dyn" 4. Start SUT and force SUT to perform a SetURCBValues request for the mismatching RptID and DatSet		
Comment - RptID field tested		

cRp3	SUT is able to process unbuffered reports with different optional fields	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT sets the configured optional fields before enabling the URCB. 4. The SUT is able to process the report.		
Test description 1. Stop SUT 2. Configure the minimum optional fields supported by the SUT for a report control block in the SUT SCL file for one server. 3. Start SUT and force SUT to enable a URCB 4. Generate a report for the configured URCB 5. Repeat step 1 to 4, this time configuring the maximum optional fields supported by the SUT in step 2		
Comment		

cRp4	SUT is able to process unbuffered reports with different trigger conditions	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 4. SUT is able to process the reports sent by the server.		

<u>Test description</u>
 1. Stop SUT
 2. Configure the following (combination of) trigger conditions supported by the SUT for a URCB in the SUT SCL file for one server:
    a) integrity
    b) data update (dupd)
    c) data update and integrity (dupd+integrity)
    d) data change (dchg)
    e) data change and quality change (dchg+qchg)
    f) data change, quality change and integrity (dchg+qchg+integrity)
 3. Start SUT and force SUT to enable the report URCB.
 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> - dchg, qchg, integrity reports were tested.		

cRp5	SUT can process segmented unbuffered reports	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 1. SUT can process the reported valuechange(s)		
<u>Test description</u> 1. Force a server to send a segmented, unbuffered report with a data- and/or quality-change		
<u>Comment</u>		

cRp6	Change buffer time	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 1. SUT successfully sends the SetURCBValues request.		
<u>Test description</u> 1. Force the SUT to perform a SetURCBValues request to change the BufTm of a URCB		
<u>Comment</u>		

cRp7	Verify client can force a General interrogation on an unbuffered report control block	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result		
1. SUT successfully performs a general interrogation request		
Test description		
1. Force the SUT to perform a general interrogation request on a URCB		
Comment		

cRp8	Enable all URCBs specified in SCL	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result		
1. The SUT configures all URCBs as specified in the SUT SCL		
Test description		
1. Force SUT to enable all URCBs that are configured in the SUT SCL		
Comment		

cRp9	Verify that the SUT can process URCB reports with complex structured data	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. SUT processes the report as normal		
Test description 1. Force SUT to Configure and enable an unbuffered report control block which contains complex structured data (e.g. WYE or DEL). 2. Force the server to send a report for the unbuffered report control block		
Comment		

cRp10	Verify that the SUT can process URCB reports with basic data	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable an unbuffered report control block which contains basic (unstructured) data (e.g. stVal or q) 2. Force the server to send a report for the unbuffered report control block.		
Comment		

cRpN1	Renamed URCB	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as specified in the PIXIT		
Test description 1. Stop a server 2. Reconfigure a URCB in the server SCL with a new valid name 3. Start server and force the SUT to perform a GetLogicalNodeDirectory(URCB) request for the LD that contains the URCB		
Comment		

cRpN2	GetURCBValues.response-	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. SUT is able to communicate to other servers and behaves like stated in PIXIT for the server with the deleted URCB.		
Test description 1. Stop a server 2. Remove a URCB in the server SCL 3. Start server and force the SUT to perform a GetURCBValues request for the non existing URCB		
Comment		

cRpN3	SetURCBValues.response-	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT processes the SetURCBValues.response- as specified in the PIXIT		
Test description 1. Stop a server 2. Change the server configuration so that one or more of the following URCB elements which where previously writable become read-only: DatSet, RptID, OptFlds, BufTm, TrgOps, IntgPd 3. Start server and force the SUT to perform a SetURCBValues request for one or more of the read-only URCB elements		
Comment		

cRpN4	Report block is already reserved	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT processes the SetURCBValues.response- as specified in the PIXIT		
Test description 1. Use another client to reserve a URCB prior to SUT and force SUT to perform a SetURCBValues request on the reserved URCB		
Comment		

cRpN7	SUT is able to handle report control blocks with a mismatching configuration	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT behaves as described in the PIXIT.		

