Test Report
No E-15-I-050-FL

PRIME Certification Tests Cases for Base Nodes

EQUIPMENT UNDER TEST	**Three-phase data concentrator**
MODEL	**DC450V2 PRIME**
FIRMWARE VERSION	**V3.9.0.0**
CERTIFICATION SCOPE	**Profile 4: PHY, MAC and CS Layers** (1)

(1) Optional test cases are outside the certification scope.
Optional test cases list: 3.3.1, 3.3.5, 3.3.6, 3.5.4, 3.7.2, 3.7.3, 3.7.4, 3.7.5, 3.8.3 and 3.8.18

Author: Fernando Lobo
Reviewer: Elena Henríquez

NOTE: This test report shows the detailed information associated with the Test Report no. E-I-15-FL-051

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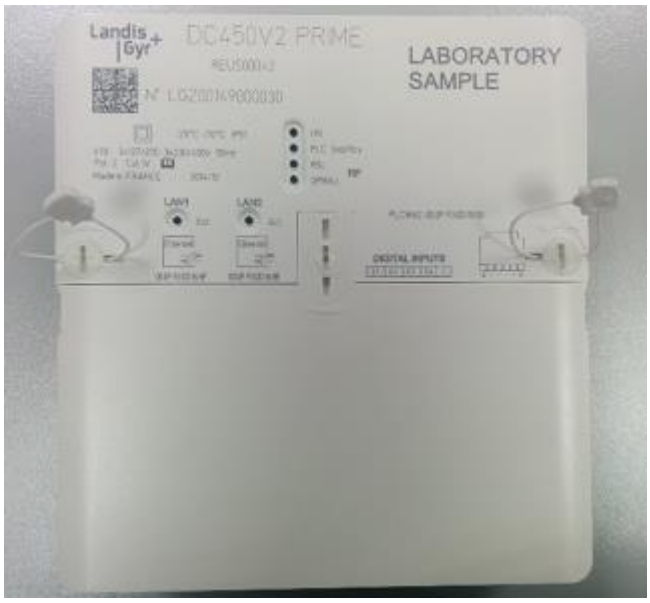
1.- EQUIPMENT UNDER TEST IDENTIFICATION

Unit:	Three-Phase Data Concentrator with PRIME PHY and PRIME MAC
Model:	DC450V2 PRIME
Trade Mark:	Landis+Gyr
Serial Number:	LGZ00149000030
Manufacturer:	Landis+Gyr



The samples were selected and delivered by the applicant.

Equipment characteristics declared by the applicant:

Device type	Three-Phase Data Concentrator with PRIME PHY and PRIME MAC
TCP Port	62627
MAC	00:0F:93:0D:10:00
Firmware version	v3.9.0.0
Applicable Optional tests	NA – See manufacturer declaration attached in Annex II
Recertification	NA

2.- SUMMARY OF TEST RESULTS

PHY LAYER		
2.2 PHY Test Cases: Functional Category		
2.2.1	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. DBPSK+CC.	PASS
2.2.2	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. DBPSK.	PASS
2.2.3	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes DQPSK.+CC.	PASS
2.2.4	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. DQPSK.	PASS
2.2.5	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. D8PSK + CC.	PASS
2.2.6	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. DBPSK.	PASS
2.2.7	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. D8PSK. High temperature.	PASS
2.2.8	Verify error free communication (<0.2% FER) with transmitter output level 122 dBLV and PPDU length 256 bytes. D8PSK.	PASS
2.4 PHY Test Cases: Signal Quality category		
2.4.1	Verify that the EVM of the received signal is above 17dB.	PASS
2.4.2	Verify that the EVM of the transmitted signal is above 17dB.	PASS
2.5 PHY Test Cases: Regulatory category		
2.5.1	PHY Test Cases: Regulatory category	PASS

