2023 5G Challenge
Stage Two - RU Test Plan

Date: March 21, 2023

Version: 1.3

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1 Version History

Version	Date	Author(s)	Notes
1.0	March 7, 2023	Spiros Kapoulas	Initial Release
1.1	March 17, 2023	Spiros Kapoulas	Incorporated comments from NTIA. Removed Beamforming UC-Plane test cases in alignment with the RU type accepted to the 5G Challenge, i.e. non beamformer RU. Added Hybrid M-Plane access control test case.
1.2	March 20, 2023	Spiros Kapoulas	Added references to O-RAN.WG4.CONF test description and test entrance criteria in each Test Case text body.
1.3	March 22, 2023	Spiros Kapoulas	Test setup section has been updated to accommodate different Hybrid M-Plane client implementations.

2 List of Figures

3 Acronyms

3GPP	3rd Generation Partnership Project
5GC	5G Core
APN	Access Point Name
BLER	Block Error Rate
CA	Carrier Aggregation
CC	Component Carrier
COTS	Commercial Off-the-Shelf
CP	Control Plane
CQI	Channel Quality Indicator
CU	Central Unit
DL	Downlink
DLM	Delay Management
DNN	Data Network Name
DRB	Data Radio Bearer
DU	Distributed Unit
DUT	Device Under Test
E2E	End-to-End
eCPRI	Enhanced Common Public Radio Interface
EMS	Element Management System
FDD	Frequency Division Duplex
FH	Fronthaul
FR1	Frequency Range 1 in 3GPP
FTP	File Transfer Protocol
gNB	gNodeB
IE	Information Elements
ICMP	Internet Control Message Protocol
IOT	Interoperability Testing
IP	Internet Protocol
KPI	Key Performance Indicators
M-Plane	Management Plane of the O-RAN Fronthaul interface
MAC	Media Access Control
MCC	Mobile Country Code
MCS	Modulation Coding Scheme
MIB	Master Information Block
MIMO	Multiple Input Multiple Output
MNC	Mobile Network Code
MO	Mobile Originating
MTU	Maximum Transmission Unit
NAS	Non Access Stratum
NGAP	NG Application Protocol
NR	New Radio
OAM	Operation and Management
ORAN	Open Radio Access Network
OTA	Over-the-Air
PCI	Physical Cell ID
PDU	Packet Data Unit
PLMN ID	Public Land Mobile Network Identity

PTP	Precision Time Protocol
RA	Resource Allocation
RAN	Radio Access Network
RB	Resource Block
RF	Radio Frequency
RLF	Radio Link Failure
RoE	Radio Over Ethernet
RRC	Radio Resource Control
RSRP	Reference Signal Received Power
RTP	Real-time Transport Protocol
RU	Radio Unit
S-Plane	Synchronization Plane of the O-RAN Fronthaul interface
SA	Standalone Architecture
SCTP	Stream Control Transmission Protocol
SFP	Small form-factor pluggable
SIB	System Information Block
SINR	Signal to Interference plus Noise Ratio
SMA	SubMiniature version A
SSB	Synchronization Signal Block
SUT	System Under Test
TAI	Tracking Area Identifier
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TNL	Transport Network Layer
UC-Plane	User and Control Plane of the O-RAN Fronthaul interface
UDP	User Datagram Protocol
UE	User Equipment
UL	Uplink
UP	User Plane
UUT	Unit Under Test
vRAN	Virtualized Radio Access Network

4 Introduction

Today, mobile wireless networks are assembled by mobile network operators and composed of many proprietary solutions. Each discrete element typically has custom, closed-source software and hardware. Changes to any single element require complex and meticulous verification of the entire network. This industry dynamic increases costs, slows innovation, and reduces competition. Security issues are often difficult to detect and fix.

In response, the National Telecommunications and Information Administration's Institute for Telecommunication Sciences (NTIA/ITS), in collaboration with Department of Defense's Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) is carrying out the 5G Challenge to accelerate the adoption of:

Open interfaces

Interoperable subsystems

Modular, multi-vendor solutions

In the envisioned future 5G market, open interfaces reflect clear-cut requirements, enabling true plug-and-play operation. Modular 5G elements let network operators quickly and easily reconfigure, update, or replace subsystems as needed. External scrutiny of open interfaces allows vulnerabilities to be identified and patched. Attracted by this open, modular, interoperable environment, new suppliers can more easily emerge. A diversified marketplace delivers targeted innovation and drives down costs. International allies and partners can establish secure, trusted supply chains. Beneficiaries of this future 5G market include DoD, international allies and partners, network operators, businesses, and consumers.

To realize this vision, the 5G Challenge will:

Utilize existing open interface standards

Leverage industry trends toward virtualization, softwarization, and cloud systems

Encourage modular product development

Demonstrate multi-vendor interoperability

Reduce barriers of entry for new solutions providers

This public prize challenge approach will support the growth of a large, vibrant community working on 5G multi-vendor interoperability. This approach is a powerful catalyst for creating diverse solutions, attracting non-traditional performers, and sparking new innovations. The 5G Challenge envisions a world where flexible 5G technologies create new supplier opportunities and enhance network security. Streamlining integration enables continuous development, integration, and testing.

5 Summary

The 5G Challenge consists of a Preliminary Event in 2022 and the 2023 5G Challenge. The Preliminary Event focused on basic functionality for individual supplier 5G RAN components utilizing open interfaces and interoperable subsystems. The Preliminary Event was conducted at the CableLabs host lab in Louisville, CO.

In the 2023 5G Challenge, also conducted at the CableLabs host lab in Louisville, CO, participating contestants will have the opportunity to integrate and test their subsystems in the host lab leading up to the prize challenge. The 2023 5G Challenge will focus on CU+DU and RU subsystem integration with an emphasis on end-to-end performance and mobility testing.

The 5G Challenge Preliminary Event consists of four stages:

Stage One: Application

Stage Two: Emulated Integration

Stage Three: End-to End (E2E) Integration

Stage Four: Mobility

The diagram below shows the 5G Challenge reference architecture and the specific interfaces that would be tested for the contestant sub-system under test.

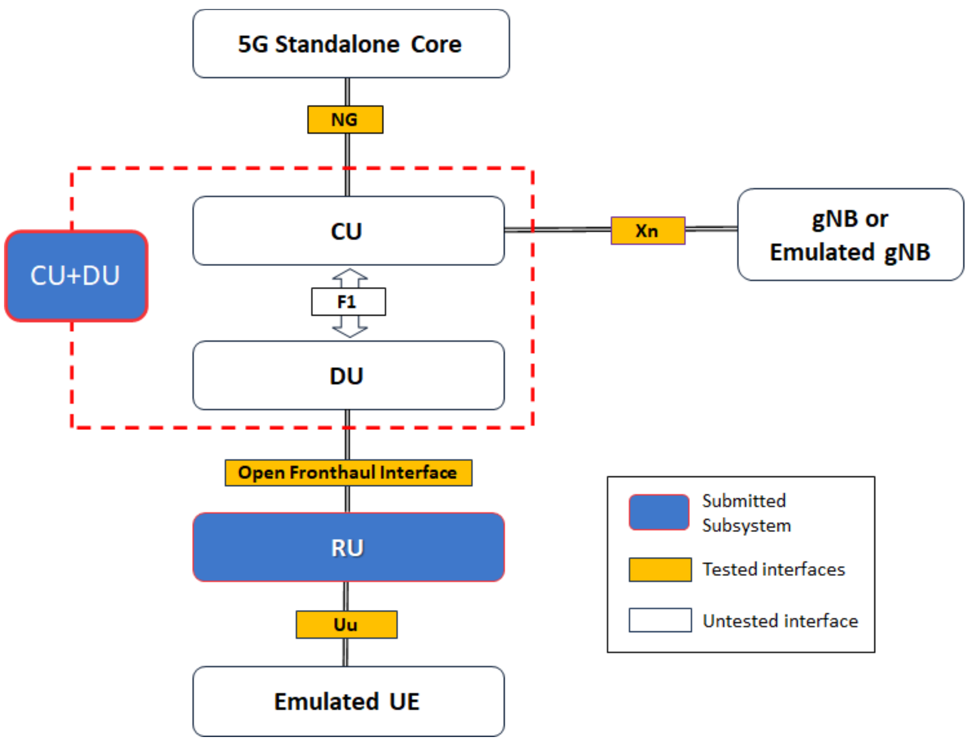

Figure 1 - 5G Challenge Reference Architecture

This document is a compendium of Radio Unit (RU) test procedures within Stage Two, which include the following levels:
Level 0 - Integration – The objective is for the RU to demonstrate successful integration into the wrap around test environment.
Level 1 - Conformance – The objective is to assess the RU conformance to the O-RAN fronthaul technical specifications.