Test description
 1. Stop a server
 2. Configure a URCB in the server SCL file in the following way:
    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 SCL file in the following way:
      - change the order of dataset members, without changing the order of the datatypes
      - change the order of dataset members, hereby changing the order of the datatypes
      - 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 containing the URCB) to conf.
 4. Start the server and force the SUT to enable the URCB		

Comment		

cRpN8	SUT is able to detect a change in ConfRev	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 3. The SUT behaves as described in the PIXIT.		
<u>Test description</u> 1. Stop a server 2. Increment the value for confRev of a URCB in the server SCL and remove a member from the referenced dataset 3. Start the server and force SUT to enable the URCB 4. Repeat step 1 to 3, this time without changing the referenced dataset in step 2		
<u>Comment</u>		

A4.3 Block 6: Buffered Reporting

Test case	Test case description
cBr1	Force the SUT to perform a GetLogicalNodeDirectory(BRCB) request for the logical nodes declared in the PIXIT.
cBr2	SetBRCBValues for RptID and DatSet. Check that the SUT overwrites mismatching RptID and DatSet values in all BRCBs..
cBr3	Verify the client is able to process the reports with different optional fields.
cBr4	Verify the client is able to process buffered reports with the following supported trigger conditions: a) on integrity b) on update (dupd) c) on update with integrity (dupd+integrity) d) on data change (dchg) e) on data and quality change (dchg+qch) f) On data and quality change with integrity period (dchg+qchg)
cBr5	Verify the client is able to process segmented reports
cBr6	Verify client can change the (pre-)configured Buffer Time (IEC 61850-7-2 clause 14.2.2.9)
cBr7	Verify client can force a General interrogation
cBr8	Verify that the SUT configures and enables the BRCBs as configured in the SCD file. The SUT is only allowed to write to the "dyn" BRCB fields in the SCL.
cBr9	Verify that the SUT can handle reporting of complex structured data (for example WYE and DEL data objects)
cBr10	Verify that the SUT can handle reporting of basic data (for example stVal and quality)
cBr11	Verify the SUT is able to process reports buffered during a lost association a) without bufferoverflow (PIXIT) b) with bufferoverflow
cBr12	Verify the SUT is able to request specific buffered reports after restoring a lost association by setting the EntryID
cBr13	Verify the SUT is able to purge buffered reports

Test case	Test case description
cBrN1	Check that the SUT still communicates with other servers when it performs a GetLogicalNodeDirectory (BRCB) request which returns a negative response.
cBrN2	Check that the SUT still works properly when it performs a GetBRCBValues request which returns a negative response.
cBrN3	Check that the SUT still works properly when it requests a SetBRCBValues and the response is negative.
cBrN4	Check that the SUT still works properly when it requests a SetBRCBValues and the BRCB is used by or pre-assigned to another client. (PIXIT)
cBrN5	Check that the SUT keeps functioning normally if it receives a Report which contains OptFlds that the SUT does not support.
cBrN6	Check that the SUT keeps functioning normally if it receives a Report which contains Trigger Options that the SUT does not support.
cBrN7	Mismatching reports: a) Report with a mismatching DataSet. b) Report with a mismatching RptID c) Report with mismatching references of the Data (when data references are enabled). Check the behaviour described in the PIXIT.
cBrN8	Verify that the SUT detects a change in the ConfRev attribute (Configuration revision, IEC 61850-7-2, 14.2.2.7) of the Report Control Block. When the SUT does not perform the ConfRev check it should check the dataset members. The means of detection needs to be specified in the PIXIT.
cBrN9	Verify the SUT can handle a severe buffer overflow with SetBRBValues(EntryID) response-