MAC LAYER		
3.2 MAC Test cases: Subnetwork Management		
3.2.1	Stability when the DUT is managing the subnetwork	NA
3.3 MAC Test Cases: Channel Access		
3.3.1	Verify that the Contention Free Period in the frame is not used for data transmission, unless after explicit allocation.	NA
3.3.2	Check that no data is sent by the DUT in the SCP if the channel is occupied with traffic.	PASS
3.3.3	Check randomness of the spacing/allocation of the PPDUs in the SCP.	PASS
3.3.4	Check priority of the channel access in the SCP (CSMA/CA).	PASS
3.3.5	Check the transmission in CFP.	NA
3.3.6	Check the adaptation of the frame structure in traffic sent by the DUT after a frame structure change (FRA) has been sent by the DUT.	NA
3.4 MAC Test Cases: Switch and Peer Tracking		
3.4.1	Check tracking by the DUT of network changes if a registered Service Node unregisters.	PASS
3.4.2	Check retransmission of MAC Control Packets to a Service Node. Check if the list with registered devices is maintained correctly in the DUT if no answer is received on a retransmitted Control Packet.	PASS
3.4.3	Check the Intelligent Beacon Slot Allocation Policy	PASS
3.5 MAC Test Cases: Switching		
3.5.1	Check the tracking by the DUT of new Switches.	PASS

3.5.2	Check the tracking by the DUT of switch demotion	PASS
3.5.3	Check the switching of Broadcast Packets by the DUT.	PASS
3.5.4	Check the switching of Multicast Packets by the DUT.	NA
	3.7 MAC Test Cases: ARQ	
3.7.1	Verify correct behaviour of the DUT if the Service Node does support ARQ.	PASS
3.7.2	Verify correct sequencing of packet ID's in the ARQ header and that the ARQ.PKTID is reset to 0 after the value 63 has been reached.	NA
3.7.3	Verify the DUT retransmits a PPDU if the transmission is not ACK-ed.	NA
3.7.4	Verify that the DUT is able to take part in the negotiation of the ARQ window size.	NA
3.7.5	Verify that the DUT is able to effectively respond to ACK policies coming from the transmitting Service node.	NA
	3.8 MAC Test Cases: Procedures	
3.8.1	Verify that the DUT sends its beacons at fixed intervals that match with the PRIME frame length.	PASS
3.8.2	Acceptance of service node registration request	PASS
3.8.3	Verify that the DUT is able to initiate a Service Node unregistration	NA
3.8.4	Service node unregistration initiated by service node.	PASS
3.8.5	Verify that the DUT is able to accept a promotion request initiated by terminal node.	PASS
3.8.6	Verify that the DUT is able to reject a terminal node promotion request	PASS
3.8.7	Verify that the DUT is able to initiate a promotion request to terminal node	PASS
3.8.8	Verify that the DUT is able to initiate a demotion process	PASS
3.8.9	Verify that the DUT has implemented the regular operation of the Keep-Alive process	PASS
3.8.10	Verify that the DUT unregisters Service Nodes after a timeout in the Keep-Alive process.	PASS
3.8.11	Verify that the DUT is able to change the interval of the Keep-Alive process.	PASS
3.8.12	Verify that the DUT is able to initiate the establishment of a connection and behaves correctly if the connection is established.	PASS
3.8.13	Verify if the DUT accepts a Connection establishment initiated by the Service node.	PASS
3.8.14	Verify that the DUT is able of rejecting a Connection establishment initiated by a Service Node.	PASS
3.8.15	Verify that the DUT behaves according to the specifications if a Connection establishment that is initiated by the DUT is rejected by the Service node.	PASS
3.8.16	Verify that the DUT can inititate the closure of a connection and behaves correctly if the closure succeeds.	PASS
3.8.17	Verify that the DUT accepts the closure of a connection initiated by the Service node.	PASS
3.8.18	Group Join initiated by the DUT. Successful join.	NA
3.8.19	Verify that the DUT implements the unicast Firmware upgrade process.	PASS
3.8.20	Verify that the DUT implements the multicast Firmware upgrade process	PASS
3.8.21	Verify that the DUT replies correctly to a PHY Robustness Management message initiated by the Service Node.	PASS
3.8.22	Verify that the DUT can correctly initiate a PHY Robustness Management process and accepts a correct response from the DUT.	PASS
3.8.23	Verify that the DUT can initiate the PHY Robustness Management process and accepts a rejection from the Service Node.	PASS

