5G Challenge
Stage Four – Mobility Test Plan

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3 Version History

Version	Date	Author(s)	Notes
1.0	February 14, 2023	Omkar Dharmadhikari	Initial Release Draft
1.1	March 20, 2023	Omkar Dharmadhikari	Addressed comments from NTIA and added a detailed test case table with scoring details in the Annex.

4 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
E2E	End-to-End
eCPRI	Enhanced Common Public Radio Interface
EMS	Element Management System
FDD	Frequency Division Duplex
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	Sub Miniature 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
vRAN	Virtualized Radio Access Network

5 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
- Secure networks
- 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.

6 Summary

The 2023 5G Challenge focuses on basic functionality of 5G RAN components utilizing open interfaces and interoperable subsystems. The Event will be conducted at CableLabs (acting as a host lab in Louisville, CO). In this Event, participating contestants will have the opportunity to integrate and test their subsystems with the host lab leading up to the prize challenge.

The 2023 5G Challenge Event consists of four stages:

- Stage One: Application
- Stage Two: Emulated Integration
- Stage Three: 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.

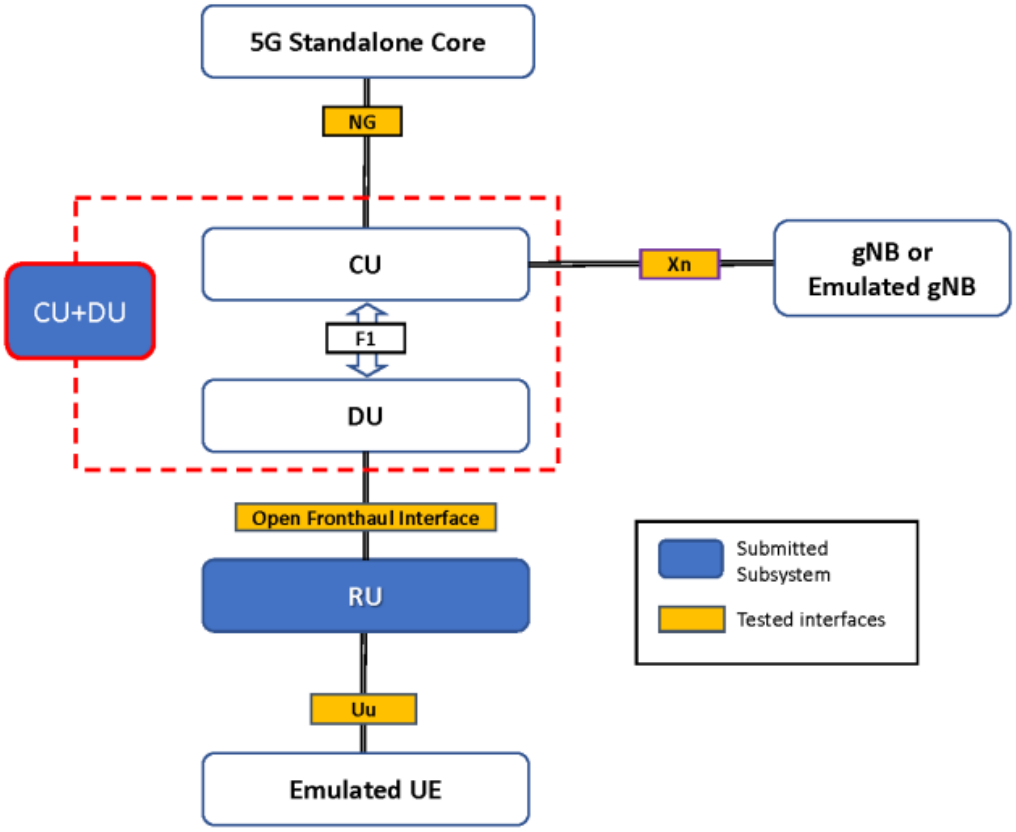

Figure 1 - 5G Challenge Reference Architecture

This document is a compendium of mobility test procedures within Stage Four, which include the following levels:

- **Level 0: Integration** - These test cases verify the basic connectivity of the mobility setup which are pre-requisite for running any further mobility test cases. The test cases validate the ability of the contestants' O-RAN sub-systems to successfully integrate with the mobility setup which consists of a UE emulator and non-emulated 5G SA core. The test cases include Interface Management Procedures (e.g., NG Setup, Xn Setup, etc.)