Detailed test procedures for Buffered Reporting

cBr2	SetBRCBValues for RptID and DatSet	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT configures the new values.		
Test description 1. Stop SUT 2. Configure the "RptID" and the "DatSet" fields for a report control block in the SUT SCL file for one server to be different from the values in the server. 3. Configure RptID and DatSet in the ReportSettings for the server to be "Dyn" 4. Start SUT and force SUT to perform a SetBRCBValues request for the mismatching RptID and DatSet		
Comment - RptID field tested		

cBr3	SUT is able to process buffered reports with different optional fields	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 3. The SUT sets the configured optional fields before enabling the BRCB. 4. The SUT is able to process the report.		
Test description 1. Stop SUT 2. Configure the minimum optional fields supported by the SUT for a report control block in the SUT SCL file for one server. 3. Start SUT and force SUT to enable a BRCB 4. Generate a report for the configured BRCB 5. Repeat step 1 to 4, this time configuring the maximum optional fields supported by the SUT in step 2		
Comment		

cBr4	SUT is able to process buffered reports with different trigger conditions	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 4. SUT is able to process the reports sent by the server.		

<u>Test description</u>
1. Stop SUT
2. Configure the following (combination of) trigger conditions supported by the SUT for a BRCB in the SUT SCL file for one server:
   a) integrity
   b) data update (dupd)
   c) data update and integrity (dupd+integrity)
   d) data change (dchg)
   e) data change and quality change (dchg+qchg)
   f) data change, quality change and integrity (dchg+qchg+integrity)
3. Start SUT and force SUT to enable the report BRCB.
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> - dchg, qchg, integrity reports were tested.		

cBr5	SUT can process segmented buffered reports	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT can process the reported valuechange(s)		
Test description 1. Force a server to send a segmented, buffered report with a data- and/or quality-change		
Comment		

cBr6	Change buffer time	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully sends the SetBRCBValues request.		
Test description 1. Force the SUT to perform a SetBRCBValues request to change the bufTm of a BRCB		
Comment		

cBr7	Verify client can force a General interrogation on a buffered report control	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully performs a general interrogation request		
Test description 1. Force the SUT to perform a general interrogation request on a BRCB		
Comment		

cBr8	Enable all BRCBs specified in SCL	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT configures all BRCBs as specified in the server SCL		
Test description 1. Force SUT to enable all BRCBs that are configured in the server SCL		
Comment		

cBr9	Verify that the SUT can process BRCB reports with complex structured data	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable a buffered report control block which contains complex structured data. (e.g. WYE or DEL) 2. Force the server to send a report for the buffered report control block		
Comment		

cBr10	Verify that the SUT can process BRCB reports with basic data	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. SUT successfully configures and enables the report control block 2. The SUT processes the report as normal		
Test description 1. Force the SUT to Configure and enable a buffered report control block which contains basic (unstructured) data (e.g. stVal or q) 2. Force the server to send a report for the buffered report control block		
Comment		

cBr11	Process buffered reports with and without buffer overflow	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 5. The SUT handles the buffered reports 8. The SUT handles the buffered reports as specified in PIXIT		
Test description 1. Configure and enable a BRCB with trigger conditions data change and all supported optional fields. 2. Force data changes in a server to force reports 3. Disconnect the Ethernet cable between the server and switch 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 7. Force many data changes in the server to force buffer overflow 8. Restore the Ethernet connection		
Comment		

cBr12	Set EntryId of buffered reports	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
<u>Expected result</u> 5. The SUT 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 4. Force data/quality changes in the server to force buffered reports 5. Restore the Ethernet connection 6. Force SUT to send a correct SetBRCBValues request for the EntryID that was last received by the SUT		
<u>Comment</u>		

cBrN1	Renamed BRCB	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT behaves as specified in the PIXIT		
Test description 1. Stop a server 2. Reconfigure a BRCB in the server SCL with a new valid name 3. Start server and force the SUT to perform a GetLogicalNodeDirectory(BRCB) request for the LD which contains the BRCB		
Comment		