3.8.24	Verify that the DUT can correctly reject the PHY Robustness Management initiated by the Service Node.	PASS
CONVERGENCE LAYER		
4.2 CL Test Cases: Common Part Convergence Sublayer		
4.2.1	Verify the the Segmentation Mechanism at the DUT.	PASS
4.2.2	Verify the Reassembly Mechanism at the DUT side.	PASS
4.3 CL Test Cases: 4-32 Connection Sublayer		
4.3.1	4-32 Connection establishment. The DUT must be able to accept an incoming 4-32 connection from a Service Node. The DUT correctly handles connection parameters (DA,SA), and processes Data SN meter serial number and stores it.	PASS

For more detailed information about the test results see Annex I

3.- APPLICANT

Name: Javier Rodríguez

Company Name: Landis+Gyr S.A.U

Address: Ctra. de la Esclusa 11, Edificio Galia Puerto, C.P 41011 Sevilla - Spain

4.- PLACE OF RECEPTION AND EXECUTION OF THE TESTS

Laboratory : DNV GL

Address: C/ Almansa 105, Planta 2ª, Oficina 1, C.P 28040 Madrid - Spain

5.- STANDARDS AND TEST PROCEDURES EMPLOYED

Standards:

- Draft Specification for PoweRline Intelligent Metering Evolution. PRIME-Specification v.1.3.6.
- EN 50065-1 (2001): “Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz. Part 1: General requirements, frequency bands and electromagnetic disturbances”.
- EN 50065-2-3 (2003) + A1 (2005): “Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz. Part 2-3: Immunity requirements for mains communications equipment and systems operating in the range of frequencies of 3 kHz to 95 kHz and intended for use by electricity suppliers and distributors”.
- EN 50065-7 (2001): “Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz. Part 7: Equipment impedance”.

Testing procedures:

- PRIME Certification BN Testcases Version 1.3

6.- CONCLUSIONS

In view of the results and in the test conditions expressed in the present report, the tested sample of:

Unit:	Three-Phase Data Concentrator with PRIME PHY and PRIME MAC
Model:	DC450V2 PRIME
Trade Mark:	Landis+Gyr
Serial Number:	LGX00149000030
Manufacturer:	Landis+Gyr

- ✓ **COMPLIES** with the tests cases defined by PRIME Alliance in its PRIME Certification BN Testcases Version 1.3 based on PRIME-Specification v.1.3.6.

ANNEX I. TEST RESULTS

Place:

DNV GL Smart Grid Lab

C. Almansa 105, Planta 2ª, Oficina 1, C.P. 28040 - Madrid - Spain

Climatic conditions:

Temperature (ºC)	Min: 15ºC Max: 35ºC
Relative humidity (%)	Max: 75%

Responsible:

Fernando Lobo

Used instruments:

Measurement instruments	
X	*SW*
	✓ *PRIME BASE NODE CERTIFICATION TESTING TOOL v1.4.5*
X	*HW*
	✓ *S.N.1*
	✓ *S.N.2*
	✓ *S.N.3*
	✓ *S.N.4*
	✓ *Sniffer*
Data registers storage place	
PBNCTT2 laptop	

Results:

4.1. PHY layer

4.1.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in the first level of the network

- Conformance Tester, a laptop with software to control sniffer and the reference service nodes and with functionality to report the result

- Isolation transformers

- LISNs (PRIME LISN and EN50065 LISN)