- **Level 1: Functional** – These test cases verify the contestant subsystem's compliance to O-RAN ALLIANCE and 3GPP specifications with regards to protocol conformance and baseline functionality for successful mobility. The test cases include Mobility Procedures (e.g., Inter CU Intra AMF/UPF connected mode via N2, Inter CU connected mode via Xn and Idle mode mobility).

The test procedures follow pass/fail criteria and are intended to be standalone procedures, not dependent upon any other test cases.

The focus of this document is to harmonize the mobility specification, conditions, methodologies, and procedures. The test configuration (parameters) recorded in the test report enable the tests to be performed in stable and repeatable conditions on stable and consistent test setups.

For each of the above test categories, the test scope, setup, procedures and expected results have been defined together with their associated success criteria.

The test cases to be executed for Stage Four mobility testing are listed below:

Stage 4: Mobility Testing						
Test Case Level	**Test Case Category**	**Test Case Number (Mapping to the ORAN E2E spec)**	**Test Case Name (Mapping to the ORAN E2E spec)**	**Sub Test Case Number**	**Sub Test Case Name**	**Mandatory / Conditional Mandatory**
Level 0	**Integration**			E2E.Mobility.TC-1	Successful NG Setup	M
				E2E.Mobility.TC-2	Successful UE registration with	M

					emulated core via SUT	
				E2E.Mobility.TC-3	Successful Xn Setup	M
Level 1	**Mobility**			E2E.Mobility.TC-4	Inter CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; Intra frequency from source to target)	M1
				E2E.Mobility.TC-5	Inter CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; Intra frequency from target to source)	M1
				E2E.Mobility.TC-6	Inter CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; Inter frequency from source to target)	M1
				E2E.Mobility.TC-7	Inter CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; Inter	M1

					frequency from target to source)	
		E2E-TC-TIFG.E2E-4.6	Inter CU mobility (Inter Vendor over Xn)	E2E.Mobility.TC-8	Inter CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; Intra frequency from source to target)	M2
				E2E.Mobility.TC-9	Inter CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; Intra frequency from target to source)	M2
				E2E.Mobility.TC-10	Inter CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; Inter frequency from source to target)	M2
				E2E.Mobility.TC-11	Inter CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; Inter	M2

					frequency from target to source)	
		E2E-TC-TIFG.E2E-4.11	Idle Mode Inter CU mobility (Inter Vendor)	E2E.Mobility.TC-12	Inter CU idle mode mobility (Inter vendor; Intra frequency from source to target)	CM
				E2E.Mobility.TC-13	Inter CU idle mode mobility (Inter vendor; Intra frequency from target to source)	CM
				E2E.Mobility.TC-14	Inter CU idle mode mobility (Inter vendor; Inter frequency from source to target)	CM
				E2E.Mobility.TC-15	Inter CU idle mode mobility (Inter vendor; Inter frequency from target to source)	CM

Table 1- Stage Four Mobility Test Cases

Level 0 is a pre-requisite for Level 1 testing. To pass Stage Four, contestants will need to pass all Mandatory (M) test cases. When there is a further classification of Mandatory (M) test cases as M1 or M2, then contestants must either pass all M1 test cases or all M2 test cases.

Each M2 test case passed will be worth two points (with regards to scoring). All other test cases passed will be worth one point (i.e., each M, M1, and CM test case). The contestant's score will be calculated as the sum of all points received for test cases that are passed.