In this test plan, the test environment -including test equipment, test setup- and test procedures have been defined together with their associated success criteria.

The table below lists the Stage-2 RU test cases.

<table>
<tr><th>Level</th><th>Category</th><th>Sub-category</th><th>Test Case ID</th><th>Test Case Name</th></tr>
<tr><td rowspan="3">0</td><td rowspan="3">Integration</td><td rowspan="3">-</td><td>RU-TC-0.1</td><td>S-Plane integration</td></tr>
<tr><td>RU-TC-0.2</td><td>M-Plane integration</td></tr>
<tr><td>RU-TC-0.3</td><td>UC-Plane integration</td></tr>
<tr><td rowspan="22">1</td><td rowspan="22">M-Plane</td><td rowspan="8">Transport and Handshake</td><td>RU-TC-WG4.CONF.3.1.1.1</td><td>M-Plane Transport for IPv4 Positive Test</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.2</td><td>M-Plane Transport for IPv4 Negative Test</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.3</td><td>M-Plane Transport IPv6 Stateful Configuration Positive Test</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.4</td><td>M-Plane Transport IPv6 Negative Test</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.5</td><td>Transport and Handshake in IPv4/TLS Environment (positive case)</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.6</td><td>Transport and Handshake in IPv4/TLS Environment (negative case)</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.7</td><td>Transport and Handshake in IPv6/TLS Environment (positive case)</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.1.8</td><td>Transport and Handshake in IPv6/TLS Environment (negative case)</td></tr>
<tr><td>Manage Alarm Requests</td><td>RU-TC-WG4.CONF.3.1.2.1</td><td>M-Plane Alarm Subscription to Notifications</td></tr>
<tr><td rowspan="2">Connection Supervision</td><td>RU-TC-WG4.CONF.3.1.3.1</td><td>M-Plane Connection Supervision Positive</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.3.2</td><td>M-Plane Connection Supervision Negative</td></tr>
<tr><td rowspan="2">Retrieval of RU's Information Elements</td><td>RU-TC-WG4.CONF.3.1.4.1</td><td>M-Plane Retrieve Information Element without Filter</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.4.2</td><td>M-Plane Retrieve Information Element with Filter</td></tr>
<tr><td rowspan="2">Fault Management</td><td>RU-TC-WG4.CONF.3.1.5.1</td><td>M-Plane FM Alarm Notification</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.5.2</td><td>M-Plane FM Retrieve Active Alarms</td></tr>
<tr><td rowspan="2">RU Software Update</td><td>RU-TC-WG4.CONF.3.1.6.1</td><td>M-Plane SW Update and Install_Pos</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.6.2</td><td>M-Plane SW Update Negative</td></tr>
<tr><td rowspan="2">RU Software Activation</td><td>RU-TC-WG4.CONF.3.1.7.1</td><td>M-Plane SW Activation No Reset</td></tr>
<tr><td>RU-TC-WG4.CONF.3.1.7.2</td><td>M-Plane Supplemental Reset after SW Activation</td></tr>
<tr><td>Access Control</td><td>RU-TC-WG4.CONF.3.1.8.</td><td>M-Plane Sudo Hybrid Positive</td></tr>
</table>

Level	Category	Sub-category	Test Case ID	Test Case Name
			RU-TC-WG4.CONF.3.1.8.6	M-Plane Sudo Hierarchical Positive
		RU Configurability	RU-TC-WG4.CONF.3.1.10.1	M-Plane RU Configurability Positive
			RU-TC-WG4.CONF.3.1.10.2	M-Plane RU Configurability Negative
		Log Management	RU-TC-WG4.CONF.3.1.12.1	M-Plane Log Management
			RU-TC-WG4.CONF.3.1.12.2	M-Plane Log Management - Trace Test
	UC-Plane FDD	RU Scenario Class NR testing Generic	RU-TC-WG4.CONF.3.2.3.1.1	UC-Plane FDD Scenario Class Base DL
			RU-TC-WG4.CONF.3.2.3.1.2	UC-Plane FDD Extended DL RA Base
			RU-TC-WG4.CONF.3.2.3.1.3	UC-Plane FDD Scenario Class Base UL
			RU-TC-WG4.CONF.3.2.3.1.4	UC-Plane FDD Extended DL RA using RB Parameter
			RU-TC-WG4.CONF.3.2.3.1.5	UC-Plane FDD Extended UL RA using RB Parameter
		UC-Plane RU Scenario Compression	RU-TC-WG4.CONF.3.2.3.3.3	UC-Plane RU Scenario Class Compression Static Format (SF) Block Floating Point (BFP)
			RU-TC-WG4.CONF.3.2.3.3.6	UC-Plane FDD Scenario Class Compression - Static Modulation-Compressed
		UC-Plane RU Scenario Class Delay Management	RU-TC-WG4.CONF.3.2.3.4.1	UC-Plane FDD Scenario Class DLM Test #1 DL Positive
			RU-TC-WG4.CONF.3.2.3.4.2	UC-Plane FDD Scenario Class DLM Test #2 UL Positive
			RU-TC-WG4.CONF.3.2.3.4.3	UC-Plane FDD Scenario Class DLM Test #3 DL Negative
			RU-TC-WG4.CONF.3.2.3.4.4	UC-Plane FDD Scenario Class DLM Test #4 UL Negative
		UC-Plane RU Scenario Class Section Type 3	RU-TC-WG4.CONF.3.2.3.8.1	UC-Plane RU Scenario Class ST3 Test #1: NR PRACH
	UC-Plane TDD	RU Scenario Class NR testing Generic	RU-TC-WG4.CONF.3.2.5.1.1	UC-Plane TDD Scenario Class Base DL/UL
			RU-TC-WG4.CONF.3.2.5.1.2	UC-Plane TDD Extended DL/UL RA Base
			RU-TC-WG4.CONF.3.2.5.1.3	UC-Plane TDD Extended DL/UL RA using RB Parameter
			RU-TC-WG4.CONF.3.2.5.1.5	UC-Plane TDD Extended DL/UL RA using reMask Parameter
		UC-Plane RU Scenario Class Compression	RU-TC-WG4.CONF.3.2.5.3.3	UC-Plane TDD Scenario Class Compression - Static Block Floating Point
			RU-TC-WG4.CONF.3.2.5.3.6	UC-Plane TDD Scenario Class Compression - Static Modulation-Compressed
		UC-Plane RU Scenario Class Delay Management	RU-TC-WG4.CONF.3.2.5.4.1	UC-Plane TDD Scenario Class DLM Test #1 DL Positive
			RU-TC-WG4.CONF.3.2.5.4.2	UC-Plane TDD Scenario Class DLM Test #2 UL Positive
			RU-TC-WG4.CONF.3.2.5.4.3	UC-Plane TDD Scenario Class DLM Test #3 DL Negative

Level	Category	Sub-category	Test Case ID	Test Case Name
			RU-TC-WG4.CONF.3.2.5.4.4	UC-Plane TDD Scenario Class DLM Test #4 UL Negative
	S-Plane	Functional	RU-TC-WG4.CONF.3.3.2	Functional test of RU using ITU-T G.8275.1 profile (LLS- C1/C2/C3)
		Performance	RU-TC-WG4.CONF.3.3.3	Performance test of RU using ITU-T G.8275.1 Profile

Table 1. Stage-2 RU Test Cases

The test procedures will evaluate basic pass/fail criteria for the RU Device Under Test (DUT).

These test procedures are subject to change, as additional information and criteria may be identified during the contest.

6 Lab entry requirements

6.1 Laptop

Contestant shall provide a laptop for facilitating local and/or remote connection to the RU.

6.2 RU Hardware

RU hardware shall support:
3GPP Rel.15 Frequency Range 1 (FR1)
An RF antenna port used to transmit/receive NR RF signal.
An Ethernet port used for local or remote access to the RU.
Devices can use AC power or DC -48V. If DC power other than -48V is needed, the contestant will need to provide their own rectifier.
Power cables should have North American plugs (or adaptors to North American outlets)
RF Ports need to be adapted to SMA.
RU vendor shall provide the necessary SFP(s) for connecting its RU to the test setup.

