Test procedures for GOOSE performance according to IEC 61850-5 and IEC 61850-10

Version 1.1

On request of UCA International Users Group

Baden, January 22, 2011

author : Richard Schimmel reviewed : UCAIUG testsub

B 28 pages 2 annexes RS approved : UCAIUG testsub

CONTENTS

1 INTRODUCTION

The scope of the test is to benchmark the GOOSE performance of the DUT against the performance classes as defined in IEC 61850-5. IEC 61850-5 clause 13 states:

13.7.1.1 Type 1A "Trip" : The trip is the most important fast message in the substation. Therefore, this message has more demanding requirements compared to all other fast messages. The same performance may be requested for interlocking, intertrips and logic discrimination between protection functions.

*a) For Performance Class P1, the total transmission time shall be in the order of half a cycle. Therefore, **10 ms** is defined.*

*b) For Performance Class P2/3, the total transmission time shall be below the order of a quarter of a cycle. Therefore, **3 ms** is defined.*

IEC 61850-5 defines the transmission time as follows

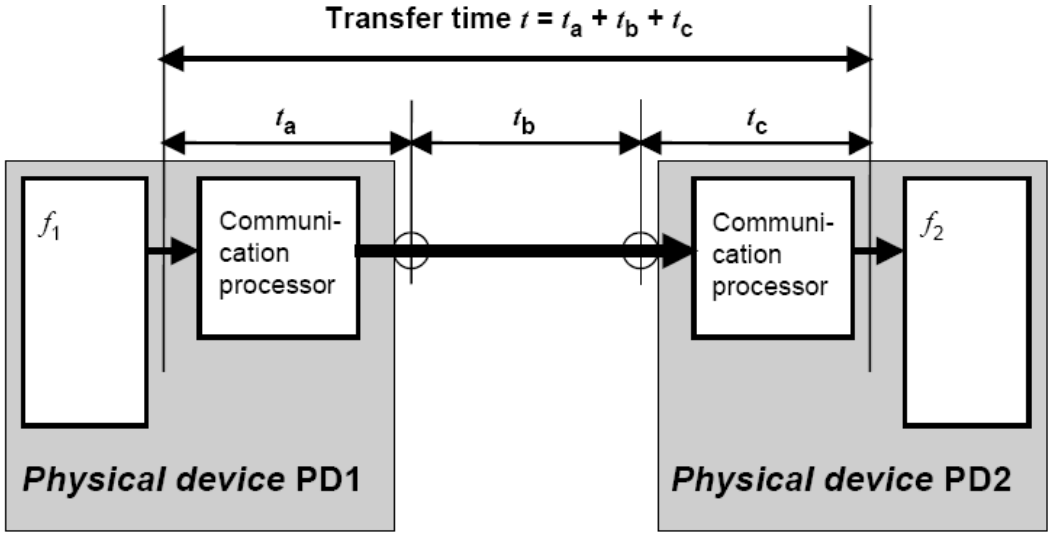

Figure 1: Transmission time definition IEC 61850-5

1.1 Test methodology

To measure the transmission time as defined in IEC 61850-5 is not possible without special access to the internal data of the device. To enable "black-box" testing a test lab needs a different test methodology referred to as the "GOOSE ping-pong" method. This method is already in use for GOOSE conformance testing.