4.1.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT	COMMENTS
	2.2 PHY Test Cases: Functional Category				
2.2.1	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation is DBPSK+CC.	2000	1996-2000	PASS	1
2.2.2	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation scheme is DBPSK.	2000	1996-2000	PASS	1
2.2.3	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation is DQPSK.+CC.	2000	1996-2000	PASS	1
2.2.4	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation scheme is DQPSK.	≥ 1999	1996-2000	PASS	1
2.2.5	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation is D8PSK + CC.	≥ 1998	1996-2000	PASS	1

2.2.6	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation is DBPSK.	2000	1996-2000	PASS	1
2.2.7	Verify error free communication (<0.2% FER) with transmitter output level 120 dBLV andPPDU length 256 bytes. The used modulation scheme is D8PSK. The test is performed at ahigh temperature.	2000	1996-2000	PASS	1
2.2.8	Verify error free communication (<0.2% FER) with transmitter output level 122 dBLV and PPDU length 256 bytes. The used modulation scheme is D8PSK.	2000	1996-2000	PASS	1
2.4 PHY Test Cases: Signal Quality category					
2.4.1	Verify that the EVM of the received signal is above 17dB. The EVM value is measured at the DUT.	≥ 17.01 dB	≥ 17 dB	PASS	1, 2
2.4.2	Verify that the EVM of the transmitted signal output level of 120 dBLV is above 17dB.The EVM is measured at the receiver.	≥ 17.90 dB	≥ 17 dB	PASS	1, 2

PHY Test Cases: Regulatory category

DUT is EN50065-1, EN50065-2-3 and EN50065-7 compliant in order to be PRIME compliant.

- Test report identification

  For release v1.1.13 Landis+Gyr S.A.U DC450 V2 PRIME three-phase PRIME concentrator is conformant to is conformant to EN 50065-1 (2011), EN 50065-2-3 (2003) + A1 (2005) and EN 50065-7 (2011) in the frequency from 9kHz to 148.5 kHz band according verification tests no. 150033/01 issued by Lacecal (26/05/2014).

- DUT identification

  Model Tested DC450V2 PRIME three-phase PRIME concentrator with Serial Number LGZ149000040.

4.2. MAC layer

4.2.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in the first level of the network

- Conformance Tester, a laptop with software to control sniffer and the reference service nodes and with functionality to report the result

- Isolation transformer

- Attenuators

4.2.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT.	COMMENTS
3.2 MAC Test cases: Subnetwork Management					
3.2.1	Stability when the DUT is managing the subnetwork			NA	3
3.3 MAC Test Cases: Channel Access					
3.3.1	Verify that the Contention Free Period in the frame is not used for data transmission, unless after explicit allocation.			NA	
3.3.2	Check that no data is sent by the DUT in the SCP if the channel is occupied with traffic.			PASS	4
3.3.3	Check randomness of the spacing/allocation of the PPDUs in the SCP.			PASS	3
3.3.4	Check priority of the channel access in the SCP (CSMA/CA).			PASS	3
3.3.5	Check the transmission in CFP.			NA	
3.3.6	Check the adaptation of the frame structure in traffic sent by the DUT after a frame structure change (FRA) has been sent by the DUT.			NA	
3.4 MAC Test Cases: Switch and Peer Tracking					
3.4.1	Check tracking by the DUT of network changes if a registered Service Node unregisters.			PASS	3

3.4.2	Check retransmission of MAC Control Packets to a Service Node. Check if the list with registered devices is maintained correctly in the DUT if no answer is received on a retransmitted Control Packet.	PASS	3
3.4.3	Check the Intelligent Beacon Slot Allocation Policy	PASS	4
	3.5 MAC Test Cases: Switching		
3.5.1	Check the tracking by the DUT of new Switches.	PASS	3
3.5.2	Check the tracking by the DUT of switch demotion	PASS	3
3.5.3	Check the switching of Broadcast Packets by the DUT.	PASS	3
3.5.4	Check the switching of Multicast Packets by the DUT.	NA	
	3.7 MAC Test Cases: ARQ		
3.7.1	Verify correct behaviour of the DUT in a setup where the Service Node does support ARQ.	PASS	3
3.7.2	Verify correct sequencing of packet ID's in the ARQ header and that the ARQ.PKTID is reset to 0 after the value 63 has been reached.	NA	
3.7.3	Verifify that the DUT correctly retransmits a PPDU if the transmission is not ACK-ed.	NA	
3.7.4	Verify that the DUT is able to take part in the negotiation of the ARQ window size.	NA	
3.7.5	Verify that the DUT is able to effectively respond to ACK policies coming from the transmitting Service node.	NA	
	3.8 MAC Test Cases: Procedures		
3.8.1	Verify that the DUT sends its beacons at fixed intervals that	PASS	3