In addition, the RU hardware serial number and RU photo(s) shall be submitted to the 5G Lab before testing begins and after testing concludes.

6.3 RU Software

6.3.1 Inventory

The RU software inventory details, following the example format shown below, shall be submitted to the 5G Lab personnel on three occasions during the testing period, i.e.:

1. Prior to entering the 5G Challenge Lab,
2. Prior final scoring testing begins, and
3. After final scoring testing ends.

software-inventory xmlns="urn:o-ran:software-management:1.0">


```
<software-inventory>
 <software-slot>
  <name>1</name>
  <status>VALID</status>
  <active>true</active>
  <running>true</running>
  <access>READ_WRITE</access>
  <vendor-code>XYZ</vendor-code>
  <build-id>XYZ</build-id>
  <build-name>XYZ</build-name>
  <build-version>XYZ</build-version>
  <files>
   <name>XYZ.bin</name>
   <version>XYZ</version>
   <integrity>OK</integrity>
  </files>
 </software-slot>
 <software-slot>
  <name>2</name>
  <status>VALID</status>
  <active>false</active>
  <running>false</running>
  <access>READ_WRITE</access>
  <vendor-code>XYZ</vendor-code>
  <build-id>XYZ</build-id>
  <build-name>XYZ</build-name>
  <build-version>XYZ/build-version>
  <files>
   <name>XYZ.bin</name>
   <version>XYZ</version>
   <integrity>OK</integrity>
  </files>
 </software-slot>
</software-inventory>
```


6.3.2 Installation

RU software installation shall be performed by the RU vendor.

6.3.3 Configuration

RU software configuration (i.e. parameter changes) that is required for executing and/or troubleshooting a test case, shall be performed by the RU vendor.

RU software and/or parameter changes during integration, preliminary/initial testing, and troubleshooting are allowed.

RU software changes and/or parameter changes during testing for the purposes of scoring are not allowed.

Any RU software and/or hardware change during testing shall require a rerun of previously passed test case(s); to validate that the compliance demonstrated before has been maintained after software and/or hardware changes have been applied.

All testing (including re-runs) needs to be completed in the testing window allocated to the contestant.

7 Level 0 Test Plan

7.1 Objective

The RU shall demonstrate its successful integration into the test environment.
The RU shall interoperate with the test environment before proceeding to Level-1 testing.

7.2 Prerequisites

An operationally validated RU IOT fronthaul interface parameters values per Annex A. have been submitted to the host lab.

7.3 Preparation

7.3.1 DU emulator

The DU FH Emulator shall be configured to match the RU Fronthaul parameter settings as provided by the Contestant.
The step-by-step procedure is described in [5] (for VIAVI) and [6] (for Keysight).

7.3.2 RU tester SW application

Before starting RU_tester UI, the steps described in section 7.1.1 [5] are necessary

7.4 Test Environment

The RU wraparound tester (RUWT) surrounds the DUT and connects to both the front haul interface and the NR air-interface interface. It consists of (a) CUSM-Plane Emulator (CUSM-E), (b) PTP, (c) RF signal analyzer, and (d) RF signal generator as shown in the figure below.

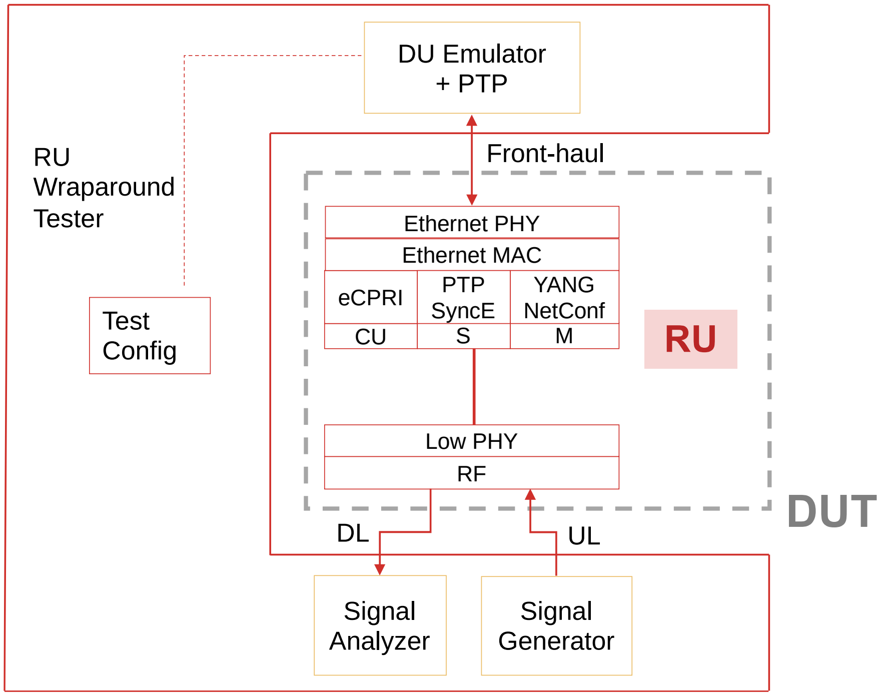

Figure 2 – Logical Set-up for RU as DUT

For UC-Plane DL testing purposes, the RU wrap-around tester provides the specific C-Plane and U-Plane DL IQ data flows, collects RF signal from the RU, and evaluates whether the RU correctly received and interpreted the fronthaul DL IQ data flow.
For UC-Plane UL testing purposes, the RU wrap-around tester generates RF signal (via the RF signal generator and VSE) and feeds it to the RU antenna connectors, in conjunction with the C-Plane UL commands sent over the fronthaul connection, to generate UL data flows on the fronthaul connection which are received and evaluated by the RU tester SW application.

7.4.1 Test Equipment

Test Equipment	Model	SW	Use
DU FH Emulator	Viavi TM500 RU Tester	NRA 1.12.0	O-RAN DU emulator which implements the required DU portions of the gNB functions, as defined by O-RAN Alliance split option 7-2x. It supports both Category A and Category B RUs.
	Keysight Open RAN Studio	2.3.1094 4.0	
PTP GM	Viavi MTS5800		Timing Grand Master (T-GM)
Signal Analyzer	Rohde-Schwarz FSW3007	V1.70	RF signal and spectrum analysis instrument used to analyze NR waveform. It works with the Rohde-Schwarz VSE software to analyze test I/Q signals
	Keysight M9411A - PXIe VXT - vector signal analyzer	M.32.57	
Signal Generator	Rohde-Schwarz SMW200A	5.00.044.34	RF generator for digitally modulated signals. It works with the Rohde-Schwarz VSE software to generate test I/Q signals
	Keysight M9411A - PXIe VXT - vector signal generator	M.32.57	

5G NR Signal Analysis & Signal Generation SW	Rohde-Schwarz VSE	2.10 SP1	PC based software, used to analyze and generate test I/Q signals. It supports 5G-NR uplink & downlink plus O-RAN measurements.
	Keysight O-RAN Studio	2.3.1094 4.0, 6.2.0.3	
Fronthaul switch	Fibrolan Falcon-RX	Falcon_ RX812G _8-0-17-4	Fronthaul transport and timing switch compatible with ORAN architecture. It has high-capacity low latency and supports extensive sync and timing options like SyncE and PTP (PTRC/GM, BC, TC).
Fronthaul Analyzer	Wireshark	4.0.3	A protocol analyzer that parses and decodes O-RAN fronthaul interface packets. It provides visibility into the fronthaul protocol messages.

Table 2 – Test equipment list

7.4.2 Test Setup

The test setup is illustrated in the diagram below.