Contestants are encouraged to pass as many Mandatory (M1/M2) and Conditional Mandatory (CM) test cases as possible. The contestant with the minimum handover latency (measured as the time between UE receiving a handover command (RRC Connection Reconfiguration with mobilityControlInfo) from the source cell and UE sending RRC Connection Reconfiguration Complete to target cell) will receive an additional 0.5 points on their score. All contestants on the mobility testing track team will receive an identical score.

7 SUT Requirements

7.1 Laptop

Contestants shall provide a laptop for facilitating local and/or remote connection to the SUT (CU+DU and RU).

7.2 Hardware

For contestants providing their own hardware for testing, the hardware shall support:

- 3GPP Rel.15 FR1 and O-RAN ALLIANCE technical specifications mandatory for the Open Fronthaul 7-2x split interface (please see section 11 for references to relevant 3GPP and ORAN ALLIANCE technical specifications)
- An RF antenna port used to transmit/receive NR RF signal (RU only)
- An Ethernet port used for local or remote access to the hardware.
- Hardware must 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 SUT hardware serial number and SUT photo(s) shall be submitted to the 5G Lab before testing begins and after testing concludes.

7.3 Software

7.3.1 Inventory

The SUT software inventory details shall be submitted to the 5G Lab personnel in three occasions during the testing period, i.e.:

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

7.3.2 Installation

- Contestants bringing their own SUT HW along with their SUT SW to the 5G Lab, are responsible for installing and integrating both their HW and SW into the test environment.

- Contestants bringing to the 5G Lab only their SUT SW are responsible for SW installation and integration into the test environment.

7.3.3 Configuration

- SUT software configuration (i.e., parameter changes) that is required for executing and/or troubleshooting a test case, shall be performed by the SUT vendor.
- SUT software and/or parameter changes during integration, preliminary/initial testing, and troubleshooting are allowed.
- SUT software changes and/or parameter changes during final scoring testing are not allowed.
- Any SUT software and/or hardware changes during Level 1 testing shall require a rerun of previously passed Level 1 test case(s); to validate that the compliance demonstrated before has been maintained after software and/or hardware changes applied.
- All testing (including re-runs) needs to be completed in the testing window allocated to the contestant.

8 Test Environment

The System Under Test (SUT), i.e., CU+DU+RU, is connected via its NG interface towards the baseline 5G SA Core and its NR air-interface towards a UE Emulator (or actual UE), as shown in the figure below.