cBrN2	GetBRCBValues.response-	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. SUT is able to communicate to other servers and behaves like stated in PIXIT for the server with the deleted BRCB.		
Test description 1. Stop a server 2. Remove a BRCB in the server SCL 3. Start server and force the SUT to perform a GetBRCBValues request for the non existing BRCB		
Comment		

cBrN3	SetBRCBValues.response-	PASSED
IEC 61850-7-2 clause 9.2.2, 14.2 IEC 61850-8-1 clause 12.3.1, 17.1, 17.2 PIXIT		
Expected result 3. The SUT processes the SetBRCBValues.response- as specified in the PIXIT		
Test description 1. Stop a server 2. Change the server configuration so that one or more of the following BRCB elements which where previously writable become read-only: DatSet, RptID, OptFlds, BufTm, TrgOps, IntgPd 3. Start server and force the SUT to perform a SetBRCBValues request for one or more of the read-only BRCB elements		
Comment		

cBrN4	Report block is already reserved	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 1. The SUT behaves as specified in the PIXIT		
Test description 1. Use another client to enable a BRCB prior to SUT and force SUT to perform a SetBRCBValues request on the BRCB		
Comment		

…

cBrN7	SUT is able to handle report control blocks with a mismatching configuration	PASSED
IEC 61850-7-2 clause 14.2 IEC 61850-8-1 clause 17.1, 17.2 PIXIT		
Expected result 4. The SUT behaves as described in the PIXIT.		

Test description
1. Stop a server
2. Configure a BRCB in the server SCL file in the following way:
    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 SCL file in the following way:
        - change the order of dataset members, without changing the order of the datatypes
        - change the order of dataset members, hereby changing the order of the datatypes
        - 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 containing the BRCB) to conf.
4. Start the server and force the SUT to enable the BRCB		

Comment		

cBrN8	SUT is able to detect a change in ConfRev	PASSED

IEC 61850-7-2 clause 14.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT

Expected result

3. The SUT behaves as described in the PIXIT.

Test description

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

Comment

cBrN9	Set non-existing EntryID	PASSED

IEC 61850-7-2 clause 14.2
IEC 61850-8-1 clause 17.1, 17.2
PIXIT

Expected result

5. The SUT will behave as specified in PIXIT

Test description

1. Force data changes in a server to force reports
2. Disconnect the Ethernet cable between the Ethernet switch and the server
3. Force many data changes in a server to force a buffer overflow
1. Restore the Ethernet connection
2. Force SUT to perform a SetBRCBValues request with an EntryID from a discarded report

Comment

A4.4 Block 12: Control

Test case	Test case description
cCtl1	Check if the SUT is able to set the TEST field in the commands (PIXIT).
cCtl2	Check if the SUT is able to set the following (combination of) CHECK bits in the commands (PIXIT) for the supported control models: a) Synchro Check b) Interlock Check c) Synchro Check and Interlock Check
cCtl3	Check if the SUT is able to change control model using online services (PIXIT).
cCtl4	Verify the values of originator category, origin identification and the control number (PIXIT)

Test case	Test case description
cCtlN1	Check if the SUT reacts as described in the PIXIT when it detects a control model mismatch: a) Server status-only, SUT expects controllable b) Server SBO, SUT expects direct operate c) Server direct operate, SUT expects SBO d) Server SBO enhanced SUT expects SBO normal
cCtlN2	Check if the SUT 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

cCtl4	Verify control number and originator	PASSED
IEC 61850-7-2 clause 17.2, 17.3 IEC 61850-8-1 clause 20, Annex E PIXIT		
Expected result The SUT sets the control number and the originator as specified in PIXIT		
Test description Execute the applicable control model specific test cases		
Comment this is a continuous effort during the conformance test of the supported control models		

cCtlN1	Control model deviations	PASSED
IEC 61850-7-2 clause 17.2, 17.3 IEC 61850-8-1 clause 20, Annex E PIXIT		
<u>Expected result</u> 4. The SUT responds as specified in the PIXIT		