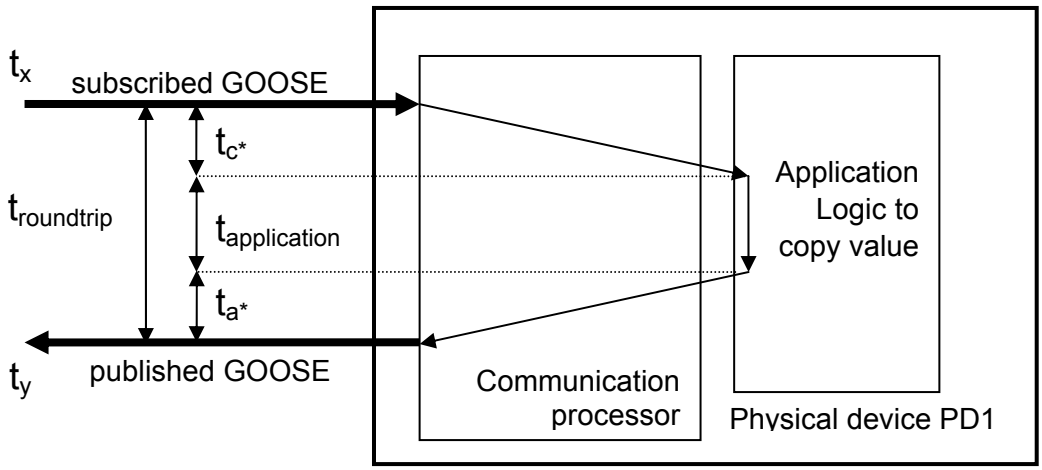

Figure 2: Measure round trip time using GOOSE ping-pong method

The GOOSE ping-pong method focuses on the round trip time as defined in figure 2. The round trip time is the time interval between the arrival of a subscribed GOOSE message and the departure of the published GOOSE message: $t_{roundtrip} = (t_y - t_x)$.

The relation between the transfer time and roundtrip time is as follows:

- $t_{transfer} = t_a + t_b + t_c$
- $t_{roundtrip} = (t_y - t_x) = t_{c*} + t_{application} + t_{a*}$

When PD1 and PD2 are the same we assume that the GOOSE publish and subscribe communication processing times are the same in figure 1 and 2. In that case we can combine these equations into:

- $t_{transfer} = t_{roundtrip} - t_{application} + t_b$

We assume the network delay for a single Ethernet switch to be minimal (< 0.1ms). Then we get

- $t_{transfer} = t_{roundtrip} - t_{application}$

t_a = GOOSE publish communication processing

t_b = network delay of one GOOSE message

t_c = GOOSE subscribe communication processing

$t_{application}$ = application time

The application time typically is the sum of the scan cycle wait time and the actual application logic processing time. On a scan cycle of for example 4 ms the average scan cycle wait time is about 2 ms (50% of scan cycle). The measured maximum – minimum roundtrip times will be close to the scan cycle. These metrics can be used to perform a plausibility check on the documented figures in the PIXIT document.

According to IEC 61850-10 a test system shall measure latency time by generating a sequence of physical/virtual input triggers to the IED and measuring the time delay to the corresponding message generated by the IED. The mean latency time and the standard deviation shall be computed across the responses to 1000 input triggers.

1.2 Test scope

The following items may have an impact on the GOOSE performance:

- Size of the published/subscribed GOOSE message (number of data set elements)
- Type of data set elements
- Which element of the data set is used
- Use of Functionally Constrained Data (FCD) or Functional Constrained Data Attributes (FCDA) in the dataset
- Number of subscribed GOOSE messages
- Time correlation of subscribed GOOSE messages state changes
- Number of non-subscribed GOOSE messages on the network
- Other communication tasks like MMS reporting, file transfer and/or Sampled Values when supported

This test procedure is intended as a benchmark for comparing relative performance of different IEDs. It defines standardized tests aimed at mimicking typical workload conditions. It does not test device performance under worst case load, worst case network conditions, or in a specific system application. Please refer to detailed vendor specifications for full description of the device capabilities, behaviour and limitations.

1.3 Glossary

BRCB	Buffered Report Control Block
DUT	Device Under Test
DP	Double Point Information
GoCB	GOOSE Control Block
GOOSE	Generic Object Oriented System Event
ICD	IED configuration description in SCL-format
IED	Intelligent Electronic Device
FCD	Functionally Constrainted Data
FCDA	Functionally Constrainted Data Attributes
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
MAC	Media Access Control
ms	milliseconds
SCD	Substation configuration description in SCL-format
SCL	Substation Configuration Language
UCAIUG	UCA International Users Group
URCB	Unbuffered Report Control Block
VLAN	Virtual Local Area Network

1.4 Identifications

The following table gives the exact identification of tested equipment and test environment used for this performance test.

DUT	<identification and short name of the device under test> <hardware and software version> Performance class: P1 or P2/P3
MANUFACTURER	<name, location of the manufacturer of the DUT>
PICS	<complete reference description of the PICS>
PIXIT	<complete reference description of the PIXIT>
ICD or SCD	<complete reference description of the SCL configuration file>
TEST INITIATOR	<name and address of test initiator>
TEST FACILITY	<name and address of test facility>
TEST ENGINEER	<name and e-mail address of test engineer>
TEST SESSION	<date and location of the test session>
ANALYSER	<name and type analyzer(s), version X.Y>
GOOSE SIMULATOR	<name and type GOOSE simulator>
CLIENT SIMULATOR	<name and type client simulator>
TIME MASTER	<name and type of time master>
ETHERNET SWITCH	<name and type of Ethernet switch>

The DUT shall be a regular production model. The only tuning that is allowed is ‘off-the-shelf’ configuration to minimize the application logic.