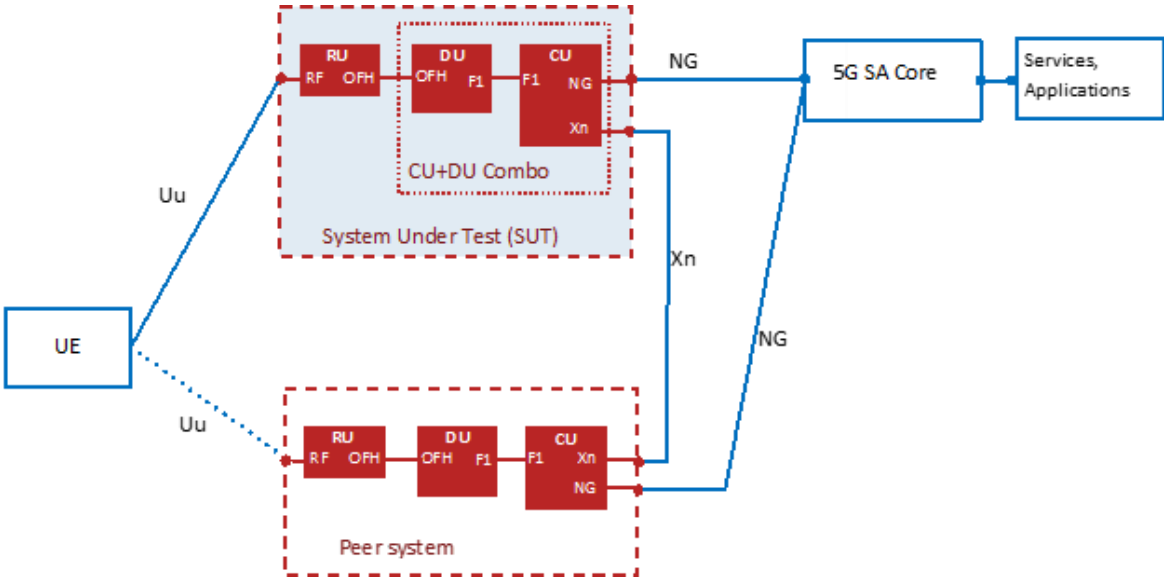

Figure 2. Stage 4 Mobility test environment

8.1 Test Equipment

Vendor	Model	SW	Use
UE Emulator	Viavi TK5000/E500	NLA 5.13.1	Emulates up to 100 UEs and used to initiate all test cases and campaigns for Stage 3 testing
	Keysight UeSIM	v23.2.1	
Core	Mavenir Core	21.4.1	Non-Emulated Rel-15 compliant 5G SA Core
Traffic Generator	Viavi RDA	15.9	Emulates network and application layer traffic for the Quality of service (QoS) and Quality of

	Keysight Ix Load	9.30.0.331	Experience (QoE) analysis. Tests and analyzes networks and network equipment by sending various forms of traffic over that network.
PTP GM	Viavi MTS5800		Timing Grand Master (T-GM)
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 3. Stage 3 Equipment List

8.2 Test Setup

The test setup is illustrated in the diagram below.