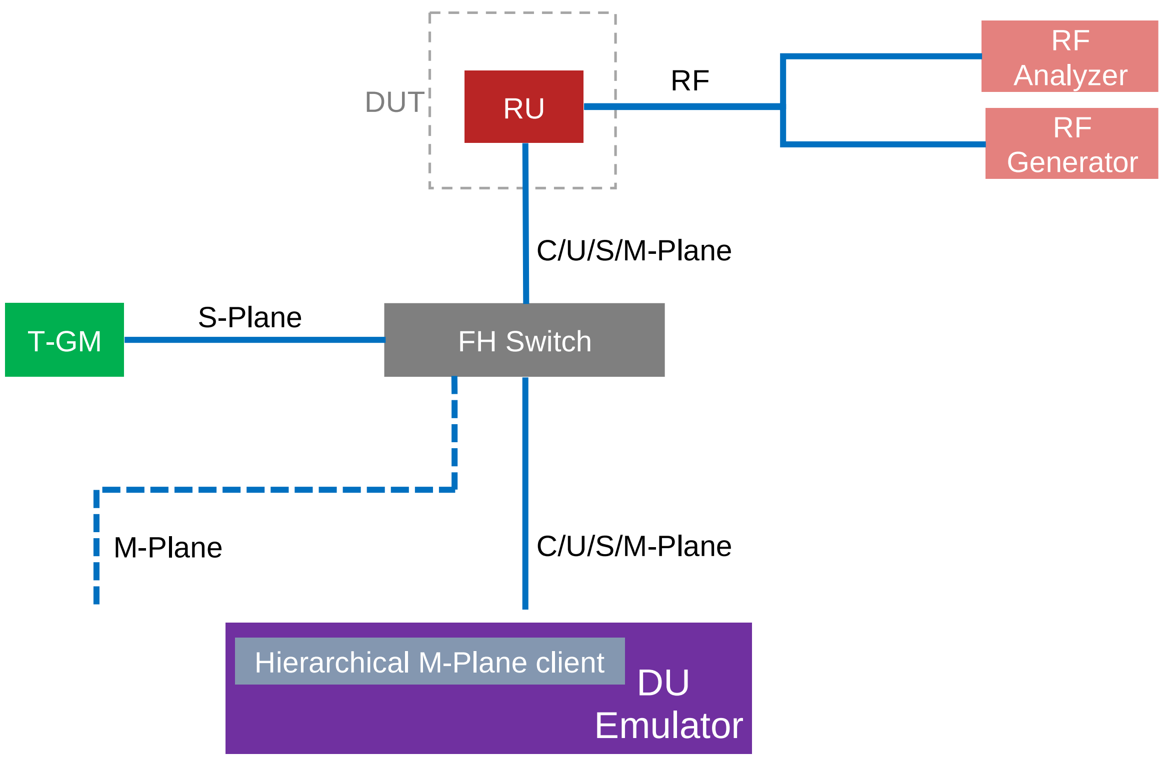

Figure 3 – Test Setup logic diagram

7.5 Test Cases

7.5.1 RU-TC-0.1 S-Plane integration

The purpose of this test is to validate the integration of RU's S-Plane to the RU wraparound test environment.
The test procedure is described in [5] (VIAVI) and in [6] (Keysight).

Success criteria:

1) The RU has been able to successfully establish S-Plane connectivity and achieve time synchronization.

Collect and store relevant log files providing evidence of the successful execution of this test case.

7.5.2 RU-TC-0.2 M-Plane integration

The purpose of this test is to validate the successful integration of M-Plane between RU and the RU wraparound tester.

Step1: in the RU wraparound tester SW application user menu initiate the M-Plane NETCONF Listen procedure.
Success criteria:

1) The RU has been able to successfully establish M-Plane connectivity with the RU wraparound tester.
2) Observe the RU wraparound tester command output log information indicating Call Home Completed.

Collect and store relevant log files providing evidence of the successful execution of this test case.

Step 2: in the RU wraparound tester SW application user menu get the M-Plane Elements unfiltered.
Success criteria:

1) The RU has been able to successfully establish M-Plane connectivity with the RU wraparound tester.
2) Observe the RU wraparound tester command output log information indicating Sending RPC Get Unfiltered.
3) Observe the RU wraparound tester M-Plane output log information showing the RU configuration parameters (unfiltered).

Collect and store relevant log files providing evidence of the successful execution of this test case.

7.5.3 RU-TC-0.3 UC-Plane integration

The purpose of this test is to validate the integration of RU's UC-Plane to the RU wraparound test environment.

The test procedure is described in [5] (VIAVI) and in [6] (Keysight).

Success criteria:

1) The RU has been able to successfully establish UC-Plane connectivity with the RU wraparound tester.
2) Observe the RU wraparound tester command output log information indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8 Level 1 Test Plan

8.1 Objective

RU to demonstrate compliance to the O-RAN Fronthaul technical specifications. Test cases include M-Plane, U-Plane, C-Plane and S-Plane procedures.

8.2 Prerequisites

RU shall have demonstrated successful integration with the test environment (Level-0), prior to proceeding to Level-1 testing.

8.3 Preparation

RU S-Plane reports its state over M-Plane.
The DU FH Emulator has been configured to match the RU fronthaul parameters.

8.4 Test Environment

Same as in Level-0.

8.4.1 Test Equipment

Same as in Level-0.

8.4.2 Test Setup

Same as in Level-0.

8.5 Test Cases - M-Plane

8.5.1 Transport and Handshake

RU-TC-WG4.CONF.3.1.1.1 M-Plane Transport for IPv4 Positive Test

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in a IPv4 environment.

The test methodology, including the test procedure, is described in section 3.1.1.1 C in [2].

Success criteria:

1) Per section 3.1.1.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.2 M-Plane Transport for IPv4 Negative Test

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in a IPv4 environment.
Two negative flows are included in this test:

- The RU wraparound tester NETCONF Client does not trigger an SSH session establishment in reaction to Call Home initiated by the RU NETCONF Server.
- The RU wraparound tester NETCONF Client uses improper credentials when trying to establish an SSH session with the RU NETCONF Server.

The test methodology, including the test procedure, is described in section 3.1.1.2 C in [2].

Success criteria:

1) Per section 3.1.1.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.3 M-Plane Transport IPv6 Stateful Configuration Positive Test

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in a IPv6 environment.

The test methodology, including the test procedure, is described in section 3.1.1.3 C in [2].

Success criteria:

1) Per section 3.1.1.3 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.4 M-Plane Transport IPv6 Negative Test

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in a IPv6 environment.
Two negative flows are included in this test:
The TER NETCONF Client does not trigger a SSH session establishment in reaction to a Call Home initiated by the RU NETCONF Server.
The TER NETCONF Client uses improper credentials when trying to establish SSH session towards the RU NETCONF Server.

The test methodology, including the test procedure, is described in section 3.1.1.4 C in [2].

Success criteria:

1) Per section 3.1.1.4 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.5 Transport and Handshake in IPv4/TLS environment (positive case)

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in an IPv4 TLS environment.

The test methodology, including the test procedure, is described in section 3.1.1.5 C in [2].

Success criteria:

1) Per section 3.1.1.5 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.6 Transport and Handshake in IPv4/TLS environment (negative case)

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in an IPv4 TLS environment.

The test methodology, including the test procedure, is described in section 3.1.1.6 C in [2].

Success criteria:

1) Per section 3.1.1.6 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.7 Transport and Handshake in IPv6/TLS environment (positive case)

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in an IPv6 TLS environment.

The test methodology, including the test procedure, is described in section 3.1.1.7 C in [2].

Success criteria:

1) Per section 3.1.1.7 D in [2].

2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.1.8 Transport and Handshake in IPv6/TLS environment (negative case)

This test case validates that the RU properly executes the M-Plane session establishment procedure with VLANs and a DHCPv4 server in an IPv6 TLS environment.

The test methodology, including the test procedure, is described in section 3.1.1.8 C in [2].

Success criteria:

1) Per section 3.1.1.8 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.2 Manage Alarm Requests

RU-TC-WG4.CONF.3.1.2.1 M-Plane Alarm Subscription to Notifications

This test case validates that the RU properly handles a NETCONF subscription to alarm notifications.

The test methodology, including the test procedure, is described in section 3.1.2.1 C in [2].

Success criteria:

1) Per section 3.1.2.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.3 Connection Supervision

RU-TC-WG4.CONF.3.1.3.1 M-Plane Connection Supervision Positive

This test case validates that the RU manages the connection supervision process correctly.

The test methodology, including the test procedure, is described in section 3.1.3.1 C in [2].

Success criteria:
1) Per section 3.1.3.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.3.2 M-Plane Connection Supervision Negative

This test case validates that the RU manages the connection supervision process correctly.

The test methodology, including the test procedure, is described in section 3.1.3.2 C in [2].

Success criteria:
1) Per section 3.1.3.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.4 Retrieval of RU's information elements

RU-TC-WG4.CONF.3.1.4.1 M-Plane Retrieve Information Element without Filter

This test case validates that the RU NETCONF Server properly executes a general get command.