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**

IS 9646 – OSI – Conformance testing methodology and framework

UCA International User Group: Quality Assurance Program

UCA International User Group: Accreditation and Recognition Program for IEC 61850 Device Testing

http://www.tissues.iec61850.com

3 TEST ENVIRONMENT

The test environment consists of the following components:

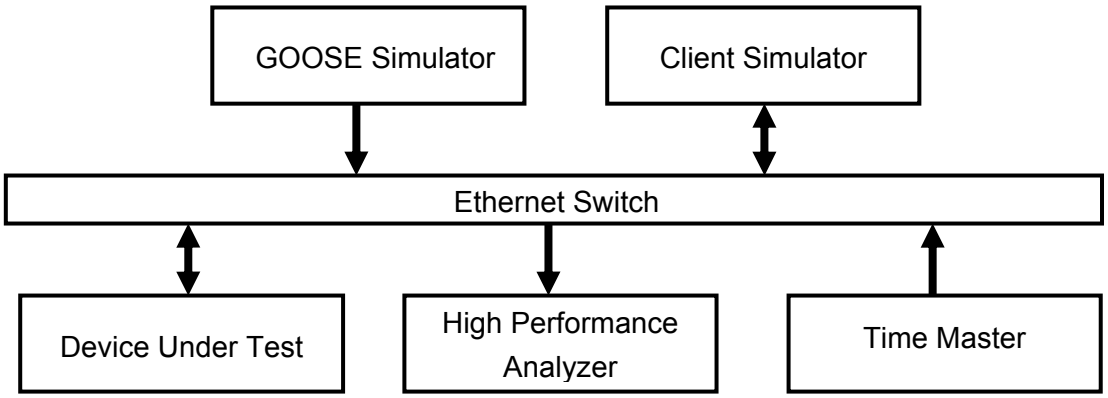

Figure 3: The test environment

The analyzer compares the published and the subscribed GOOSE messages from the DUT.

The client simulator simulator is used to simulate specific communication during the test.

The DUT shall not be reconfigured during the performance test. The test procedures are designed in such a way that the DUT doesn't need to be reconfigured during the performance test.

4 GOOSE PERFORMANCE TESTING

4.1 Message definitions

The general message requirements are:

- Each GOOSE has unique multicast destination MAC address
- Each GOOSE has VLAN priority = 4 and VLAN ID = 0
- Each GOOSE has APPID[1] = 0x3001
- Each GOOSE has Test = FALSE, NdsCom = FALSE
- The GOOSE datasets contain functionally constrained data attributes (FCDA)
- The BRCB or URCB datasets contain functionally constrained data (FCD)

4.1.1 Published GOOSE used for ping-pong

The DUT will publish the following GOOSE:

Dataset	normal dataset = 4 Boolean data values and 4 qualities Structure normal dataset: (bool1, q1, bool2, q2, bool3, q3, bool4, q4) large dataset[2] = 20 Double Point data values, 20 Boolean Data values and 40 qualities Structure large dataset: (bool1, q1, bool2, q2, …., bool20, q20, DP1, q1, DP2, q2, ….,DP20, q20)	
Transmission schema	4 state changes of the last data value element per second (about each 250 ms).	
GoCB name[3]	GPFPPpongNormal,	GPFPPpongLarge
Dataset name	GPFPPpongNormal	GPFPPpongLarge
Destination MAC	0x01 0C CD 01 00 01,	0x01 0C CD 01 00 02

[1] The APPID shall be the same for all GOOSE Messages during the Tests but the value it self can be different as defined above in case there are some limitation related to the DUT

[2] In case the DUT does not support 20 Boolean or 20 DP, or the DUT has some limitations regarding dataset size, the LARGE Dataset shall contain at least 40 values and 40 qualities or the maximum number of dataset entries that is possible according to the description in PIXIT.

