

## IEC 61850 Server Conformance Test Conditions

This document describes the conditions for the IEC 61850 server conformance test. It describes:

- Reference documents for the test, Subjects of the test, Deliverables of the test
- Test approach and Completion of the test
- Quality assurance and Starting points for the test
- IED configuration requirements and Test configurations
- Mandatory technical issues
- Guidelines for GOOSE testing

### General Referenced Documents

Both Edition 1 and Edition 2 tests are based on the following documents:

- Conformance statements of the device under test: PICS, MICS and TICS
- Extra information for testing: PIXIT
- ICD file of the device under test
- PICS, MICS, PIXIT and TICS templates are available on request
- Mandatory green “IntOp” technical issues as specified in the TICS template from the UCAiug and ([www.tissues.iec61850.com](http://www.tissues.iec61850.com))

### Referenced Documents Edition 1 testing

In addition to the general referenced documents an Edition 1 conformance test is based on the following documents:

- IEC 61850 part 10 “Conformance testing” edition 1
- IEC 61850 part 6, 7-1, 7-2, 7-3, 7-4 and 8-1 edition 1 and SCL schema version 1.4
- UCAiug Conformance Test Procedures for Server Devices with IEC 61850-8-1 interface (revision 2.3)
- UCAiug test procedures approved test procedures change list for server revision 2.3 (TPCL) version 1.7

### Referenced Documents Edition 2 testing

In addition to the general referenced documents an Edition 2 conformance test is based on the following documents:

- IEC 61850 part 10 “Conformance testing” edition 2
- IEC 61850 part 6, 7-1, 7-2, 7-3, 7-4 and 8-1 edition 2 and SCL schema version 3.1
- UCAiug Conformance Test Procedures for Server Devices with IEC 61850-8-1 Edition 2 interface (revision 1.0)

## Test Subjects

The applicable subjects of the conformance test are:

- The PICS, MICS, TICS and PIXIT documents
- The data model as implemented in the device
- The SCL configuration file
- The ACSI services as implemented in the device for the following service models:
  - Association and Server / logical device / logical node model
  - Data set, Substitution, Reporting and Setting group model
  - Control, File transfer, GOOSE and Time synchronization model
  - Other ACSI services can be tested on request.

The conformance test excludes the IEC 61850-10 performance measurements. A GOOSE performance test to verify the performance class P1, P2 and P3 is available on request as an additional certification service.

## Deliverables

The deliverables of the conformance test are:

- Test plan and report; The test plan (and after test: report) describes the server conformance test; Also negative tests are part of the conformance test. Additional test cases can be added on request (and may result in additional work). The test report describes the results of the tests and forms the basis of the resulting Certificate
- Level A Certificate; If the conformance test ends with a positive result, DNV KEMA grants the UCA international user group Level A (independent third party) certificate. The certificate summarizes the conformance blocks that are validated and is the written statement that these blocks worked according to the standard. The certificate will be posted on the new UCA international users group website: go to [www.ucaiug.org/org/TechnicalO/Testing](http://www.ucaiug.org/org/TechnicalO/Testing) and click "UCAIug Testing Quality Assurance Program". If you don't have a login account you can create a free guest account at the home page of the user group

## Test Approach

Below test approach is optimized to save traveling and flexible scheduling. On request DNV KEMA can travel to the test initiator to perform the pre-test and/or conformance test (test phase 5 and 6).

When the purchase order is confirmed DNV KEMA and test initiator will discuss time slots for performing the pre-test and conformance test.

<u>Test phase</u>	<u>Activity</u>	<u>Indicative week</u>
0.	<b>Test initiator</b> provides draft device documentation and configuration files and confirms the testing timeslot(s)	-6
1.	DNV KEMA reviews document(s) and SCL file	-3
2.	<b>Test initiator</b> configures the IED for the test, set-up the test configuration and connect it to the Internet	-3
3.	DNV KEMA performs the pre-test on a location of choice; optionally a partial <u>remote</u> pre-test is executed over the Internet. After the pre-test DNV KEMA reports the test results to the <b>test initiator</b> .	-2
4.	<b>Test initiator</b> resolves the detected issues. Repeat step 3 and 4 till all applicable test cases are executed and all test issues are resolved	-1
5.	<b>Test initiator</b> prepares the final IED and provides the final device documentation (PICS, MICS, TICS, PIXIT) and configuration files (ICD and SCD/CID). In case of testing at DNV KEMA the final IED needs to be shipped.	-1
6.	DNV KEMA executes the conformance test	0
7.	DNV KEMA performs internal review of the test results and sends draft version of the certificate to <b>test initiator</b> for review	+2
8.	DNV KEMA provides reviewed Certificate to the UCAIUG users group for formal review, approval and posting on the UCAIUG users group website	+3
9.	DNV KEMA provides final Certificate and Test report and registers the device in DNV KEMA's "Conformance Test Register"	+6