	match with the PRIME frame length.		
3.8.2	Section 4.7.1. Acceptance of service node registration request	PASS	3
3.8.3	Verify that the DUT is able to initiate a Service Node unregistration, as specified in [1], section 4.7.2	NA	
3.8.4	Section 4.7.2. Service node unregistration initiated by service node.	PASS	3
3.8.5	Verify that the DUT is able to accept a promotion request initiated by terminal node, as specified in [1] section 4.7.3.	PASS	3
3.8.6	Verify that the DUT is able to reject a terminal node promotion request, as specified in [1], section 4.7.3.	PASS	3
3.8.7	Verify that the DUT is able to initiate a promotion request to terminal node, which is configured to reject request. See [1] section 4.7.3	PASS	3
3.8.8	Verify that the DUT is able to initiate a demotion process, as specified in [1] section 4.7.4.	PASS	3
3.8.9	Verify that the DUT has implemented the regular operation of the Keep-Alive process as specified in [1], section 4.7.5	PASS	4
3.8.10	Verify that the DUT unregisters Service Nodes after a time out in the Keep-Alive process. As specified in [1], section 4.7.5.	PASS	3
3.8.11	Verify that the DUT is able to change the interval of the Keep-Alive process . See [1] section 4.7.5	PASS	3
3.8.12	Verify that the DUT is able to initiate the establishment of a connection and behaves correctly if the connection is established. See [1] section 4.7.6.	PASS	3

3.8.13	Verify if the DUT accepts a Connection establishment that is initiated by the Service node. See [1] section 4.7.6	PASS	3
3.8.14	Verify that the DUT is able of rejecting a Connection establishment initiated by a Service Node. See [1] section 4.7.6.	PASS	3
3.8.15	Verify that the DUT behaves according to the specifications if a Connection establishment that is initiated by the DUT is rejected by the Service node. See [1] section 4.7.6.	PASS	3
3.8.16	Verify that the DUT can inititate the closure of a connection and behaves correctly if the closure succeeds.. See [1] section 4.7.6.	PASS	3
3.8.17	Verify that the DUT accepts the closure of a connection initiated by the Service node. See [1]section 4.7.6.	PASS	3
3.8.18	Section 4.7.7.1 Group Join initiated by the DUT. Successful join.	NA	
3.8.19	Verify that the DUT implements the unicast Firmware upgrade process correctly. See [1],section 6.2.	PASS	3, 5
3.8.20	Verify that the DUT implements the multicast Firmware upgrade process correctly. See [1] section 6.2	PASS	4, 6
3.8.21	Verify that the DUT replies correctly to a PHY Robustness Management message initiated by the Service Node. See [1].section 4.7.8	PASS	3
3.8.22	Verify that the DUT can correctly initiate a PHY Robustness Management process and accepts a correct response from the DUT. See [1].section 4.7.8	PASS	3
3.8.23	Verify that the DUT can initiate the PHY Robustness Management process and accepts a rejection	PASS	3

	from the Service Node. See [1] section 4.7.8		
3.8.24	Verify that the DUT can correctly reject the PHY Robustness Management initiated by the Service Node . See [1] section 4.7.8	PASS	3

4.3. CL layer

4.3.1. Test setup

The network setup for these tests consists on the following modules:

- PRIME sniffer module, connected in the first level of the network

- Conformance Tester, a laptop with software to control sniffer and the reference service nodes and with functionality to report the result