The test methodology, including the test procedure, is described in section 3.1.4.1 C in [2].

Success criteria:
1) Per section 3.1.4.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.4.2 M-Plane Retrieve Information Element with Filter

This test case validates that the RU NETCONF Server properly executes a get command with a filter applied.

The test methodology, including the test procedure, is described in section 3.1.4.2 C in [2].

Success criteria:
1) Per section 3.1.4.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.5 Fault Management

RU-TC-WG4.CONF.3.1.5.1 M-Plane FM Alarm Notification

This test case validates that the RU NETCONF Server properly sends and alarm notification.

The test methodology, including the test procedure, is described in section 3.1.5.1 C in [2].

Success criteria:

1) Per section 3.1.5.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.5.2 M-Plane FM Retrieve Active Alarms

This test case validates that the RU NETCONF Server can send an active alarms list to the TER NETCONF Client.

The test methodology, including the test procedure, is described in section 3.1.5.2 C in [2].

Success criteria:

1) Per section 3.1.5.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.6 RU Software Update

RU-TC-WG4.CONF.3.1.6.1 M-Plane SW Update and Install_Pos

This test case validates that the RU can successfully perform a software download and software installation procedure.

The test methodology, including the test procedure, is described in section 3.1.6.1 C in [2].

Success criteria:

1) Per section 3.1.6.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.6.2 M-Plane SW Update Negative

This test case validates that the RU can successfully perform a software download procedure. One or more files are intentionally corrupted to make sure that the RU is able to recognize an invalid software update file and protect itself from installing this file.

The test methodology, including the test procedure, is described in section 3.1.6.2 C in [2].

Success criteria:
1) Per section 3.1.6.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.7 RU Software Activation

RU-TC-WG4.CONF.3.1.7.1 M-Plane SW Activation No Reset

This test case validates that the RU can successfully activate software in a specific slot on the RU.

The test methodology, including the test procedure, is described in section 3.1.7.1 C in [2].

Success criteria:
1) Per section 3.1.7.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.7.2 M-Plane Supplemental Reset after SW Activation

This test case validates that the RU can successfully start up with activated software.

The test methodology, including the test procedure, is described in section 3.1.7.2 C in [2].

Success criteria:
1) Per section 3.1.7.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.8 Access Control

RU-TC-WG4.CONF.3.1.8.1 M-Plane Sudo Hybrid Positive

This test case validates that the RU can successfully start up with activated software in the case where both RU and DU support the Hybrid M-plane architecture model.

The test methodology, including test procedure, is described in section 3.1.8.1 in [2].

Success criteria:

1) Per section 3.1.8.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.8.6 M-Plane Sudo Hierarchical Positive

This test case validates that the RU can successfully start up with activated software in the case where both RU and DU support the Hierarchical M-plane architecture model.

The test methodology, including test procedure, is described in section 3.1.8.6 in [2].

Success criteria:

3) Per section 3.1.8.6 D in [2].
4) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.9 RU Configurability

RU-TC-WG4.CONF.3.1.10.1 M-Plane RU Configurability Positive

This test case validates RU eAxC configuration and validation.

The test methodology, including test procedure, is described in section 3.1.10.1 in [2].

Success criteria:

1) Per section 3.1.10.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.10.2 M-Plane RU Configurability Negative

This test case validates RU rejects configuration when the same eAxC_ID is assigned to more than one low-level-tx-endpoint or/and more than one low-level-rx-endpoint.

The test methodology, including test procedure, is described in section 3.1.10.2 in [2].

Success criteria:

1) Per section 3.1.10.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.5.10 Log Management

RU-TC-WG4.CONF.3.1.12.1 M-Plane Log Management - Troubleshooting test

This test case validates the capability of the RU to upload troubleshooting logs including alarm information.

The test methodology, including test procedure, is described in section 3.1.12.1 in [2].

Success criteria:

1) Per section 3.1.12.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.1.12.2 M-Plane Log Management - Trace Test

This test case validates the capability of the RU to upload troubleshooting logs including alarm information.

The test methodology, including test procedure, is described in section 3.1.12.2 C in [2].

Success criteria:

1) Per section 3.1.12.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.6 Test Cases - UC-Plane FR1 FDD (Conducted RF Signal)

Note: This section is applicable only to RU that supports FDD. The RU can either run the FDD or the TDD UC-Plane (or both) test cases depending on the duplexing option(s) supported.

The UC-Plane aims to demonstrate that the RU correctly interprets and generates the O-RAN C-Plane and U-Plane messages.
Note: The test cases in this section are applicable to FR1 FDD conducted RF testing.

8.6.1 UC-Plane RU Scenario Class NR testing Generic

Prerequisite: The RU must support the default radio parameters in section 3.2.1.1.3 in [2].

RU-TC-WG4.CONF.3.2.3.1.1 UC-Plane FDD Scenario Class Base Downlink

This test case validates the capability of the RU to meet the basic downlink requirements for O-RAN fronthaul using a standard 3GPP NR-FR1-TM1.1 test frame for FDD.
The RU wraparound tester generates C-Plane and U-Plane messages using the default parameters specified in sections 3.2.1.1.3 and 3.2.1.1.5 in [2].

Test description per section 3.2.3.1.1 A in [2].
Test entrance criteria per section in 3.2.3.1.1 B in [2].
Test procedure per section 3.2.3.1.1 C in [2].

Success criteria:

1) Per section 3.2.3.1.1 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.1.2 UC-Plane FDD Extended DL RA Base

This test case validates the capability of the RU to interpret C-Plane resource allocation messages, transfer U-Plane data into the correct resource blocks and transmit this data in the downlink.

Test description per section 3.2.3.1.2 A in [2].
Test entrance criteria per section in 3.2.3.1.2 B in [2].
Test procedure per section 3.2.3.1.2 C in [2].

Success criteria:

1) Per section 3.2.3.1.2 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.1.3 UC-Plane FDD Scenario Class Base Uplink

This test case validates that the RU can interpret C-Plane messages and uplink U-Plane messages from a reference RF signal.

Test description per section 3.2.3.1.3 A in [2].
Test entrance criteria per section in 3.2.3.1.3 B in [2].
Test procedure per section 3.2.3.1.3 C in [2].

Success criteria:

1) Per section 3.2.3.1.3 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.1.4 UC-Plane FDD Extended DL RA using RB Parameter

This test case validates that the RU can interpret C-Plane resource allocation (RA) messages with the *RB* parameter set, transfer U-Plane data into the resource blocks and transmit this data in the downlink.

Test description per section 3.2.3.1.4 A in [2].
Test entrance criteria per section in 3.2.3.1.4 B in [2].
Test procedure per section 3.2.3.1.4 C in [2].

Success criteria:

1) Per section 3.2.3.1.4 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.1.5 UC-Plane FDD Extended UL RA using RB Parameter

This test case validates that the RU capability of interpreting the *RB* parameter in C-Plane messages and uplink U-Plane messages from a reference 3GPP RF signal.

Test description per section 3.2.3.1.5 A in [2].
Test entrance criteria per section in 3.2.3.1.5 B in [2].
Test procedure per section 3.2.3.1.5 C in [2].

Success criteria:

1) Per section 3.2.3.1.5 D in [2].

2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.6.2 UC-Plane RU Scenario Compression

RU-TC-WG4.CONF.3.2.3.3.3 UC-Plane FDD Scenario Class Compression – Static Format (SF) Block Floating Point (BFP)

This test case validates that the RU supports Static Modulation Compression according to the requirements specified in [2].

Test description per section 3.2.3.3.3 A in [2].
Test entrance criteria per section in 3.2.3.3.3 B in [2].
Test procedure per section 3.2.3.3.3 C in [2].

Success criteria:
1) Per section 3.2.3.3.3 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.3.6 UC-Plane FDD Scenario Class Compression - Static Modulation-Compressed

This test case validates that the RU supports Static Modulation Compression according to the requirements specified in [2].

Test description per section 3.2.3.3.6 A in [2].
Test entrance criteria per section in 3.2.3.3.6 B in [2].
Test procedure per section 3.2.3.3.6 C in [2].