[3] By using the names defined in the test procedures the analyzing of the capture files would be much easier, but the names have no impact to the performance. So alternative names are allowed

4.1.2 **Subscribed GOOSE used for ping-pong**

The DUT will subscribe to the following GOOSE:

Dataset	normal dataset = 4 Boolean data values and 4 qualities Structure normal dataset: (bool1, q1, bool2, q2, bool3, q3, bool4, q4) large dataset[4] = 20 Boolean values with qualities and 20 DP values with qualities. Structure large dataset: (bool1, q1, bool2, q2, …., bool20, q20, DP1, q1, DP2, q2, ….,DP20, q20)	
Transmission schema	4 state changes of the last data value element per second (about each 250 ms) uniform distributed over the scancycle Retransmission at 4 and 32 ms (or more)	
GoCB name[5]	GPFPPpingNormal,	GPFPPpingLarge
Dataset name	GPFPPpingNormal	GPFPPpingLarge
Destination MAC	0x01 0C CD 01 00 03	0x01 0C CD 01 00 04

[4] In case the DUT does not support 20 Boolean or 20 DP, or the DUT has some limitations regarding dataset size, the LARGE Dataset shall contain at least 40 values and 40 qualities or the maximum number of dataset entries that is possible according to the description in PIXIT.

[5] By using the names defined in the test procedures the analyzing of the capture files would be much easier, but the names have no impact to the performance. So alternative names are allowed.

4.1.3 **Time correlated Subscribed GOOSE not used for ping-pong**

The DUT will also subscribe to the following GOOSE:

	Dataset large dataset[6] = 20 Boolean values with qualities and 20 DP values with qualities. Structure of dataset: (bool1, q1, bool2, q2, …., bool20, q20, DP1, q1, DP2, q2, ….,DP20, q20)
Transmission schema	5 subscribed GOOSE control blocks Retransmission at 4, 32 and 256 ms (or more) 5 subscribed GOOSE each having one state change of the 5th data value element at approxamatly -4.0, -2.0, 0.0, 2.0 and 4.0 ms before and after the subscribed GOOSE state change used for ping-pong.
Gocb name[7]	GPFsubscribed1.. 5
Dataset name	GPFsubscribed1..5
Destination MAC	0x01 0C CD 01 00 05 to 0x01 0C CD 01 00 09

4.1.4 **Not subscribed GOOSE**

Dataset	large dataset[6] = 20 Boolean values with qualities and 20 DP values with qualities. Structure of dataset: (bool1, q1, bool2, q2, …., bool20, q20, DP1, q1, DP2, q2, ….,DP20, q20)
Transmission schema	100 GOOSE control blocks each with 1 state change per second (about every 10 ms) and 2 retransmissions per second (at 32 and 256 ms or more). The total number of these GOOSE messages will be at least 300 messages per second.
Gocb name[8]	GPFnotSubscribed001..100
Dataset name	GPFnotSubscribed001..100
Destination MAC	0x01 0C CD 01 11 01 to 0x01 0C CD 01 11 64

[6] In case the DUT does not support 20 Boolean or 20 DP, or the DUT has some limitations regarding dataset size, the LARGE Dataset shall contain at least 40 values and 40 qualities or the maximum number of dataset entries that is possible according to the description in PIXIT.

[7] By using the names defined in the test procedures the analyzing of the capture files would be much easier, but the names have no impact to the performance. So alternative names are allowed.

4.1.5 Other communication tasks

In case the DUT supports reporting one client shall be connected to the DUT during all test cases. The client enables two BRCBs or when buffered reporting is not supported two URCBs with same data values (as FCD) as the normal and large dataset in the published GOOSE. The report control blocks shall be configured to send reports on data change and quality change[8] with all supported optional fields.

4.2 Test cases

The following table gives an overview of the test cases.

Test ID	Subscribe (ping)	Publish (pong)	Time correlated Subscribed GOOSE not used for ping-pong	Not subscribed
Gpf1	Normal	Normal	No	No
Gpf2	LARGE	LARGE	No	No
Gpf3	Normal	Normal	YES	No
Gpf4	LARGE	LARGE	YES	No
Gpf5	Normal	Normal	No	YES
Gpf6	LARGE	LARGE	No	YES
Gpf7	Normal	Normal	YES	YES
Gpf8	LARGE	LARGE	YES	YES

Note: "No" means that the GOOSE simulator will not publish GOOSE message, because they are not relevant for this test case.

The DUT shall not be reconfigured during the tests.

GOOSE Simulator will not publishing the LARGE GCB during NORMAL tests (Gpf1,3,5,7) and not publishing NORMAL GCB during LARGE tests (Gpf2,4,6,8). DUT will publishing in all test cases LARGE and Normal GCB.

[8] In case trigger option “quality change” is not supported data change is sufficient.