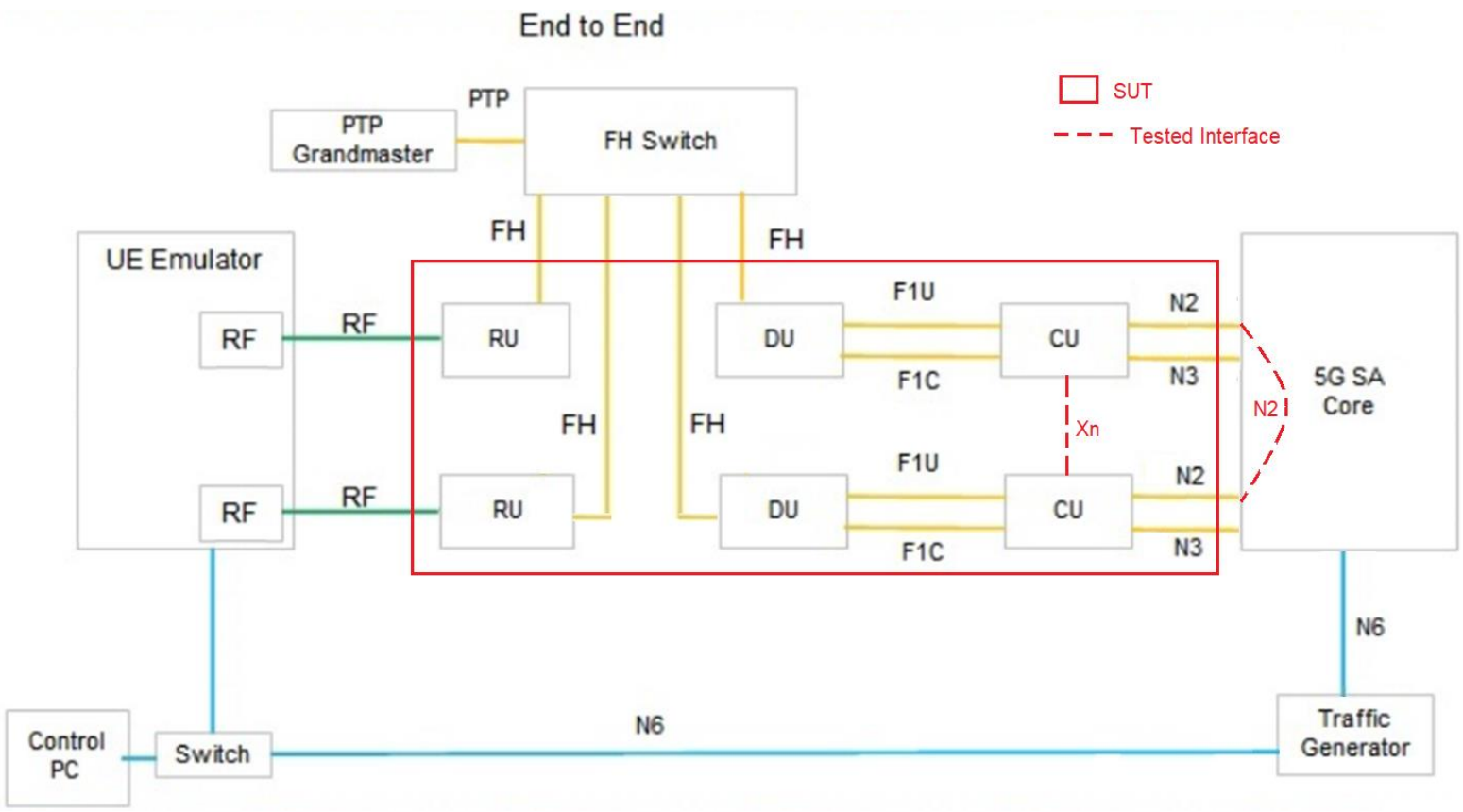

Figure 3. Stage 4 Mobility test setup

9 Test Cases - Level 0: Network Sanity/Connectivity Test Cases

These test cases verify the basic connectivity of the mobility setup which is pre-requisite for running any further mobility test cases. The test cases validate the ability of the contestants' O-RAN sub-systems to successfully integrate with the mobility setup which consists of a UE emulator and non-emulated 5G SA core.

Level 0 test cases will be pre-requisite for the further levels of testing.

9.1 E2E-Mobility-TC-0.1 Successful NG Setup

The test case will validate N2 connectivity between two inter-vendor CU+DU subsystems towards the 5GC.

9.1.1 Scope

The purpose of this test case is to verify N2 connectivity as a pre-requisite to test inter CU mobility.

9.1.2 Call Flow

The call flow will be as defined by the 3GPP TS 38.413 Figure 8.7.1.2-1 for NG setup procedure over N2 interface between gNB CU-CP and AMF.

9.1.3 Procedure

Step #	**Step Description**			
1.1	Ensure the physical connectivity between CU+DU of vendor 1 and vendor 2 to 5GC with appropriate switch configurations.			
1.2	Ensure basic configuration on CU+DU of vendor 1 and vendor 2 aligns with 5GC configuration.			
1.3	Start the packet capture on 5GC and CU+DU of vendor 1 and vendor 2 and initiate the NG setup procedure.			
1.4	Stop the packet capture on 5GC and CU+DU of vendor 1 and vendor 2.			
1.5	Verify that the CU+DU of vendor 1 and vendor 2 performs successful NG setup procedure over the N2 interface with 5GC by checking the logs.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.5.1	N2 Setup Request (CU+DU of vendor 1)	Present		
1.5.2	N2 Setup Response (CU+DU of vendor 1)	Present		
1.5.3	N2 Setup Request (CU+DU of vendor 2)	Present		
1.5.4	N2 Setup Response (CU+DU of vendor 2)	Present		

9.1.4 Expected Result (Pass/Fail Criteria)

The expected result and pass/fail criteria will be the successful validation of N2 connectivity between the 5GC and the CU+DU from vendor 1 and vendor 2.

9.2 E2E-Mobility-TC-0.2 Successful UE registration with emulated core via NG-RAN (system under test)

This test case validates the Registration procedure as per 3GPP specified signaling.