Success criteria:
1) Per section 3.2.3.3.6 D in [2].
2) Observe the RU wraparound tester command output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.6.3 UC-Plane RU Scenario Class Delay Management

RU-TC-WG4.CONF.3.2.3.4.1 UC-Plane FDD Scenario Class DLM Test #1 DL Positive

This test case validates that the timing on the air interface is according to the requirements specified in [2], when the C-Plane and the U-Plane messages are received within the RU's reception windows.

Test description per section 3.2.3.4.1 A in [2].
Test entrance criteria per section in 3.2.3.4.1 B in [2].
Test procedure per section 3.2.3.4.1 C in [2].

<u>Success criteria:</u>

1) Per section 3.2.3.4.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.4.2 UC-Plane FDD Scenario Class DLM Test #2 UL Positive

This test case will validate that RU Fronthaul U-Plane data in uplink direction is transmitted correctly within RU's transmission window.

Test description per section 3.2.3.4.2 A in [2].
Test entrance criteria per section in 3.2.3.4.2 B in [2].
Test procedure per section 3.2.3.4.2 C in [2].

<u>Success criteria:</u>

1) Per section 3.2.3.4.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.4.3 UC-Plane FDD Scenario Class DLM Test #3 DL Negative

This test case will validate that the RU has increment relevant M-Plane counters if C-Plane and/or U-Plane messages are not received within the RU reception window.

Test description per section 3.2.3.4.3 A in [2].
Test entrance criteria per section in 3.2.3.4.3 B in [2].
Test procedure per section 3.2.3.4.3 C in [2].

<u>Success criteria:</u>

1) Per section 3.2.3.4.3 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.3.4.4 UC-Plane FDD Scenario Class DLM Test #4 UL Negative

This test case will validate that the RU correctly increments relevant M-Plane counters if C-Plane and/or U-Plane messages are not received within the DU reception window.

Test description per section 3.2.3.4.4 A in [2].
Test entrance criteria per section in 3.2.3.4.4 B in [2].
Test procedure per section 3.2.3.4.4 C in [2].

Success criteria:
1) Per section 3.2.3.4.4 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.6.4 UC-Plane RU Scenario Class Section Type 3

RU-TC-WG4.CONF.3.2.3.8.1 UC-Plane RU Scenario Class ST3 Test #1: NR PRACH

This test case will validate that the RU correctly decoding of C-Plane messages containing section type 3 in 5G NR scenario by testing the correct detection of a PRACH signal.

Test description per section 3.2.3.8.1 A in [2].
Test entrance criteria per section in 3.2.3.8.1 B in [2].
Test procedure per section 3.2.3.8.1 C in [2].

Success criteria:
1) Per section 3.2.3.8.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

8.7 Test Cases - UC-Plane FR1 TDD (Conducted RF Signal)

Note: This section is applicable only to RU that supports TDD. The RU can either run the FDD or the TDD UC-Plane (or both) test cases depending on the duplexing option(s) supported.

The UC-Plane aims to demonstrate that the RU correctly interprets and generates the O-RAN C-Plane and U-Plane messages.
Note: The test cases in this section are applicable to FR1 TDD conducted RF testing.

8.7.1 UC-Plane RU Scenario Class NR testing Generic

Prerequisite: The RU must support the default radio parameters in section 3.2.1.1.3 in [2].

RU-TC-WG4.CONF.3.2.5.1.1 UC-Plane TDD Scenario Class Base DL/UL

This test case validates the capability of the RU to transmit and receive a basic 3GPP, TDD test frame using the default parameters in section 3.2.1.1.3 in [2] (one spatial stream on one antenna).

Test description per section 3.2.5.1.1 A in [2].
Test entrance criteria per section in 3.2.5.1.1 B in [2].
Test procedure per section 3.2.5.1.1 C in [2].

Success criteria:
1) Per section 3.2.5.1.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.1.2 UC-Plane TDD Extended DL/UL RA Base

This test case validates the capability of the RU to transmit and receive an extended 3GPP TDD test frame using the default parameters in section 3.2.1.1.3 in [2] (one spatial stream on one antenna).

Test description per section 3.2.5.1.2 A in [2].
Test entrance criteria per section in 3.2.5.1.2 B in [2].
Test procedure per section 3.2.5.1.2 C in [2].

Success criteria:
1) Per section 3.2.5.1.2 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.1.3 UC-Plane TDD Extended DL/UL RA using RB Parameter

This test case validates the capability of the RU to transmit and receive an extended 3GPP TDD test frame using the default parameters in section 3.2.1.1.3 in [2] (one spatial stream on one antenna) and using the *rb* bit in both uplink and downlink.

Test description per section 3.2.5.1.3 A in [2].
Test entrance criteria per section in 3.2.5.1.3 B in [2].
Test procedure per section 3.2.5.1.3 C in [2].

Success criteria:
Test results, per section 3.2.5.1.3D in [2]. Observe the command output log information (RU wraparound tester→User Interface→Command Output) indicating PASS.
Collect and store relevant log files providing evidence of successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.1.5 UC-Plane TDD Extended DL/UL RA using reMask Parameter

This test case validates the capability of the RU to transmit and receive an extended 3GPP TDD test frame using the default parameters in section 3.2.1.1.5 in [2] (one spatial stream on one antenna) and using the *reMask* bit in both uplink and downlink.

Test description per section 3.2.5.1.5 A in [2].
Test entrance criteria per section in 3.2.5.1.5 B in [2].
Test procedure per section 3.2.5.1.5 C in [2].

Success criteria:
1) Test results, per section 3.2.5.1.5 D in [2].
2) Observe the command output log information indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

8.7.2 UC-Plane RU Scenario Compression

RU-TC-WG4.CONF.3.2.5.3.3 UC-Plane TDD Scenario Class Compression - Static Block Floating Point

This test case validates that the RU supports IQ signals compression for Block Floating Point format for 9 bits and 14 bits bit-width.

Test description per section 3.2.5.3.3 A in [2].
Test entrance criteria per section in 3.2.5.3.3 B in [2].
Test procedure per section 3.2.5.3.3 C in [2].

Success criteria:
1) Per section 3.2.5.3.3 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.3.6 UC-Plane TDD Scenario Class Compression - Static Modulation-Compressed

This test case validates that the RU supports Modulation Compression in downlink (note: Modulation Compression is not applicable to uplink).

Test description per section 3.2.5.3.6 A in [2].
Test entrance criteria per section in 3.2.5.3.6 B in [2].
Test procedure per section 3.2.5.3.6 C in [2].

Success criteria:

1) Per section 3.2.5.3.6D in [2].
2) Observe the command output log information indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

8.7.3 UC-Plane RU Scenario Class Delay Management

RU-TC-WG4.CONF.3.2.5.4.1 UC-Plane TDD Scenario Class DLM Test #1 DL Positive

This test case validates that the C-Plane and the U-Plane messages are received within the RU's reception windows, when TDD waveform (per section 3.2.1.1.3 in [2]) is used.

Test description per section 3.2.5.4.1 A in [2].
Test entrance criteria per section in 3.2.5.4.1 B in [2].
Test procedure per section 3.2.5.4.1 C in [2].

Success criteria:

1) Per section 3.2.5.4.1 D in [2].
2) Observe the command RU wraparound tester output log indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.4.2 UC-Plane TDD Scenario Class DLM Test #2 UL Positive

This test case will validate that RU Fronthaul U-Plane data in uplink direction is transmitted correctly within RU's transmission window, when TDD waveform (per section 3.2.1.1.3 in [2]) is used.

Test description per section 3.2.5.4.2 A in [2].
Test entrance criteria per section in 3.2.5.4.2 B in [2].
Test procedure per section 3.2.5.4.2 C in [2].

Success criteria:

1) Per section 3.2.5.4.2 D in [2].
2) Correct data is received at DU Emulator within the correct time window. Observe the command output log information indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.4.3 UC-Plane TDD Scenario Class DLM Test #3 DL Negative

This test case will validate that the RU has increment relevant M-Plane counters if C-Plane and/or U-Plane messages are not received within the RU reception window, when TDD waveform (per section 3.2.1.1.3 in [2]) is used.

Test description per section 3.2.5.4.3 A in [2].
Test entrance criteria per section in 3.2.5.4.3 B in [2].
Test procedure per section 3.2.5.4.3 C in [2].