4.3 Test passed criteria

For performance class P1 the transmission limit is defined as 10 ms and 3 ms for P2/P3. According to IEC 61850-10 clause 7.2.1 the performance results are the average and standard deviation over 1000 input triggers and that the sum of the measured output and input latency shall be less than or equal to 80 % of the total transmission (because 20% is reserved for network latency).

In clause 1.1 we determined: $t_{transfer} = t_{roundtrip} - t_{application.}$ The application time typically is the sum of the internal scan cycle wait time and the actual logic processing time. To represent the worst case transfer time we set the actual logic processing time to zero (this means that the logic processing time is considered as part of the transfer time). As a result we get:

- Average application time = 50% of scan cycle
- Maximum application time = 100% of scan cycle
- Minimum application time = 0% of scan cycle

Now the transfer time can be calculated as follows:

- Average: $t_{transfer.avg} = t_{roundtrip.avg} - t_{application.avg} = t_{roundtrip.avg} - scancycle/2$
- Maximum: $t_{transfer.max} = t_{roundtrip.max} - t_{application.max} = t_{roundtrip.max} - scancycle$
- Minimum: $t_{transfer.min} = t_{roundtrip.min} - t_{application.min} = t_{roundtrip.min}$

Note: it is possible that the calculated maximum transfer time is less than the calculated minimum transfer time.

Plausibility checks:

- Documented scan cycle ≥ Measured scan cycle = $t_{roundtrip.max} - t_{roundtrip.min}$
- Documented scan cycle ≥ Measured standard deviation * 3.46 (for uniform distribution[9])

In case the measured scan cycle is more than 1 ms below the documented scan cycle, the documented scan cycle shall be adjusted by the vendor.
The adjusted scan cycal time has to be taken for the final performance calculation
In case the DUT has an event driven method (no scan cycle) the scan cycle for the calculations is set to 0.0 ms.

To pass the performance test the criteria are:

- Gpf1 to Gpf6 test are passed when the calculated average, maximum and minimum transfer times are less than 80% of the applicable performance class limit (IEC 61850-10 clause 7.2.1 Note 1):
    - Performance class P1; $t_{transfer} < 8.0$ ms
    - Performance class P2/P3; $t_{transfer} < 2.4$ ms
- Gpf7 and Gpf8 test is passed when the average, maximum and minimum calculated transfer times are less than 100% of the performance class limit:
    - Performance class P1; $t_{transfer} < 10.0$ ms
    - Performance class P2/P3; $t_{transfer} < 3.0$ ms

The PIXIT document shall specify the GOOSE performance class and application logic scan cycle(s).

The DUT has passed the GOOSE performance test when all test cases are passed.

[9] http://en.wikipedia.org/wiki/Uniform_distribution_(continuous)

4.4 Test results

Documented scan cycle = x.y ms
Measured scan cycle = x.y ms
Performance class = P1 or P2/P3

Test ID	Minimum	Maximum		Average			Verdict
		Round-trip	Transfer	Round-trip	Transfer	Stddev	
Gpf1	x.y	x.y	x.y	x.y	x.y	x.yy	Passed
Gpf2	x.y	x.y	x.y	x.y	x.y	x.yy	Failed
Gpf3	x.y	x.y	x.y	x.y	x.y	x.yy	
Gpf4	x.y	x.y	x.y	x.y	x.y	x.yy	
Gpf5	x.y	x.y	x.y	x.y	x.y	x.yy	
Gpf6	x.y	x.y	x.y	x.y	x.y	x.yy	
Gpf7	x.y	x.y	x.y	x.y	x.y	x.yy	
Gpf8	x.y	x.y	x.y	x.y	x.y	x.yy	

4.5 Detailed test procedure

Gpf1	GOOSE performance tests Based on Normal Dataset	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf1 = with normal Subscribe (ping)		
Comment Gpf1 transfertime$_{max}$ =		

Gpf2	GOOSE performance tests Based on Large Dataset	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf2 = with large Subscribe (ping)		
Comment Gpf2 $transfertime_{max}$ =.. Any deviation to Large Dataset structure as defined? *In case the DUT does not support the Large dataset structure as defined, the configured dataset structure shall be documented here.*		

Gpf3	GOOSE performance tests Based on Normal Dataset and time correlated Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf3 = with normal Subscribe (ping) & time correlated Subscribed GOOSE not used for ping-pong		
Comment Gpf3 transfertime$_{max}$ =		