- Isolation transformer

4.3.2. Test results

CODE	DESCRIPTION	RESULT	EXPECTED	STAT.	COMMENTS
	4.2 CL Test Cases: Common Part Convergence Sublayer				
4.2.1	Verify the correct implementation of the Segmentation Mechanism at the DUT side.			PASS	3
4.2.2	Verify the correct implementation of the Reassembly Mechanism at the DUT side.			PASS	3, 6
	4.3 CL Test Cases: 4-32 Connection Sublayer				
4.3.1	4-32 Connection establishment. The DUT must be able to accept an incoming 4-32 connection from a Service Node. The DUT correctly handles connection parameters (DA,SA), and processes Data SN meter serial number and stores it.			PASS	3

1. All Physical tests where done with S.N.1 as transmitting (or, in case of test 2.4.2 as receiving) device. Also, the extended power range capability required for test case 2.2.8 is only available in this hardware module.

   The bit-to-bit check on the content of the bursts was checked by starting the sniffer from the command prompt and by visual inspection that only burst with the content "PRIME IS A WONDERFUL TECHNOLOGY" were sniffed.

2. When the DUT is in 'silent mode', resulting from the 'phy start rx' or 'phy start tx' console command in each case, the EVM is calculated according to the new arithmetic average method.

3. Test cases with comment-3 are those which were performed with normal state of the DUT. It is needed to configure the DUT using PuTTY.exe (Release 0.62) to have access to the management plane through the PBNCTT.

4. Test cases with comment-4 are those which were performed with AppEmu state of the DUT. It is needed to configure correctly the DUT using PuTTY.exe (Release 0.62) to manage correctly AppEmu connections and also have access to the management plane of it.

5. Test cases with comment-5 are those which were performed using PuTTY.exe (Release 0.62) to initiate firmware upgrade process. Those cases are needed to use two putty connections:

    - Configure the DUT in the correct mode (according comment-3 or 4)
    - Initiate firmware upgrade process

6. Test case with commet-6 is that which was performed using PuTTY.exe (Release 0.62) to check the correctness of the reassembly mechanism is proven.

ANNEX II. MANUFACTER'S DECLARATION

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Landis+Gyr manage energy better

Seville, 08 Abril 2015

DECLARATION OF LANDIS+GYR

For DNV GL
Address C/ Almansa 105, 28040 - Madrid

DC450 PRIME v2 Base Node Certification

Herein we confirm that Landis+Gyr's Data Concentrator DC450 PRIME v2 / FW version 3.9.0.0 PRIME Base Node Certification in DNVGL does not support the tests-cases that are "optional".

For the sake of clarity we summarize below the test-cases we are referring to:

- **3.3 Channel Access**
  - **3.3.1** Verify that the Contention Free Period in the frame is not used for data transmission, unless after explicit allocation.
  - **3.3.5** Check the transmission in CFP.
  - **3.3.6** Check the adaptation of the frame structure in traffic sent by the DUT after a frame structure change (FRA) has been sent by the DUT.
- **3.5 Switching**
  - **3.5.4** Check the switching of Multicast Packets by the DUT.
- **3.7 ARQ**
  - **3.7.2** Verify correct sequencing of packet ID's in the ARQ header and that the ARQ.PKTID is reset to 0 after the value 63 has been reached.
  - **3.7.3** Verify that the DUT correctly retransmits a PPDU if the transmission is not ACK-ed.
  - **3.7.4** Verify that the DUT is able to take part in the negotiation of the ARQ window size.
  - **3.7.5** Verify that the DUT is able to effectively respond to ACK policies coming from the transmitting Service node.
- **3.8 MAC Procedures**
  - **3.8.3** Verify that the DUT is able to initiate a Service Node unregistration
  - **3.8.18** Group Join initiated by the DUT. Successful join.

Yours sincerely,

Baldomero Cano
Product Management
Landis+Gyr | Landis&Gyr, S.A.U.
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