Success criteria:

1) Per section 3.2.5.4.3 D in [2].
2) M-Plane performance measurements in the list "rx-window-measurement-objects" for RX_EARLY and RX_LATE are incremented according to the test procedure.
3) Observe the command output log information indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

RU-TC-WG4.CONF.3.2.5.4.4 UC-Plane TDD Scenario Class DLM Test #4 UL Negative

This test case will validate that the RU correctly increments relevant M-Plane counters if C-Plane and/or U-Plane messages are not received within the DU reception window, when TDD waveform (per section 3.2.1.1.3 in [2]) is used.

Test description per section 3.2.5.4.4 A in [2].
Test entrance criteria per section in 3.2.5.4.4 B in [2].
Test procedure per section 3.2.5.4.4 C in [2].

Success criteria:

1) Per section 3.2.5.4.4 D in [2].
2) M-Plane performance measurements in the list "rx-window-measurement-objects" for RX_EARLY and RX_LATE are incremented properly.
3) Observe the command output log information indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

8.8 Test Cases - S-Plane

The objective of S-Plane testing is to validate the RU time synchronization state under different time synchronization topologies.

- LLS-C1; when RU is directly connected to an DU.
- LLS-C2; when the synchronization is delivered to the RU via the DU and over a bridged network.
- LLS-C3; when the synchronization is distributed to the RU without involving the DU.

RU-TC-WG4.CONF.3.3.2-Functional test of RU using ITU-T G.8275.1 profile (LLS-C1/C2/C3)

This test case validates that the RU can synchronize to the RU wrap-around test environment delivering both PTP and SyncE using ITU-T G.8275.1 profile.

LLS-C1

Applicable when RU supports a direct connection between DU and RU. Test setup as shown below.

Note: The Signal Analyzer and Signal Generator are not used for S-Plane functional testing purposes. They are used as auxiliary test equipment in case further troubleshooting is needed.

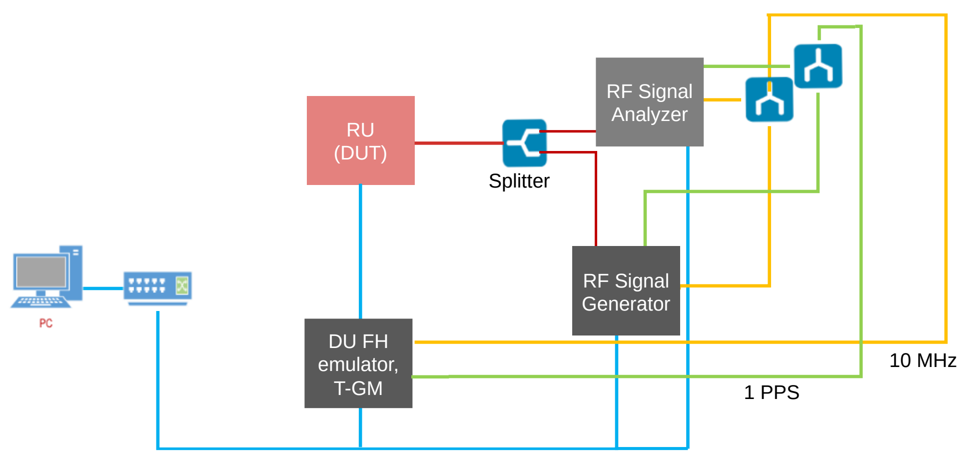

Figure 4 – LLS-C1 Test setup: T-GM in DU FH emulator and direct connection to the RU

The test procedure is described in section 3.3.2 in [2].

Success criteria:

1) Per Table 3.3.2 2 in [2].
2) Observe the command output log information of the RU wraparound tester indicating PASS.

Collect and store relevant log files providing evidence of successful execution of this test case.

LLS-C2

Applicable when RU supports a synchronization network -between DU and RU- and the synchronization is delivered to the RU via the DU and over the bridged network. Test setup as in the figure below.

Note: The Singal Analyzer and Signal Generator are not used for S-Plane functional testing purposes. They are used as auxiliary test equipment in case further troubleshooting is needed.

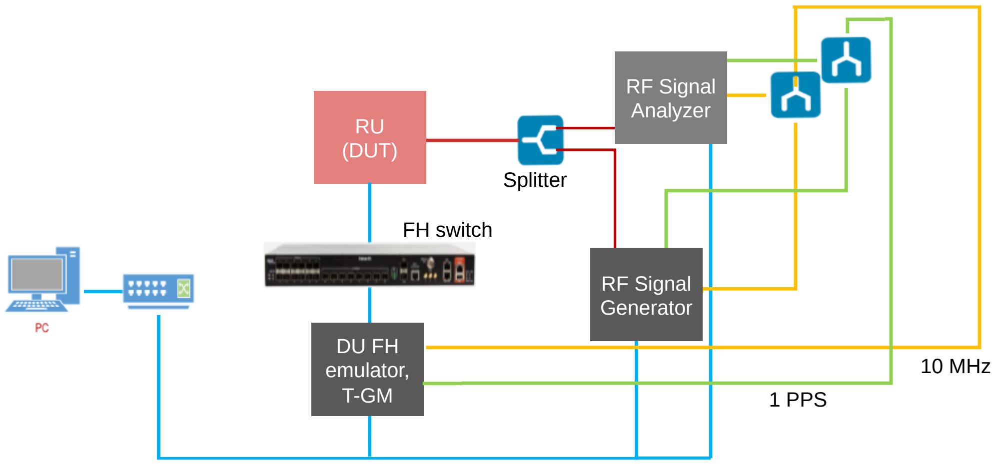

Figure 5 – LLS-C2 Test setup: T-GM in DU FH emulator and FH switch as BC

The test procedure is described in section 3.3.2 in [2].

Success criteria:
1) Per Table 3.3.2 2 in [2].
2) Observe the command output log information from the RU wraparound tester indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

LLS-C3

Applicable when RU supports a synchronization network -between DU and RU- and the synchronization is distributed to the RU without involving the DU. Test setup as in the figure below.

Note: The Signal Analyzer and Signal Generator are not used for S-Plane functional testing purposes. They are used as auxiliary test equipment in case further troubleshooting is needed.

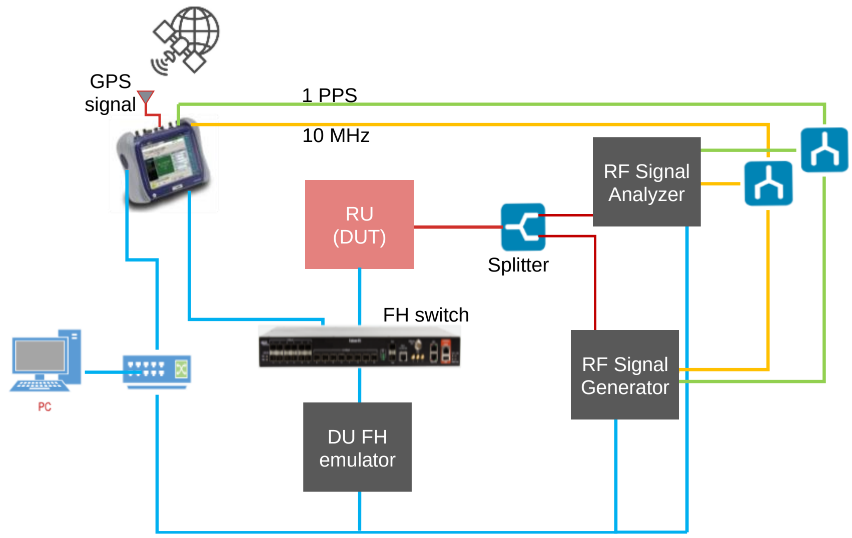

Figure 6 – LLS-C3 Test setup: T-GM distributed via the FH transport switch to both RU and DU FH emulator

The test procedure is described in section 3.3.2 in [2].

Success criteria:

3) Per Table 3.3.2 2 in [2].
4) Observe the command output log information from the RU wraparound tester indicating PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

RU-TC-WG4.CONF.3.3.3 Performance test of RU using ITU-T G.8275.1 profile (LLS- C1)

This test case validates that the RU can synchronize to the RU wrap-around tester delivering configured PTP (ideal and normal operating conditions) and (optionally) SyncE using ITU-T G.8275.1 profile. Applicable when RU supports LLS-C1.

The test setup is the same used in 0.

The test methodology, including the test procedure, is described in section 3.3.3 in [2].

Success criteria:

1) Per section 3.3.3 D in [2].
2) The RU wraparound tester command output log information indicates PASS.