9.2.1 Scope

The purpose of this test case is to validate the UE registration in order to trigger a N2 (intra AMF/UPF) mobility and Xn mobility.

9.2.2 Call Flow

The call flow will be as defined by the 3GPP TS 23.502 Figure 4.2.2.2.2-1 for Registration.

9.2.3 Procedure

Step #	Step Description			
1.1	Ensure physical connectivity between CU+DU of vendor 1 and vendor 2 each connected to a separate RU (which can be from the same CU+DU vendor or a different vendor).			
1.2	Ensure physical connectivity between the two RUs and UE emulator.			
1.3	Ensure configuration alignment across the E2E network (both instances of CU+DU and RU, 5GC and UE Emulator).			
1.4	Start the packet capture on CU+DU of vendor 1, the RU it is connected to and the UE emulator.			
1.5	Run the registration test case from the UE emulator to register to 5GC via CU+DU of vendor 1, the RU it is connected to.			
1.6	Stop the packet capture on CU+DU of vendor 1, the RU it is connected to and the UE emulator.			
1.7	Verify that the UE is successfully registered to 5GC via CU+DU of vendor 1, the RU it is connected to by checking the logs.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.7.1	NAS Registration Request Count	Present		
1.7.2	NAS Registration Success Count	Present		

9.2.4 Expected Result (Pass/Fail Criteria)

The expected result and pass/fail criteria will be successful registration of the UE emulator to register to 5GC via CU+DU of vendor 1, the RU it is connected to.

9.3 E2E-Mobility-TC-0.3 Successful Xn Setup

The test case will validate Xn setup between two inter-vendor CU+DU subsystems.

9.3.1 Scope

The purpose of this test case is to validate that both vendor's CU+DU are able to initiate and successfully complete the Xn setup in order to perform inter-CU mobility over Xn interface.

9.3.2 Call Flow

The call flow will be as defined by the 3GPP TS 38.423 Figure 8.4.1.2 for Xn setup.

9.3.3 Procedure

Step #	Step Description			
1.1	Ensure IP connectivity between CU+DU of vendor 1 and vendor 2.			
1.2	Ensure basic configuration related to Xn interface aligns on CU+DU of both vendor 1 and vendor 2.			
1.3	Start the packet capture on CU+DU of vendor 1 and vendor 2 and initiate the Xn setup procedure.			
1.4	Stop the packet capture on CU+DU of vendor 1 and vendor 2.			
1.5	Verify that the CU+DU of vendor 1 initiates the Xn Setup Request and performs successful Xn setup procedure with CU+DU of vendor 2 by checking the logs.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.5.1	Xn Setup Request (from CU+DU of vendor 1 to CU+DU of vendor 2)	Present		
1.5.2	Xn Setup Response (from CU+DU of vendor 2 to CU+DU of vendor 1)	Present		
1.6	Verify that the CU+DU of vendor 1 initiates the Reset Request and both vendor's CU+DU successfully resets Xn interface or selected UE contexts.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.6.1	Reset Request (from CU+DU of vendor 1 to CU+DU of vendor 2)	Present		
1.6.2	Reset Response (from CU+DU of vendor 2 to CU+DU of vendor 1)	Present		
1.7	Verify that the CU+DU of vendor 2 initiates the Xn Setup Request and performs successful Xn setup procedure with CU+DU of vendor 1 by checking the logs.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.7.1	Xn Setup Request (from CU+DU of vendor 2 to CU+DU of vendor 1)	Present		

1.7.2	Xn Setup Response (from CU+DU of vendor 1 to CU+DU of vendor 2)	Present		
1.8	Verify that the CU+DU of vendor 1 initiates the Reset Request and both vendor's CU+DU successfully resets Xn interface or selected UE contexts.			
	Element Tested	**Expected Value**	**Recorded Value**	**Pass/Fail**
1.8.1	Reset Request (from CU+DU of vendor 2 to CU+DU of vendor 1)	Present		
1.8.2	Reset Response (from CU+DU of vendor 1 to CU+DU of vendor 2)	Present		

9.3.4 Expected Result (Pass/Fail Criteria)

The expected result and pass/fail criteria will be the successful validation of Xn setup between the CU+DU from vendor 1 and vendor 2.