<u>Test description</u>
1. Stop a server
2. Reconfigure the server:
    a) Reconfigure one controllable object to status only
    b) Reconfigure one SBO object to direct operate
    c) Reconfigure one direct object to SBO
    d) Reconfigure SBO enhanced security control object to SBO normal security
3. Start server
4. Force the SUT to perform a Select/Operate request for the reconfigured control object		

<u>Comment</u>		

A4.4a Block 12a: Direct Control

Test case	Test case description
cDOns1	OperReq[test ok] resp+ Perform a correct Operate request. Check that the SUT does not generate an error.
cDOns2	OperReq[test not ok] resp- Client requests Oper resulting in Test not ok. Check that the SUT realizes the operation failed.
cDOns3	TimOperReq[test not ok] resp- Client requests TimOper resulting in Test not ok. Check that the SUT realizes the time operation failed.
cDOns4	TimOperReq[test ok] + TimerExpired[test ok] resp+ Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Verify the WaitForActionTime results in a timer expired 'Test ok' and that the SUT realizes the operation succeeded.
cDOns5	TimOperReq[test ok] + TimerExpired[test not ok] resp- Send a TimeActivatedOperate request, thereby making sure the device will generate a 'test Ok'. Force situation that the WaitForActionTime results in a timer expired 'Test not ok'. Check that the SUT realizes the operation failed.

Detailed test procedures for Direct Control with normal security (DOns), excluding TimeActivatedOperate test cases.

cDOns1	Successful Operate	PASSED
IEC 61850-7-2 clause 17.2.1 IEC 61850-8-1 clause 20.7		
Expected result 1. The SUT processes the response		
Test description 1. Force the SUT to perform an Operate request on a DOns control object		
Comment		

cDOns2	Failed Operate	PASSED
IEC 61850-7-2 clause 17.2.1		
IEC 61850-8-1 clause 20.7		
<u>Expected result</u>		
1. The SUT processes the response- as specified in the PIXIT		
<u>Test description</u>		
1. Force the SUT to perform an Operate request on a DOns control object that results in a Operate.response- with a Last Application Error (Tissue #246)		
<u>Comment</u>		

A4.4b Block 12b: SBO Control

Test case	Test case description
cSBOns1	SelectReq[test not ok] resp-: Force the SUT to perform a Select request that results in Test not ok. Check that the SUT handles the Select.response- as specified in the PIXIT.
cSBOns2	SelectReq[test ok] resp+ and OperReq[test ok] resp+ of selected object Force the SUT to send a Select request for an SBOns object. Force the SUT to perform a correct Operate request. Check that the SUT sends correct Select and Operate requests.
cSBOns3	SelectReq[test ok] resp+ and OperReq[test not ok] resp- of selected object. Force the SUT to perform a correct Select request, followed by an Operate request that results in Test not ok. Check that the SUT is able to process the Operate.response-
cSBOns4	SelectReq[test ok] resp+ and CancelReq of selected object. Check that the SUT can send a correct Cancel request.
cSBOns5	SelectReq[test ok] resp+ and TimOperReq[test ok] resp+ of selected object Check that the SUT is able to send a correct TimeActivated Operate request and that the SUT is able to process the response.
cSBOns6	SelectReq[test ok] resp+ and TimOperReq[test not ok] resp- of selected object Check that the SUT can process a Operate.response-

Detailed test procedures for SBO Control with normal security (SBOns), excluding TimeActivatedOperate test cases.