Collect and store relevant log files providing evidence of the successful execution of this test case.

9 References

[1] O-RAN.WG4.CUS.0-v05.00

[2] O-RAN.WG4.CONF.0-v05.00
[3] O-RAN.WG4.M.0-v05.00
[4] O-RAN.WG4.IOT.0-v05.00
[5] Viavi RU Tester User Guide
[6] Keysight O-RAN Studio User Guide

10 Annex A. Fronthaul M-Plane IOT Profiles

See external directory for Fronthaul M-Plane IOT profile.

11 Annex B. Fronthaul UC-Plane IOT Profile

See external directory for Fronthaul UC-Plane IOT profile.

12 Annex C. Viavi RU-tester RU configuration information

See external directory for Viavi configuration information.

13 Annex D. Keysight ORAN Studio RU configuration information

See external directory for Keysight configuration information.

14 Annex E. Scoring

For RU Stage-Two is pass / fail. Test cases are labeled as MANDATORY (M) and CONDITIONAL MANDATORY (CM).

A CONDITIONAL MANDATORY test case becomes MANDATORY for a contestant who will use the corresponding functionality in Stage Three or Stage Four. Otherwise, the CONDITIONAL MANDATORY test case will be treated as OPTIONAL.

RU shall have successfully completed Stage Two testing once it passes all the MANDATORY test cases and applicable CONDITIONAL MANDATORY test cases (see above).

Table 3. RU test requirements

Level	Category	Sub-category	Test Case ID	Test Case Name	INITIAL Requirement
0	Integration	-	RU-TC-0.1	S-Plane integration	M
			RU-TC-0.2	M-Plane integration	CM
			RU-TC-0.3	UC-Plane integration	M
1	M-Plane	Transport and Handshake	RU-TC-WG4.CONF.3.1.1.1	M-Plane Transport for IPv4 Positive Test	CM
			RU-TC-WG4.CONF.3.1.1.2	M-Plane Transport for IPv4 Negative Test	CM
			RU-TC-WG4.CONF.3.1.1.3	M-Plane Transport IPv6 Stateful Configuration Positive Test	CM
			RU-TC-WG4.CONF.3.1.1.4	M-Plane Transport IPv6 Negative Test	CM
			RU-TC-WG4.CONF.3.1.1.5	Transport and Handshake in IPv4/TLS Environment (positive case)	CM
			RU-TC-WG4.CONF.3.1.1.6	Transport and Handshake in IPv4/TLS Environment (negative case)	CM
			RU-TC-WG4.CONF.3.1.1.7	Transport and Handshake in IPv6/TLS Environment (positive case)	CM
			RU-TC-WG4.CONF.3.1.1.8	Transport and Handshake in IPv6/TLS Environment (negative case)	CM
		Manage Alarm Requests	RU-TC-WG4.CONF.3.1.2.1	M-Plane Alarm Subscription to Notifications	CM
		Connection Supervision	RU-TC-WG4.CONF.3.1.3.1	M-Plane Connection Supervision Positive	CM
			RU-TC-WG4.CONF.3.1.3.2	M-Plane Connection Supervision Negative	CM
		Retrieval of RU's Information Elements	RU-TC-WG4.CONF.3.1.4.1	M-Plane Retrieve Information Element without Filter	CM
			RU-TC-WG4.CONF.3.1.4.2	M-Plane Retrieve Information Element with Filter	CM
		Fault Management	RU-TC-WG4.CONF.3.1.5.1	M-Plane FM Alarm Notification	CM
			RU-TC-WG4.CONF.3.1.5.2	M-Plane FM Retrieve Active Alarms	CM
		RU Software Update	RU-TC-WG4.CONF.3.1.6.1	M-Plane SW Update and Install_Pos	CM
			RU-TC-WG4.CONF.3.1.6.2	M-Plane SW Update Negative	CM
		RU Software Activation	RU-TC-WG4.CONF.3.1.7.1	M-Plane SW Activation No Reset	CM
			RU-TC-WG4.CONF.3.1.7.2	M-Plane Supplemental Reset after SW Activation	CM
		Access Control	RU-TC-WG4.CONF.3.1.8.1	M-Plane Sudo Hybrid Positive	CM

			RU-TC-WG4.CONF.3.1.8.6	M-Plane Sudo Hierarchical Positive	CM
		RU Configurability	RU-TC-WG4.CONF.3.1.10.1	M-Plane RU Configurability Positive	CM
			RU-TC-WG4.CONF.3.1.10.2	M-Plane RU Configurability Negative	CM
		Log Management	RU-TC-WG4.CONF.3.1.12.1	M-Plane Log Management - Troubleshooting test	CM
			RU-TC-WG4.CONF.3.1.12.2	M-Plane Log Management - Trace Test	CM
	UC-Plane FDD	RU Scenario Class NR testing Generic	RU-TC-WG4.CONF.3.2.3.1.1	UC-Plane FDD Scenario Class Base DL	M
			RU-TC-WG4.CONF.3.2.3.1.2	UC-Plane FDD Extended DL RA Base	M
			RU-TC-WG4.CONF.3.2.3.1.3	UC-Plane FDD Scenario Class Base UL	M
			RU-TC-WG4.CONF.3.2.3.1.4	UC-Plane FDD Extended DL RA using RB Parameter	CM
			RU-TC-WG4.CONF.3.2.3.1.5	UC-Plane FDD Extended UL RA using RB Parameter	CM
		UC-Plane RU Scenario Compression	RU-TC-WG4.CONF.3.2.3.3.3	UC-Plane RU Scenario Class Compression Static Format (SF) Block Floating Point (BFP)	CM
			RU-TC-WG4.CONF.3.2.3.3.6	UC-Plane FDD Scenario Class Compression - Static Modulation-Compressed	CM
		UC-Plane RU Scenario Class Delay Management	RU-TC-WG4.CONF.3.2.3.4.1	UC-Plane FDD Scenario Class DLM Test #1 DL Positive	M
			RU-TC-WG4.CONF.3.2.3.4.2	UC-Plane FDD Scenario Class DLM Test #2 UL Positive	M
			RU-TC-WG4.CONF.3.2.3.4.3	UC-Plane FDD Scenario Class DLM Test #3 DL Negative	M
			RU-TC-WG4.CONF.3.2.3.4.4	UC-Plane FDD Scenario Class DLM Test #4 UL Negative	M
		UC-Plane RU Scenario Class Section Type 3	RU-TC-WG4.CONF.3.2.3.8.1	UC-Plane RU Scenario Class ST3 Test #1: NR PRACH	M
	UC-Plane TDD	RU Scenario Class NR testing Generic	RU-TC-WG4.CONF.3.2.5.1.1	UC-Plane TDD Scenario Class Base DL/UL	M
			RU-TC-WG4.CONF.3.2.5.1.2	UC-Plane TDD Extended DL/UL RA Base	CM
			RU-TC-WG4.CONF.3.2.5.1.3	UC-Plane TDD Extended DL/UL RA using RB Parameter	CM
			RU-TC-WG4.CONF.3.2.5.1.5	UC-Plane TDD Extended DL/UL RA using reMask Parameter	CM
		UC-Plane RU Scenario Class Compression	RU-TC-WG4.CONF.3.2.5.3.3	UC-Plane TDD Scenario Class Compression - Static Block Floating Point	CM
			RU-TC-WG4.CONF.3.2.5.3.6	UC-Plane TDD Scenario Class Compression - Static Modulation-Compressed	CM
		UC-Plane RU Scenario Class Delay Management	RU-TC-WG4.CONF.3.2.5.4.1	UC-Plane TDD Scenario Class DLM Test #1 DL Positive	M
			RU-TC-WG4.CONF.3.2.5.4.2	UC-Plane TDD Scenario Class DLM Test #2 UL Positive	M
			RU-TC-WG4.CONF.3.2.5.4.3	UC-Plane TDD Scenario Class DLM Test #3 DL Negative	M
			RU-TC-WG4.CONF.3.2.5.4.4	UC-Plane TDD Scenario Class DLM Test #4 UL Negative	M
	S-Plane	-	RU-TC-WG4.CONF.3.3.2	Functional test of RU using ITU-T G.8275.1 profile (LLS- C1/C2/C3)	M
			RU-TC-WG4.CONF.3.3.3	Performance test of RU using ITU-T G.8275.1 Profile	CM