10 Level 1: Functional Test Cases

These test cases verify the contestant subsystem's compliance to O-RAN Alliance and 3GPP specifications with regards to protocol conformance and baseline functionality for successful connected and idle mode mobility over N2 and Xn interface. The mobility can be either intra or inter frequency.

10.1 E2E-Mobility-TC-1.1 Inter CU mobility (via N2)

The test validates the CU, DU functionality in handling inter CU connected mode mobility (via N2) connected to same 5G Core Network (in SA).

10.1.1 Scope

The purpose of the test is to verify inter CU handover (via N2) of the UE.

10.1.2 Call Flow

As defined by the 3GPP TS 23.502 Figure 4.9.1.3.2-1 (Preparation Phase) and 4.9.1.3.3-1(Execution phase) with the exception of intra AMF/UPF scenario.

10.1.3 Procedure

The test procedure will be as per 3GPP TS 23.502 clause 4.9.1.3.2 and 4.9.1.3.3 with the exception of intra AMF/UPF scenario.

10.1.4 Expected Result (Pass/Fail Criteria)

The pass-fail criteria will be validating successful connected mode mobility (handover) from source to target CU (via N2) and vice versa.

10.2 E2E-TC-TIFG.E2E-4.6 Inter-O-CU mobility (via Xn)

The test validates the CU, DU functionality in handling inter CU connected mode mobility (via Xn) connected to same 5G Core Network (in SA).

10.2.1 Scope

The purpose of the test is to verify inter CU handover (via Xn) of the UE.

10.2.2 Call Flow
As defined by 3GPP TS 38.401 Figure 8.9.4-1 for Inter-gNB handover involving gNB-CU-UP change (and TS 38.300 Figure 9.2.3.2.1-1 for Intra-AMF/UPF handover).

10.2.3 Procedure
As per 3GPP TS 38.401, Section 8.9.4 and Section 8.9.5.

The actual testing procedure will be as per O-RAN.TIFG.E2E-Test.0-v04.00 section 4.6.3 (for SA mode).

10.2.4 Expected Result (Pass/Fail Criteria)
The expected result will be as per O-RAN.TIFG.E2E-Test.0-v04.00 section 4.6.4.

The pass-fail criteria will be validating successful connected mode mobility (handover) from source to target CU (via Xn) and vice versa.

10.3 E2E-TC-TIFG.E2E-4.11 Idle Mode Inter CU mobility
The test validates the CU, DU functionality in handling inter CU idle mode mobility connected to same 5G Core Network (in SA).

10.3.1 Scope
The purpose of the test is to verify inter CU idle mode mobility of the UE.

10.3.2 Procedure
As defined by 3GPP 38.133, Section 4.2.2.3 and Section 4.2.2.4 for intra frequency and inter frequency cell selection measurement, respectively. And 3GPP 38.304, Section 5.2.2 for the state transition.

The actual testing procedure will be as per O-RAN.TIFG.E2E-Test.0-v04.00 section 4.11.3.

10.3.3 Expected Result (Pass/Fail Criteria)
The expected result will be as per O-RAN.TIFG.E2E-Test.0-v04.00 section 4.11.4.

The pass-fail criteria will be validating successful idle mode mobility from source to target CU and vice versa.