cSBOns1	Failed Select	PASSED
IEC 61850-7-2 clause 17.2.2, 17.5.3.2 IEC 61850-8-1 clause 20.4 PIXIT		
Expected result 3. The SUT handles the Select.response- as described in the PIXIT		
Test description 1. Force the SUT to perform a correct Select request for which the server sends a response-		
Comment		

cSBOns2	Select and successful Operate	PASSED
IEC 61850-7-2 clause 17.2.2, 17.5.3.5 IEC 61850-8-1 clause 20.7		
Expected result 1. The SUT sends a correct Select request for the SBOns object 2. The SUT sends a correct Operate request on the selected SBOns object		
Test description 1. Force the SUT to perform a Select request on an SBOns object 2. Force the SUT to perform an Operate request on the selected SBOns object		
Comment		

cSBOns3	Select and failed Operate	PASSED
IEC 61850-7-2 clause 17.2.2, 17.5.3.5 IEC 61850-8-1 clause 20.7		
Expected result 5. SUT indicates Operate failure		
Test description 1. Force the SUT to send a correct Select request 2. Force the SUT to perform an Operate request that results in an Operate.response- with a Last Application error (Tissue #246)		
Comment		

cSBOns4	Cancel		PASSED
IEC 61850-7-2 clause 17.2.2, 17.5.3.4			
IEC 61850-8-1 clause 20.6			
Expected result			
1. The SUT sends a correct Select request			
2. The SUT sends a correct Cancel request			
Test description			
1. Force the SUT to perform a Select request for an SBOns object			
2. Force the SUT to perform a Cancel request on the selected object			
Comment			

A4.4c Block 12c: Direct Control with Enhanced Security

Test case	Test case description

cDOes1	OperReq[test ok] resp+:
	
	Force the SUT to send a correct Operate request that causes the server to send an Operate.response+ and:
	
	    a) a CommandTermination+.
	    b) a CommandTermination- (PIXIT)
	
	Check that the SUT processes the CommandTermination+ and the CommandTermination- as specified in the PIXIT

cDOes2	OperReq[test not ok] resp-: Check that the SUT behaves as specified in the PIXIT when it receives an Operate.response-
cDOes3	TimOperReq[test not ok] resp-: Check that the SUT behaves as described in the PIXIT when it receives a Operate.response-

cDOes4	TimOperReq[test ok] resp+:
	
	Force the SUT to send a correct TimeActivated Operate request that causes the server to send a Operate.response+ and:
	
	    a) a CommandTermination+
	    b) a CommandTermination-
	
	Check that the SUT can process the CommandTermination+ and the CommandTermination-

Detailed test procedures for Direct Control with enhanced security (DOes), excluding TimeActivatedOperate test cases.

cDOes1	Successful Operate with command termination	PASSED
IEC 61850-7-2 clause 17.3.2, 17.5.3.5 IEC 61850-8-1 clause 20.7 and 20.8 PIXIT		
Expected result		
1. Check that the SUT processes the Command termination as specified in the PIXIT		
Test description		

1. Force the SUT to send a correct Operate request that causes the server to send an Operate.response+ and:
   a) a CommandTermination+
   b) a CommandTermination-		

Comment		

cDOes2	Operate failure	PASSED
IEC 61850-7-2 clause 17.3.2, 17.5.3.5 IEC 61850-8-1 clause 20.7 and 20.8 PIXIT		
Expected result		
1. The SUT processes the Operate.response- as specified in the PIXIT		
Test description		
1. Force the SUT to perform an Operate that results in an Operate.response-		
Comment		

A4.4d Block 12d: Enhanced SBO Control

Test case	Test case description
cSBOes1	SelectWithValue [test not ok] resp-: Force the SUT to perform a SelectWithValue request that results in a test not ok.
cSBOes2	SelectWithValue [test ok] resp+ and OperReq[test ok] resp+ of selected object Force the SUT to send a correct SelectWithValue request, followed by a correct Operate request.
cSBOes3	SelectWithValue [test ok] resp+ and OperReq[test not ok] resp- of selected object. Force the SUT to send a correct SelectWithValue request, followed by an Operate request that results in test not ok. Check that the SUT behaves as described in the PIXIT when it recieves the Operate.response-
cSBOes4	SelectWithValue [test ok] resp+ and CancelReq of selected object. Force the SUT to send a correct SelectWithValue request, followed by a correct Cancel request.
cSBOes5	SelectWithValue [test ok] resp+ and TimOperReq[test ok] resp+ of selected object Force the SUT to perform a correct SelectWithValue request, followed by a correct TimeActivedOperare request. Check that the SUT processes the response as specified in the PIXIT.
cSBOes6	SelectWithValue [test ok] resp+ and TimOperReq[test ok] resp- of selected object Force the SUT to perform a correct SelectWithValue request, followed by a TimeActivedOperate request that results response-..