## Completion of the Test

Phase 3 and 6 ends after either

- all applicable protocol elements and functions have been tested or
- one or more *blocking* errors occur that cannot be repaired during the test itself.

After detected errors have been repaired, an assessment of the necessary re-tests is performed in consultation with the parties concerned, after which the actual re-testing takes place. If ultimately the conformance test is positive, that is if it ends without defects, the Certificate is granted. In all cases DNV KEMA drafts a test report, which contains all the necessary test results.

## Quality Assurance

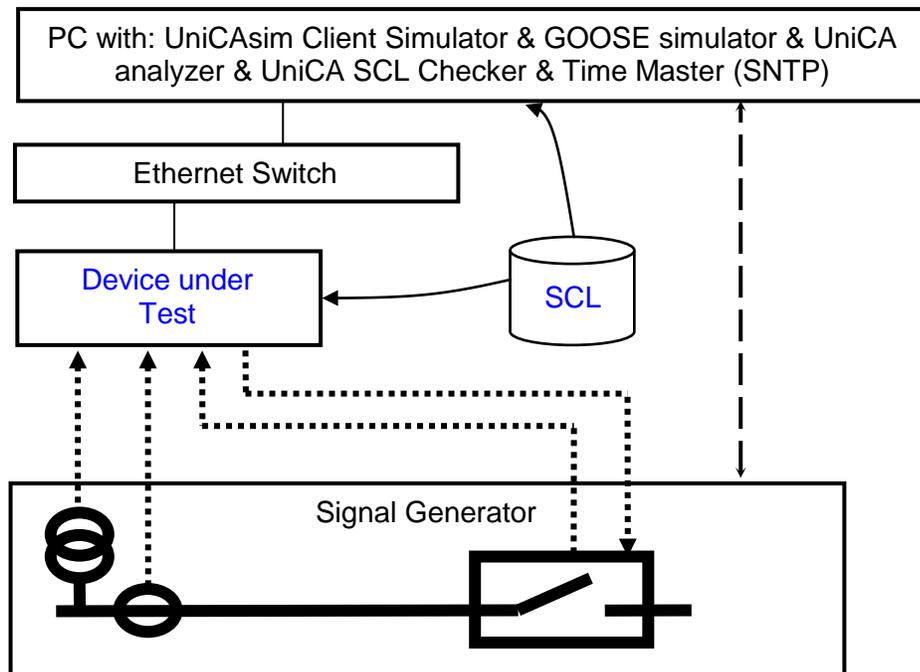
With respect to the above-described activities the quality assurance is done through:

- a regular (electronic) progress report from DNV KEMA in the periods where activities are performed and if this is required because of the project duration. Intermediate changes in planned activities and consequences thereof in terms of time, money and/or quality are reported and discussed beforehand with the principal and only carried out after written permission
- review of DNV KEMA document deliverables by customer. For this purpose the final draft of the document deliverable will be available for each party at least **one** week before the (formal) review date. Resulting comments from this review will be incorporated in the final version. This final version forms the basis of further activities.

## Starting Points for the Conformance Test

- the device under test is available and is configured as specified in the SCL file and the IED configuration sheet
- GOOSE ping-pong: The device under test is configured to accept a subscribed GOOSE message and reply the value in a published GOOSE (compare Guidelines for GOOSE testing)
- test initiator provides, configures and connects a signal generator that generates at least 2 binary signals for the device to force single point events to test reporting of buffered events AND two binary signals to test SBO double point control of a XCBR
- test initiator provides local/remote support in operating and configuring the Device under Test during the conformance test
- the conformance test focuses on the protocol elements and functions only; the test does not include the protection application logic and the operation of the tested device; the conformance test does not include the performance measurements
- the information necessary by DNV KEMA is timely available to prepare properly for the test.