11 References

- O-RAN.TIFG.E2E-Test.0-v04.00
- O-RAN.WG4.IOT.0-v05.00
- 3GPP TS 23.501 - System architecture for the 5G System (5GS)
- 3GPP TS 23.502 - Procedures for the 5G System (5GS)
- 3GPP TS 33.501 - Security architecture and procedures for 5G System
- 3GPP TS 33.551- Security Assurance Specification (SCAS)
- 3GPP TS 38.133 - 5G; NR; Requirements for support of radio resource management
- 3GPP TS 38.211 - 5G; NR; Physical channels and modulation
- 3GPP TS 38.214 - 5G; NR; Physical layer procedures for data
- 3GPP TS 38 300 - 5G NR Overall description Stage-2
- 3GPP TS 38.304 – 5G; NR; User Equipment (UE) procedures in idle mode and in RRC Inactive state
- 3GPP TS 38.306 – NR; User Equipment (UE) radio access capabilities
- 3GPP TS 38.401 - NG-RAN; Architecture description
- 3GPP TS 38.410 NG-RAN; NG general aspects and principles
- 3GPP TS 38.411 NG-RAN; NG layer 1
- 3GPP TS 38.412 NG-RAN; NG signaling transport
- 3GPP TS 38.413 NG-RAN; NG Application Protocol (NGAP)
- 3GPP TS 38.414 NG-RAN; NG data transport
- 3GPP TS 38.425 NG-RAN; NR user plane protocol

12 Annex A – Test Cases and Scoring

Stage 4: Mobility Testing (Total Test Cases = 15; Mandatory Test Cases = 11; Conditional Mandatory Test Cases = 4)							
Test Case Level	**Test Case Category**	**Test Case Number (Mapping to the ORAN E2E spec)**	**Test Case Name (Mapping to the ORAN E2E spec)**	**Sub Test Case Number**	**Sub Test Case Name**	**Mandatory / Conditional Mandatory**	**Scoring**
Level 0	**Integration (3 Test Cases) (Mandatory = 3)**			E2E.Mobility.TC-1	Successful NG Setup	M	1
				E2E.Mobility.TC-2	Successful UE registration with emulated core via SUT	M	1
				E2E.Mobility.TC-3	Successful Xn Setup	M	1

Level 1	**Mobility (12 Test Cases) (Mandatory = 8; Conditional Mandatory = 4)**			E2E.Mobility.TC-4	Inter-O-CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; **Intra** frequency from **source to target**)	M1	1
				E2E.Mobility.TC-5	Inter-O-CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; **Intra** frequency from **target to source**)	M1	1
				E2E.Mobility.TC-6	Inter-O-CU connected mode mobility via N2 (Inter vendor; intra	M1	1

					AMF/UPF; **Inter** frequency from **source to target**)		
				E2E.Mobility.TC-7	Inter-O-CU connected mode mobility via N2 (Inter vendor; intra AMF/UPF; **Inter** frequency from **target to source**)	M1	1
		E2E-TC-TIFG.E2E-4.6	Inter-O-CU mobility (Inter Vendor over Xn)	E2E.Mobility.TC-8	Inter-O-CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; **Intra** frequency from **source to target**)	M2	2
				E2E.Mobility.TC-9	Inter-O-CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; **Intra** frequency from **target to source**)	M2	2

				E2E.Mobility.TC-10	Inter-O-CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; **Inter** frequency from **source to target**)	M2	2
				E2E.Mobility.TC-11	Inter-O-CU connected mode mobility via Xn (Inter vendor; intra AMF/UPF; **Inter** frequency from **target to source**)	M2	2
		E2E-TC-TIFG.E2E-4.11	Idle Mode Inter-O-CU mobility (Inter Vendor)	E2E.Mobility.TC-12	Inter-O-CU idle mode mobility (Inter vendor; **Intra** frequency from **source to target**)	CM	1
				E2E.Mobility.TC-13	Inter-O-CU idle mode mobility (Inter vendor; **Intra** frequency from **target to source**)	CM	1

				E2E.Mobility.TC-14	Inter-O-CU idle mode mobility (Inter vendor; **Inter** frequency from **source to target**)	CM	1
				E2E.Mobility.TC-15	Inter-O-CU idle mode mobility (Inter vendor; **Inter** frequency from **target to source**)	CM	1