Detailed test procedures for SBO Control with enhanced security (SBOes), excluding TimeActivatedOperate test cases.

cSBOes1	SelectWithValue – test not ok	PASSED
IEC 61850-7-2 clause 17.3.3, 17.5.3.3 IEC 61850-8-1 clause 20.5, 20.8		
Expected result 2. SUT indicates SelectWithValue failure		
Test description 1. Force the SUT to perform a SelectWithValue request that results in a SelectWithValue.response-		
Comment SelectWithValue.response- was caused by using a second client to Select the control object before the SUT performed the SelectWithValue.request. SUT responds as described in PIXIT (an entry is made in the i61.log file).		

cSBOes2	SelectWithValue and successfull Operate	PASSED
IEC 61850-7-2 clause 17.3.3, 17.5.3.5		
IEC 61850-8-1 clause 20.5, 20.7, 20.8		
Expected result		
1. The SUT performs a correct SelectWithValue request		
2. The SUT performs a correct Operate request		
Test description		
1. Force the SUT to perform a SelectWithValue request for an SBOes object		
2. Force the SUT to perform an Operate request for the selected object		
Comment		

cSBOes3	SelectWithValue and failed Operate	PASSED
IEC 61850-7-2 clause 17.3.3, 17.5.3.5		
IEC 61850-8-1 clause 20.5, 20.7, 20.8		
Expected result		
1. The SUT performs a correct SelectWithValue request		
2. The SUT performs a correct Operate request		
Test description		
1. Force the SUT to perform a SelectWithValue request		
2. Force the SUT to perform an Operate request that results in an Operate.response-		
Comment		

cSBOes4	Cancel	PASSED
IEC 61850-7-2 clause 17.3.3, 17.5.3.4		
IEC 61850-8-1 clause 20.6, 20.8		
Expected result 1. The SUT performs a correct SelectWithValue request 2. The SUT performs a correct Cancel request		
Test description 1. Force the SUT to perform a SelectWithValue request 2. Force the SUT to perform a Cancel request		
Comment		

A4.5   Block 13: Time and time synchronization

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

cTmN1	Verify that a lost time synchronisation is detected after a specified period and the timestamp quality invalid is set
cTmN2	Verify the SUT handles the time stamp quality coming from the time server

Detailed test procedures for Time and time synchronization

cTm1	Time synchronisation	PASSED
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 3. The SUT uses the new timestamp		
Test description 1. SUT exposes the time and time quality as specified in the PIXIT 2. Test engineer changes the time of the time server and waits till SUT has received the new time synch message 3. SUT exposes the time and time quality as specified in the PIXIT		
Comment		

cTm2	Time accuracy	PASSED
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21 PIXIT		
Expected result 1. SUT timestamp accuracy matches with the documented accuracy 3. SUT uses the new timestamp		
Test description 1. SUT 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 SUT has received the new time synch message 3. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp		
Comment		

cTmN1	Time synchronisation lost	PASSED
IEC 61850-7-2 clause 18 and 5.5.3.7.3.3 IEC 61850-8-1 clause 21, PIXIT		
Expected result 1. SUT uses the correct timestamp 3. SUT uses the timestamp with "ClockNotsynchronized" 5. SUT uses the correct timestamp		
Test description 1. SUT 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 SUT to detect the time server is lost 3. SUT 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 SUT has received the time synch message 5. SUT displays the time and time quality (PIXIT) or requests a service including the timestamp		
Comment 		