Gpf4	GOOSE performance tests Based on Large Dataset and time correlated Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf4 = with large Subscribe (ping) & time correlated Subscribed GOOSE not used for ping-pong		
Comment Gpf4 $transfertime_{max}$ = Any deviation to Large Dataset structure as defined? *In case the DUT does not support the Large dataset structure as defined, the configured dataset structure shall be documented here.*		

Gpf5	GOOSE performance tests Based on Normal Dataset and not Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf5 = with normal Subscribe (ping) & not subscribed GOOSE		
Comment Gpf5 transfertime$_{max}$ =		

Gpf6	GOOSE performance tests Based on Large Dataset and not Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf6 = with large Subscribe (ping) & not subscribed GOOSE		
Comment Gpf6 transfertime$_{max}$ = Any deviation to Large Dataset structure as defined? *In case the DUT does not support the Large dataset structure as defined, the configured dataset structure shall be documented here.*		

Gpf7	GOOSE performance tests Based on Normal Dataset , time correlated Subscribed GOOSE and not Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf7 = with normal Subscribe (ping) & not subscribed GOOSE & time correlated Subscribed GOOSE not used for ping-pong		
Comment Gpf7 $transfertime_{max}$ =		

Gpf8	GOOSE performance tests Based on Normal Dataset , time correlated Subscribed GOOSE and not Subscribed GOOSE	☐ Passed ☐ Failed ☐ Inconclusive
IEC 61850-5 clause 13		
Expected result 4. The device publishes GOOSE pong messages with copied values 7. According to paragraph "3.3 Test passed criteria"		
Test description 1. Configure and start DUT 2. Client simulator associates with DUT, configures and enables the BRCB or URCB 3. Start high performance analyzer capture 4. Start GOOSE simulator as indicated below 5. Wait for 1000 uniform distributed Subscribe (ping/pong) state changes 6. Stop and save the analyzer capture 7. Calculate the 1000 roundtrip times and calculate the average, minimum, maximum roundtrip time and standard deviation Gpf8 = with large Subscribe (ping) & not subscribed GOOSE & time correlated Subscribed GOOSE not used for ping-pong		
Comment Gpf8 transfertime$_{max}$ = Any deviation to Large Dataset structure as defined? *In case the DUT does not support the Large dataset structure as defined, the configured dataset structure shall be documented here.*		

ANNEX A: PIXIT TEMPLATE FOR GOOSE PERFORMANCE TEST

Introduction

This document specifies the protocol implementation extra information for testing (PIXIT) of the IEC 61850 GOOSE performance in the server device: "<product>" with version "<version>".

Together with the PICS this PIXIT forms the basis for a GOOSE performance test according to IEC 61850-5 and IEC 61850-10.

PIXIT for GOOSE performance test

Description	Value / Clarification
Performance class	P1 or P2/P3
GOOSE ping-pong processing method	Event driven based or Scan cycle based
Application logic scan cycle(ms)	
Maximum number of Goose Dataset entries (value and quality has to be counted as separate entries)	50
Maximum number of Goose Control Blocks to be published	5
Maximum number of Goose Control Blocks to be subscribed	50
Data types supported to publish Goose	Boolean / Double Point / Analog
Data types supported to subscribe Goose	Boolean / Double Point / Analog

ANNEX B: TEMPLATE FOR GOOSE PERFORMANCE TEST CERTIFICATE

IEC 61850 Certificate Level A/B[1]

Issued to:
<<MANUFACTURER>>
<< FULL ADDRESS>>

For the product:
<<PRODUCT NAME>>
<<VERSION NUMBER>>

Issued by: << TEST LAB >>

The product has not shown to be non-conforming to:

IEC 61850-5 performance class <<P1 or P2/P3>>

The performance test has been performed according to the UCA International Users Group GOOSE performance Test Procedures version X.Y with product's protocol implementation conformance statements: "<<PICS>>", and product's extra information for testing: "<<PIXIT>>".

This Certificate summaries test results as carried out at <<TESTLAB>> in <<COUNTRY>> with <<GOOSE simulator VERSION>> and <<Analyzer VERSION>>. This document has been issued for information purposes only, and the original paper copy of the test report: No. <<REPORT NUMBER>> will prevail.

The GOOSE performance has been measured with <<Boolean and/or Double Point>> informations.

<<LOCATION>>, <<DATE>>

<<Signature of responsible test engineer>>
<<Name of responsible test engineer>>

1 Level A - Independent Test lab with certified ISO 9000 or ISO 17025 Quality System