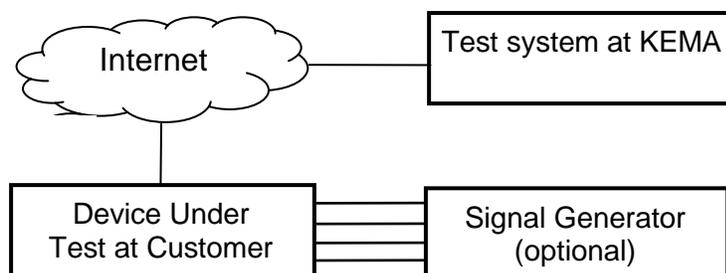
## Local Test Configuration



The signal generator is controlled by the UniCAsim Client Simulator to enable closed-loop testing. As such the numerous reporting test cases can be automated. In case the DUT has no physical binary inputs the test time will increase by about one day.

## Remote Test Configuration

To perform the remote part of the test we set-up the test configuration as follows.



### Required hardware and software

- Stable internet connection allowing incoming TCP connection request on port 102
- Device Under Test configured for the test and hard wired to signal Generator (optional) that generate events every few seconds

With the remote test configuration the DNV KEMA test engineer can only execute those test cases which do not require manual intervention from the test engineer. The following communication services cannot be tested over a remote connection:

- Buffered and unbuffered reporting of events
- Control commands with state changes
- GOOSE publish and subscribe
- Time synchronization

## Guidelines for Conformance Testing IEC 61850 GOOSE

Testing a GOOSE implementation in an IED is divided in two parts: subscriber and publisher tests. Each group consists of positive and negative testing. Some of these GOOSE tests trigger IED behavior that is not recorded by the UniCA analyzer, as it does not produce any network traffic. For example, a GOOSE-subscribing IED does not produce network traffic when a GOOSE-publishing simulator sends an incorrect GOOSE message. The IED will examine the GOOSE header and/or GOOSE data and will invalidate the message. This is correct behavior, but cannot be recorded in order to proof correct IEC 61850 implementation.

In order to test correct implementation and behavior of GOOSE the **GOOSE Ping-Pong** configuration described below is necessary when an IED is tested for IEC 61850 conformance.

### Test setup

The GOOSE simulator will publish GOOSE messages with at least three GOOSE Data elements. The first one is of type Boolean (BOOL\_P1), the second one is of type quality (QUAL\_P1) and the third one is also of type integer32 (INT32\_P1). INT32\_P1 is used in test where GOOSEData is re-ordered. To be able to record correct GOOSEs the IED shall publish a GOOSE message. Apart from a correct GOOSE header (DatSet, GoID, GoCBRef, etc.) the message shall have at least two GOOSE data. One shall be of type Boolean (BOOL\_P2) and one shall be of type quality (QUAL\_P2).

### Preferred IED Behavior

Two situations can be identified during conformance testing GOOSE:

- 1) When the IED validates the subscribed GOOSE message it shall (possibly invert and) copy the value of BOOL\_P1 to BOOL\_P2 of the GOOSE message published by the IED. In this case 'Validity' in QUAL\_S1 shall be set to 'Good' in the published message shall be zero (Quality = '00xxxxxxxxxx'). When the value of BOOL\_P1 differs from the current value of BOOL\_P2, the IED shall publish a new GOOSE message according to the implemented re-transmission scheme with incremented stNum.

- 2) When the IED invalidates the subscribed GOOSE message (E.g., NdsCom = true) or when the message is not received (E.g., missing/delayed GOOSE messages) or when the message is not recognized (E.g., the GoID is different) it shall set the 'Validity' in QUAL\_P2 to 'Invalid' (Quality = '01xxxxxxxxxx'). Because QUAL\_P2 changed the IED shall publish a new GOOSE message according to the implemented re-transmission scheme with incremented stNum.

Goose ping-pong schematic test setup

The figure below shows the schematic setup of the described GOOSE communication.

